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Green M&A and Shareholder Value: Analyzing Abnormal Returns in the U.S. Market

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Abstract

This study examines the impact of green mergers and acquisitions (M&A) on shareholder value by analyzing cumulative abnormal returns (CARs) in the U.S. market. Using data from 2000 to 2023, the sample consists of 36,774 M&A deals, of which 2,462 are classified as green M&A deals, all involving U.S. acquiring firms. Employing an event study method and cross-sectional regression models, the study investigates whether acquiring green target firms results in positive CARs for the acquiring firms. The main findings reveal that green M&A announcements do not result in statistically significant short-term CARs for acquiring firms. Moreover, higher Environmental, Social, and Governance (ESG) scores of green target firms do not significantly enhance the CARs, and cross-border green M&A deals do not yield higher CARs compared to domestic deals.

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1 Introduction

The urgency of dealing with environmental issues has pushed the idea of green to the forefront of corporate and societal priorities. The modern sustainability movement can be tracked back to the 1980s, when sustainable development was described as development that meets current needs without harming future generations (World Commission on Environment and Development, 1987). Throughout the years, as the harmful effect of climate change have become more apparent, the international community has focused more on implementing eco-friendly actions and regulations.

The need to switch to sustainable business models has become more urgent in recent years. The worldwide movement toward achieving net-zero greenhouse gas emissions requires corporations to shift their assets significantly towards low-emissions models. This shift presents not just a moral and environmental necessity but also a significant economic chance, driving extensive mergers and acquisitions (M&A) activity globally (McKinsey & Company, 2020). In different sectors, firms are seeing green-related M&A as a strategic method to boost growth, improve operations, and strengthen their Environmental, Social, and Governance (ESG) profiles (Deloitte, 2021; EY, 2020).

In today's business environment, the focus on green practices is not only a reaction to regulations but a crucial strategic decision. In 2015, the Paris Agreement was a major achievement, as countries pledged to restrict global warming (United Nations, 2015). This global agreement has motivated companies to implement more environmentally friendly strategies to stand by changing regulations and satisfy the increasing demands of stakeholders. Corporate strategies are now including more green initiatives to tackle climate change, boost sustainability, and meet investor expectations for ethical business practices. Companies that implement green practices can lower their impact on the environment, improve their brand reputation, and attract investors who prioritize sustainability (Giese et al., 2019). In addition, green initiatives can result in reduced costs by enhancing energy efficiencies and minimizing waste, encouraging their adoption even more.

This research concentrates on green M&A, examining acquiring firms' stock return, the ESG performance of green targets, and cross-border M&A dynamics. Green M&A entails acquisitions of target firms with eco-friendly practices. There are two reasons for this focus. Initially, the growing frequency of green M&A demonstrates a change in company focuses on incorporating sustainability into their fundamental activities. Furthermore, comprehending the financial consequences of these acquisitions offers useful information for investors and policymakers. It is essential to examine abnormal returns, which indicate the difference between a stock's actual returns and the expected returns derived from market performance. Abnormal returns offer understanding into the effects of these events on shareholder value and market perception (MacKinlay, 1997). Earlier research has shown that abnormal returns can indicate the success or failure of corporate strategies, therefore offering useful insights for investors and policymakers (Andrade et al., 2001; Jensen & Ruback, 1983). Therefore, this research aims to answer the following question:

"What is the impact of acquiring a green target firm on the acquiring firm's stock returns?"

Using data from the Orbis database of green M&A deals, I employed an event study methodology to answer my research question. I estimated a series of cross-sectional regression models to evaluate cumulative abnormal returns (CARs) associated with the announcements of green M&A deals. My main results indicate that green M&A announcements do not lead to statistically significant short-term CARs for acquiring firms.

The decision to focus on green M&A is influenced by the increasing importance of environmental sustainability in modern business strategies. With the threat of climate change reaching a critical level, businesses are urgently required to shift towards green operations. This has resulted in a rise in green M&A, in which acquiring companies aim to incorporate eco-friendly practices to comply with regulations and satisfy the needs of stakeholder. Besides, there is an increasing amount of literature backing the significance of green initiatives in corporate strategy. Research shows that companies that adopt green practices can gain important competitive benefits such as improved reputation, more efficient operations, and entry into new markets (Kolk & Van Tulder, 2010; Eccles et al., 2014). Additionally, incorporating eco-friendly strategies has been proven to be in line with the creation of long-term shareholder value, as seen in the boosted stock performance and investor attraction towards environmentally conscious firms (Clark et al., 2014).

This study contributes to the existing literature by offering empirical evidence on the financial outcomes of green M&A deals in the U.S. market. Previous research has highlighted the overall advantages of green practices, but there is a gap in understanding how these practices impact the stock returns of acquiring firms in the United States. The literature on this context is very limited, and no studies have investigated the green practices in the context of M&A activities on the stock returns of acquiring firms. This study provides insights into how green M&A can impact shareholder value by focusing on the dynamic and highly regulated U.S. market. The environment in the U.S. market is defined by strict regulations and policies that have changed a lot in recent decades. For example, the Environmental Protection Agency (EPA) in the U.S. created extensive rules to decrease pollution and encourage sustainability, influencing corporate behavior significantly (Vandenbergh, 2003). Additionally, regulations at the state level, like California's strict emissions standards, frequently go beyond federal requirements, leading to a complicated regulatory environment (Carlson, 2012). My study offers valuable insights for investors and policymakers regarding the financial advantages and challenges of incorporating green strategies through M&A in a highly regulated setting.

Furthermore, the U.S. market experiences extensive investor activism and stakeholder involvement regarding environmental concerns. Investors in the U.S. are more and more seeking transparency and accountability when it comes to companies' environmental practices. This has resulted in the extensive implementation of ESG reporting standards and has had a significant impact on corporate strategies (Kell, 2018). According to research by Eccles et al. (2014), U.S. companies are more inclined to adopt green practices and disclose their sustainability initiatives in response to these pressures.

Moreover, the U.S. financial market leads globally in sustainable investing, with a large amount of capital going towards ESG funds. The rise in sustainable in the U.S. has led companies to focus on green initiatives to appeal to the expanding group of investors (Giese et al., 2019). The size and influence of the U.S. market have a global impact, making it crucial to study for understanding the broader effects of green M&A trends and regulatory changes.

The remainder of this research is organized in the following manner: the next section reviews the theoretical background, including the concepts of traditional and green M&A, and the role of stock returns in evaluating these transactions. It also introduces the tested hypotheses aimed at addressing the research question. Section 3 focuses on the dataset collection process, detailing the sample selection and variables used. The methodology for testing the hypotheses is explained in the fourth section and is followed by the presentation of the empirical results. The last part addresses the implications of the results, acknowledges the limitations of the study, and suggests recommendations for future research.

2 Theoretical Background

This section provides a brief explanation of theory and hypotheses, includes strategic perspectives on mergers and acquisitions (M&A), their impact on stock returns, the concept of green M&A, importance for both ESG performance as well as cross-border dynamics. It also provides the hypotheses that will be tested in this study.

2.1 Green vs. Traditional M&A

Building on the general understanding of mergers and acquisitions (M&A), we can distinguish them between traditional and green M&A, with each having different goals and motives. Traditional M&A focuses primarily on financial and strategic benefits, while green M&A aims to combine financial goals with environmental sustainability. Understanding these differences is important for analyzing the strategic and environmental impacts of these transactions.

2.1.1 Traditional M&A

Traditional mergers and acquisitions (M&A) involve two or more separate entities combining their operations to create one entity, or when an entity gains control over another entity. These deals are usually motivated by strategic goals like market growth, enhanced market influence, efficiency advantages, and financial synergies (Moskovicz, 2018; Pantazi, 2012).

The motivations for traditional mergers and acquisitions (M&A) can be broadly categorized into value-enhancing and non-value enhancing group (Nguyen et al., 2012). M&As that increase value focus on taking advantage of synergies resulting from combining the physical operations of merging entities. This can include gaining more market power, efficiencies of scale, and financial benefits. M&As that do not increase value can be influenced by reasons like manager's self-interest, expanding the company, and diversification for risk reduction, but they may not benefit shareholders (Nguyen et al., 2012; Jensen, 1986; Roll, 1986). Kellner's (2024) study shows that various reasons motivate M&A deals, such as seeking new business opportunities, entering foreign markets, and gaining a competitive advantage by acquiring competitors. Moreover, M&A transactions can enhance market position and facilitate the adoption of innovative technologies (Schuler & Jackson, 2001; Lubatkin, 1983).

2.1.2 Green M&A

In contrast to traditional mergers and acquisitions (M&A), green M&A refers to deals that incorporate environmentally sustainable practices in the acquisition process (Han et al., 2022). The goals of green M&A are to lower costs in managing the environment and promote green innovation for sustainable developments. These transactions are motivated by a company's commitment to eco-friendly efforts, such as decreasing carbon emissions and employing renewable energy, to address environmental and social challenges. Simultaneously, they aim to achieve a competitive advantage through corporate social responsibility and entrepreneurship (Kanchan et al., 2015; Yunus & Rahman, 2014).

Another element of green M&A includes acquiring companies or assets that support environmental sustainability, and align with overall sustainability objectives (Kwon et al., 2018; Robinson et al., 2018). Green M&As are also focused on improving a company's environmental skills, aligning with broader sustainability goals, reducing potential risks to reputation, and taking advantage of increased competitiveness and performance (Kwon et al., 2018; Robinson et al., 2018; Fikru & Gautier, 2020). In industries, like energy, manufacturing, automotive, and chemicals, firms might participate in green M&A to reach these environmental goals, while also enhancing their market position and performance.

2.2 Abnormal returns

Continuing from the discussion on traditional and green M&A, I now explore their significant influence on corporate strategy and shareholder value through abnormal returns. Event studies, like the ones conducted by Andrade et al. (2001), evaluates the benefits from mergers and acquisitions by examining abnormal returns during merger announcements. These studies offer understanding on how markets respond and shareholder wealth effects. Abnormal returns are profits that exceed the usual expectations for an investment. Investors seek these returns to determine the profitability of an acquisitions. Mitchell and Stafford (2000) discovered significant abnormal returns for acquiring firms, especially right after M&A announcements, which supports this perspective.

2.2.1 Efficient Market Hypothesis

This study is based on the Efficient Market Hypothesis (EMH), which proposes that financial markets exhibit informational efficiency. This indicates that asset prices incorporate all available information at any given moment as stated by Fama (1970). In line with the EMH, any recent information like a merger and acquisition (M&A) announcement will be rapidly and accurately reflected in stock prices. We can evaluate the market's perception of the M&As value by analyzing stock price changes before and after the announcement data.

Kellner (2024) expands this viewpoint to evaluate market efficiency concerning M&A announcements. He identifies abnormal stock price trends around announcements, indicating possible deviations from market efficiency. Target firms experience more positive abnormal returns compared to acquiring firms, a phenomenon known as the announcement effect. This demonstrates how quickly the market responds to new information, highlighting the significant impact that M&A announcements have on stock prices (Jensen & Ruback, 1983).

Rani et al. (2012) present proof of substantial abnormal returns for acquiring firms' shareholders after M&A announcements. This indicates the possibility of favorable returns after the announcement. Furthermore, Andrade and Stafford (2004) emphasize the potential for creating value for both acquiring and target firms, noting market expectations of synergies and increased productivity from M&A activities.

On the other hand, Stunda (2014) points out that acquiring firms typically experience negative effects on their stock prices in comparison to firms not involved in M&As. Industry dynamics further influence these effects, with different sectors showing varied market reactions to M&A activities. Hackbarth and Morellec (2008) suggest that acquiring companies often face low or negative abnormal returns, indicating initial market uncertainty or concerns about takeovers. Hence, the results related to the influence of M&A on stock returns are conditional and mixed, varying significantly across different context and industries.

2.2.2 Abnormal Returns of Green M&A

Delving into the specific context of green mergers and acquisitions (M&A), we find that their impact on abnormal returns has become a focus of interest in the fields of finance and environmental management. Research such as the one conducted by Salvi et al. (2018) demonstrates that green M&A announcements lead to favorable market responses, resulting in enhanced financial performance for the acquiring firms post-acquisition. This is motivated by improved operational efficiency and strategic positioning in sustainable markets. According to Ghoul et al. (2023), engaging in green M&A can attract green investors, resulting in lower capital costs and potentially increased abnormal returns.

Wei and Pujari (2023) discovered that green acquisitions result in favorable responses from the stock market, but the industry context plays a significant role in how investors view the acquisitions. Han et al. (2022) emphasize that green M&A can save costs by reducing environmental management expenses while also promoting innovation. Although there was no immediate effect on market performance, the cost efficiencies and innovation potential related to green M&A could have a long-term impact on stock returns.

The effect of green M&A on stock returns could differ based on the risk profile of the companies participating. Li et al. (2020) have discovered that engaging in green M&A with heavily polluting industries leads to increased level of risk-taking behavior, which could have consequences for abnormal returns. Levi and Newton (2016) suggest that sustainable abnormal returns driven by the environment imply that green M&A could result in lasting, favorable stock performance.

Moreover, acquisitions of green target firms have received interest because of to their potential to generate value through sustainability-focused strategies (King & Lenox, 2001). Ambec and Lanoie (2008) point out the positive association between green acquisitions and shareholder value. They highlight that the strategic benefits of these acquisitions, like enhanced environmental performance and entry into green markets, lead to positive responses from the market. Various factors, such as corporate environmental reputation, play a role in influencing the magnitude and direction of market responses to green acquisitions (Bansal & Clelland, 2004). Firms that have a strong track record in sustainability may see more positive reactions from the market when engaging in green acquisitions, emphasizing the significance of environmental legitimacy in shaping investor perceptions.

Based on the literature, I expect that the market will react positively to green M&A announcements because of the perceived advantages in strategy and operation linked to sustainability-focused investments. This observed trend leads to the formulation of the first hypothesis. The aim of the hypothesis is to capture the immediate market reaction to green M&A announcements, reflecting investor sentiment and market dynamics.

Hypothesis 1: "*The market will react positively to the announcement of an acquisitions of a green target firm, resulting in positive abnormal returns for the acquiring firm's stock in the short-term event window.*"

2.3 ESG Performance

In examining the broader context of green mergers and acquisitions (M&A), the importance of Environmental, Social, and Governance (ESG) performance cannot be overlooked. Recently, the relevance of ESG scores has increased, as they are now essential measures for assessing the sustainability practices and performance of companies. ESG scores indicate the level of commitment a firm has to environmental protection, socially responsibility, and effective governance practices.

ESG scores provide a detailed assessment of companies' sustainability initiatives in the areas of Environmental, Social, and Governance. These scores offer important information about how a company is running, managing risks, and performing regarding sustainability (Filbeck et al., 2019).

Studies indicate that firms with higher ESG scores often exceed market performance, where stronger governance and social scores are correlated to abnormal returns (Filbeck et al., 2019). Moreover, companies that have higher ESG scores are generally seen as financially strong, benefitting from cost reductions, improved operations, and increased availability of green financing (Zhou et al., 2022).

ESG scores not only affect how individual companies perform but also have an impact on mergers and acquisitions (M&A) activities and the resulting abnormal returns. Acquiring companies with better ESG performance can result in post-merger advantages, such as enhanced ESG performance and higher market value (Tampakoudis & Anagnostopoulou, 2020). Yet, the impact of target firms' ESG scores on acquiring firm's abnormal returns is still being studied.

Recent research has emphasized the subtle impacts of target firms' ESG scores on the financial outcomes of acquiring firms following mergers and acquisitions. According to Feng (2021), target companies with higher ESG scores may mitigate the decrease in return on assets for acquiring firms with lower ESG scores, while worsening it for those with higher ESG scores. Additionally, Kang & Jung (2020) discovered that strong environmental rating can lower debt financing expenses, highlighting the financial advantages of excellent ESG performance.

Moreover, Pellegrini et al. (2019) noted that higher ESG scores may lower equity costs and enhance firm value. Kim & Li (2021) emphasize that ESG scores have a positive effect on corporate profitability, with governance practices having the most notable impact. Ademi and Klungseth (2022) emphasize that firms with outstanding ESG performance surpass their industry peers in financial performance and command higher market values. Kotsantonis et al. (2016) and Qureshi et al. (2021) state that firms with strong ESG scores have seen benefits like competitive advantages, better average profits, reduced risks, and improved operational effectiveness. Together, these results highlight the crucial role of ESG scores impacting firms' financial outcomes.

Given the extensive research conducted, there is still a significant gap in understanding the varying impacts of green target firms' ESG scores on the financial results of acquiring firms.

The second hypothesis suggests that investors value higher ESG scores as they reflect better sustainability practices and corporate governance. Companies that have higher ESG scores are anticipated to gain more advantages from such acquisitions because of the improved reputation, operational effectiveness, and cost reductions related to strong ESG performance.

Hypothesis 2: *"The market will react more positively to the announcement of an acquisition of a green target firm with a higher ESG score, resulting in greater positive abnormal returns for the acquiring firm's stock in the short-term event window."*

2.4 Cross-Border M&A

Finally, considering the geographical scope of mergers and acquisitions (M&A), cross-border M&A present distinct advantages despite the prevalent occurrence of domestic transactions within the U.S. (Viva et al., 2020). Cross-border M&A involve the acquisition of a firm situated in a different country or jurisdiction than the acquiring entity, whereas domestic M&A refers to acquisitions within the same country or jurisdiction as the acquiring entity. The difference between these two types of transaction is based on their complexities, risks, and potential benefits.

Danbolt and Maciver (2012) emphasized the advantages for both targets and bidders in international takeovers, especially when the acquiring company possesses a strong governance structure. However, research conducted by Moeller and Schlingemann (2005) and Meng and Sutton (2017) revealed that U.S. acquirers in cross-border transactions experienced reduced abnormal returns and operational performance changes, which were linked to the target firms' listing status. On the other hand, Francis et al. (2007) highlighted the positive effects for U.S. acquirers in cross-border mergers, particularly when acquiring targets from isolated financial markets. Viva et al. (2020) stated that U.S. firms involved in cross-border M&A show greater innovation potential, but they have lower short-term returns and higher returns in the long run compared to deals within the country.

Despite not always enhancing productivity as much as domestic M&A (Zhou et al., 2019), cross-border M&A transactions frequently result in greater abnormal returns (Hsu et al., 2021). Studies by Ding et al. (2021) and Marikides and Ittner (1994) suggested that there were short-term improvements in firm market value and shareholder profits following cross-border acquisitions. Additionally, Barrell and Pain (1997) emphasized the impact of foreign investment on evaluating costs and benefits, shaping economic development.

Although there are potential advantages, it is important to be cautious when engaging in cross-border M&A deals, as certain research indicates a possible reduction in the acquirer's market value after the transaction (Gugler et al., 2003). However, it has been demonstrated that cross-border M&A waves can generate value by resulting in announcement returns and improved post-merger operating performance (Xu, 2017). Positive investor attitudes towards cross-border M&A may be due to the belief in increased competitiveness and growth prospects (Tao et al., 2017).

Tougher regulations greatly influence foreign direct investment in M&A outcomes, as environmental factors play a significant role (Cai et al., 2016). Enhancing environmental regulations can help reduce negative environmental effects and promote green economic growth of foreign investment (Liu et al., 2017; Xiao et al., 2023).

Although there have been many studies on the differences between cross-border and domestic M&A, there has not been much research specifically investigating how acquiring green target firms affect these scenarios.

The third hypothesis investigates how cross-border and domestic green M&A have different effects. Cross-border deals bring unique opportunities and challenges, such as entering new markets and gaining varied resources. The hypothesis suggests that cross-border green M&A will lead to higher positive abnormal returns than domestic acquisitions due to potential strategic advantages like international market growth and increased competitive advantage.

Hypothesis 3: *"The market will react more positively to the announcement of a cross-border acquisition of a green target firm compared to a domestic acquisition, resulting in greater positive abnormal returns for the acquiring firm's stock in the short-term event window."*

3 Data

This section describes the data used in the study, explaining the sample selection process, the dependent and independent variables, and the control variables employed. The following parts give a detailed description of each stage of the data collection and preparation process.

3.1 Sample

This research investigates the impact of green merger and acquisitions (M&As) on the stock returns of acquiring firms, focusing on transactions involving a green firm as the target. The sample includes M&A deals from 2000 to 2023, with the acquiring firm situated in the United States and the target firm located either domestically or globally. These M&A deals were sourced from the Orbis database, which has detailed data on worldwide M&A activity.

To ensures the relevance and specificity of the sample, several criteria from the paper by Deng et al. (2013) were applied:

- **Publicly Traded Acquiring Firm:** The acquiring firm must be publicly traded to ensure the availability of stock price data.
- **Completed Deal Status:** Only completed deals are included to ensure that the transactions were fully executed and reflect actual market reactions.
- **U.S.-Based Acquiring Firm:** The acquiring firms must be based in the United States.
- **Cross-border and domestic deals:** Both cross-border and domestic M&A deals are included to analyze the potential differences in market reactions.
- **Majority Stake Acquisitions:** The acquiring firm must purchase at least 50% of the target's shares to ensure significant control over the target.
- **Deal Value:** The deal value must exceed $1 million to exclude minor transactions that might not significantly impact the acquiring firm's stock returns.

To distinguish green targets additional steps are required since Orbis does not provide a specific filter for green targets. In order to address this, a text search based on the targets' business descriptions was used, as suggested by Zephyr (2013) and Wei & Pujari (2023). The search terms outlined in Appendix 1 helped to accurately identify and categorize M&A deals in the green sector. Additionally, the search term "green" was specifically added to refine the results further, improving the accuracy of identifying green targets. The final dataset includes 15,627 M&A deals involving publicly listed acquiring firms with available stock data, of which 1,000 are green.

3.2 Variables

This subsection outlines the dependent, independent, and control variables used in this study. Understanding these variables is essential for comprehending the methodology of the study and interpreting the results.

3.2.1 Dependent Variable

In this research, the dependent variable is the cumulative abnormal returns (CARs), which measure the difference between the actual returns of the acquiring firm's stock and the expected return, accounted for market returns, around the M&A announcement period. CARs are frequently employed in event studies to assess the impact of certain events on stock returns (MacKinlay, 1997). To calculate CARs, the stock prices of the acquiring firm are needed. Since one of the requirements is that the acquiring firm must be publicly traded, the required stock price information is available.

The S&P 500 serves as the market index to determine market returns. The S&P 500 is considered a valuable market index as it consists of 500 major firms that are publicly traded on U.S. stock exchanges, giving a comprehensive view of the market. According to Fama and French (1993), the S&P 500 is frequently used in empirical finance research because it is comprehensive and represents the market well. Additionally, the S&P 500 index is considered a reliable standard for evaluating market performance according to Elton et al. (2009).

The event window refers to the time period surrounding the event being focused on, where day 0 is considered the date of announcement (Shah & Arora, 2014). This research utilizes the event window [-1, 1] to observe the impact of the announcement on abnormal returns. Prior research has shown that choosing a three-day window effectively captures the immediate market reaction while reducing noise from unrelated market activities (MacKinlay, 1997; Brown & Warner, 1985). In order to consider the possibility of information being leaked around the announcement date, the event window has been modified as recommended by McWilliams et al. (1999). This study uses an estimation window of 120 days before the event window as it is commonly used in short-term event analysis to ensure accurate calculation of expected returns (MacKinlay, 1997).

Expected returns are calculated using the market model as outlined by Brown and Warner (1985):

$$E(R_{it}) = \alpha_i + \beta_i R_{mt} + \varepsilon_{it}$$

$E(R_{it})$ represents the expected daily returns for firm i on day t, while R_{mt} stands for the market index's daily return, which is equally weighted, α_i and β_i are estimated related to the firm, and ε_{it} is the error term that is independently, identically, and normally distributed.

The daily abnormal returns for each firm are calculated as:

$$AR_{it} = R_{it} - E(R_{it}) = R_{it} - (\alpha_i + \beta_i R_{mt} + \varepsilon_{it})$$

AR_{it} is the abnormal return for firm i on day t, and R_{it} is the actual daily return for firm i on day t.

Cumulative abnormal returns (CARs) are determined by adding the daily abnormal returns during the event window, and serves as the dependent variable for this study:

$$CAR_i[t_1, t_2] = \sum_{t_1}^{t_2} AR_{it}$$

3.2.2 Independent Variables

The main independent variable in this study is the classification of the merger and acquisition (M&A) deal as green or not. A M&A deal is considered green when the target firm meets the green firm criteria through text search. The green variable has a value of 1 for green M&A deals and 0 for non-green M&A deals. This dummy variable helps distinguish between M&A deals that are green and those that are not.

Additionally, this research examines how the ESG performance of the target company prior to the M&A deal influences outcomes. ESG score is a continuous variable ranging from 0 to 100, obtained from LSEG Workspace. These scores offer important information about the sustainability of companies engaged in M&A activities. The combined ESG score is used to assess its impact on stock returns. This method enables a detailed examination of how market reactions are affected by overall sustainability performance.

The study also explores the distinctions between green mergers that are cross-border and those that are within the U.S. Although the acquiring firm is consistently based in the United States, the target may be situated in either the U.S. or abroad. The dummy variable is set to 1 for cross-border deals, while for domestic deals it is set to 0. This variable is used to investigate if the geographic scope of the merger impacts the stock returns of the acquiring firms.

3.2.3 Control Variables

Several control variables are utilized to guarantee a more precise evaluation of the influence of green M&A on abnormal returns. These control variables consider additional factors that could impact abnormal returns and isolate the specific effect of green M&A. As recommended by existing research, the control variables consist of various acquirer-specific and deal-specific factors. Data for acquirer-specific control variables were retrieved from WRDS (Wharton Research Data Services), while deal-specific control variables data were sourced from the Orbis database.

The following control variables are acquirer-specific:

Market Value: The total value of a firm's outstanding shares. Larger firms usually experience lower benefits from acquisitions in comparison to smaller firms, possibly because of their existing market share and reduced growth potential (Fuller et al., 2002).

Market-to-Book Ratio: Compares a firm's market value with its book value, offering information on potential growth. Firms with higher market-to-book ratios often have better abnormal returns, because they are believed to possess greater growth prospects (Dong et al., 2006; Vermaelen & Rau ,1998).

Returns on Assets (ROA): Assesses the company's efficiency in generating profits using its assets. Firms that have a higher return on assets before merging typically have better performance after merging, which shows their efficiency and profitability in operations (Healy et al., 1992; Travlos, 1987).

Free Cash Flow (FCF): Cash remaining after deducting capital expenditures. Firms with high free cash flow are in a better position to pursue acquisitions that add value, as they have the necessary financial means to fund these deals (Jensen, 1986; Harford, 1999; Moeller, 2004).

Leverage: The amount of debt a firm employs to fund its operations and expansion. Increased leverage may result in greater negative abnormal returns during the announcement of an acquisition, indicating market concerns about increased financial risk (Maloney et al., 1993; Ghosh & Jain, 2000).

The following control variables are deal-specific:

Homogeneity: The deal is considered homogeneous when both the acquirer and target firm have matching three-digit SIC codes, potentially resulting in improved performance after acquisition. Understanding industry norms and regulatory landscapes aids in seamless integrations and achieving successful results (Cui & Leung, 2020).

Deal Size: Larger deal sizes result in lower announcement returns because of higher complexity and risk, according to Alexandridis et al. (2010).

Payment Method: The payment method has the potential to impact how investors perceive and react to the market. Cash bids typically lead to positive abnormal returns (Travlos, 1987), whereas stock payments could result in negative responses due to concerns about overvaluation, as indicated by Hansen (1987). Martin (1996) found that receiving mixed payments leads to responses ranging from neutral to slightly positive.

Private Target: Public acquisitions yield lower abnormal returns than private targets because public firms often pay higher premiums and face more competition (Moeller et al., 2004).

All control variables were not normally distributed, so they were winsorized at 2^{nd} and 98^{th} percentiles, except for the dummy variables. Figure A1 and A2 in the Appendix show the difference in distribution for a control variable before and after winsorizing. Winsorizing is used to reduce the influence of outliers and to enhance the data's resilience against violations of normality assumptions (Tukey, 1962). Winsorizing is also utilized due to the presence of negative values, making natural logarithm transformations ineffective. The dependent variable, which is the CAR [-1. 1], has also been winsorized at the 5^{th} and 95^{th} percentiles to improve its normal distribution. Huber (1981) states that this helps in reducing the impact of outliers on the results. However, the variables Free Cash Flow and Market Value are not winsorized but are instead transformed using the natural logarithm due to their lack of negative values. This change is applied to correct skewness and normalize variance, as taking the logarithmic is a well-known technique for dealing with non-normal distributions (Osborne, 2010).

Additionally, the pairwise correlation matrix shown in Table A1 of the Appendix suggests that there is no issue with multicollinearity since all correlations are less than 0.5. Dormann et al. (2012) stated that if the correlation is below 0.5, multicollinearity is usually not a concern in regression analyses. This threshold strikes a balance by detecting possible multicollinearity problems while still allowing significant relationships between variables. Furthermore, the test results of Variance Inflation Factor (VIF) in Table A1 of the Appendix indicate that there is no issue of multicollinearity among the independent variables, as all VIF values are below the widely accepted threshold of 5 (Shreshta, 2020).

Table 1. Descriptive Statistics

Variable	Description	Expected Sign	Mean	Std. Dev.
Green	Equal to 1 if the M&A deal is green and 0 if not	+	.063	.242
ESG	Combined ESG Score of the target firm, indicating overall sustainability performance from 0 to 100	+	33.755	16.075
Cross-Border	Equal to 1 if the M&A deal is cross-border and 0 if domestic	+	.239	.427
Ln(Market Value)	Total value of a company's outstanding shares in millions	-	16.756	2.046
Market-to-Book	Compares a company's market value to its book value in percentages (Market-to-Book Ratio)	+	.238	1.979
ROA	Net income divided by total assets in percentage (Returns on Assets)	+	.018	.169
Ln(FCF)	Cash generated after accounting for capital expenditure in millions (Free Cash Flow)	+	13.555	2.954
Leverage	Debt-to-equity ratio in percentages	-	.237	.202
Homogeneity	Equals 1 if the acquirer and target are in the same industry and 0 if not	+	.551	.497
Deal Size	Deal value of the M&A deal relative to the total assets of the acquirer	-	.258	.096
Cash Payment	Equals 1 if the method of payment in the M&A deal is cash and 0 if not	+	.442	.497
Stock Payment	Equals 1 if the method of payment in the M&A deal is stock and 0 if not	-	.085	.279
Mixed Payment	Equals 1 if the method of payment in the M&A deal is mixed and 0 if not	+	.4	.49
Private Target	Equals 1 if the target firm is private 0 if public	+	.886	.317

Notes: Table 1 shows the description of the variables, the expected signs, and descriptive statistics of all variables used in the estimated models.

Table 2 displays the cumulative abnormal returns (CARs) descriptive statistics for the full sample, green sample, and non-green sample across various event windows. The slight differences in CARs between green and non-green samples suggest a potential influence of green M&A on abnormal returns.

Table 2. Descriptive Statistics Cumulative Abnormal Returns

	(1)		(2)		(3)	
	Full Sample		**Sub Sample Green**		**Sub Sample Non-Green**	
	Mean	Median	Mean	Median	Mean	Median
CAR [-1, 1]	.008	.003	.008	.004	.008	.003
CAR [-2, 2]	.008	.003	.009	.005	.008	.003
CAR [-3, 3]	.008	.003	.01	.004	.008	.003
CAR [-5, 5]	.008	.004	.01	.006	.008	.004

Notes: Table 2 shows the descriptive statistics of the cumulative abnormal returns (CARs) of the total sample, green sample and non-green sample

4 Methodology

This section describes the methods used in the study, explaining the event study approach and cross-sectional regression models used to assess the impacts of green mergers and acquisitions on abnormal returns. Every aspect of methodology is clarified to ensure clarity and comprehensiveness.

4.1 Event Study

This study uses an event study approach to assess how green mergers and acquisitions (M&A) affect the abnormal returns of acquiring companies. Event studies are a commonly used empirical method in finance and economics to analyze how events affect the financial market, as stated by Mackinlay (1997). In this context, the focus is on the green M&A deal announcement, where the acquiring firm buys a target company recognized for its environmentally sustainable practices. The event study approach works well for M&A because it can represent abnormal returns as coefficients in a regression framework (Binder, 1997). Event study analysis helps in evaluating the impact of economic events on firm value by identifying expected shifts in economic profitability (Beverley, 2008).

4.2 Cross-sectional Regression Models

Cross-sectional regression models are used to further analyze the factors affecting the influence of green mergers and acquisitions (M&A) on abnormal returns. This method enables the analysis of variations in market responses depending on firm and deal characteristics (Fama & French, 1993).

4.2.1 Model 1 Green M&A

The first model assesses the first hypothesis that examines the overall influence of green M&A on abnormal returns. The cumulative abnormal returns (CARs) are regressed against various explanatory variables, such as a dummy variable for green M&A and specific control variables for the acquirer and deal. The model contains fixed effects for both time and industry. Time fixed effects are included to account for temporal changes that could impact abnormal returns in various time periods. This consists of macroeconomic conditions, regulatory changes, and market sentiment, all of which can fluctuate and impact how the market responds to M&A announcements (Schwert, 2000). Incorporating time fixed effects assists in separating the effects of the M&A announcement from other time-related factors. Industry specific characteristics that could impact abnormal returns are controlled for by including industry fixed effects. Various industries may experience different market dynamics, competition pressures, and regulatory environments, which can influence how the market perceives M&A announcements (Mitchell & Stafford, 2000). By incorporating industry fixed effects, the study considers these sector variations to prevent industry-specific factors from distorting the estimated effects of green M&A.

The first model is specified as follows:

$$CAR_{ijt} = \beta_0 + \beta_1 Green_{ijt} + \mu_1 A_{ijt} + \mu_2 D_{ijt} + \gamma_{Industry\ j} + \delta_{Time\ t} + \varepsilon_{ijt}$$

where CAR_{ijt} is the cumulative abnormal return for firm i in industry j on day t. $Green_{ijt}$ is the dummy variable for green M&A, A_{ijt} and D_{ijt} are acquirer-specific and deal-specific control variables, respectively. $\gamma_{Industry\ j}$ represents the industry fixed effects, and $\delta_{Time\ t}$ are time fixed effects. The error term ε_{ijt} accounts for the unobserved factors that affect the CARs but are not included in the model.

4.2.2 Model 2 ESG Performance Green M&A

The second hypothesis examines if the effect of green M&A is greater when the acquiring firm targets a green company with higher ESG scores in the second model. The ESG score of the target firm is incorporated and interacted with the green M&A dummy variable. The model is specified as follows:

$$CAR_{ijt} = \beta_0 + \beta_1 Green_{ijt} + \beta_2 ESGScore_{ijt-1} + \beta_3 (Green_{ijt}\ x\ ESGScore_{ijt-1}) + \mu_1 A_{ijt} + \mu_2 D_{ijt} + \gamma_{Industry\ j} + \delta_{Time\ t} + \varepsilon_{ijt}$$

Where $ESGScore_{ijt-1}$ is the ESG score of the target firm before the M&A deal and $Green_{ijt}\ x\ ESGScore_{ijt-1}$ is the interaction term. This model examines whether green M&A with target firms having higher ESG scores result in increased positive abnormal returns.

4.2.3 Model 3 Cross-border Green M&A

The third model tests the third hypothesis, which investigates if the influence of green M&A is greater for cross-border deals. A variable is added that interacts the green M&A variable and the cross-border variable. The model is specified as follows:

$$CAR_{ijt} = \beta_0 + \beta_1 Green_{ijt} + \beta_2 CrossBorder_{ijt} + \beta_3 (Green_{ijt}\ x\ CrossBorder_{ijt}) + \mu_1 A_{ijt} + \mu_2 D_{ijt} + \gamma_{Industry_j} + \delta_{Time_t} + \varepsilon_{ijt}$$

where $CrossBorder_{ijt}$ is the dummy variable for cross-border M&A and $Green_{ijt}$ x $CrossBorder_{ijt}$ is the interaction term. This specification enables the examination of the potential differences in effects between cross-border green M&A and domestic green M&A.

5 Empirical Results

This part shows the empirical results of the study, showing the abnormal average returns and cumulative average abnormal returns, and detailing the impact of green mergers and acquisitions (M&A) on cumulative abnormal returns (CARs) through a series of pooled ordinary least squares (OLS) regression models. The analysis is structured to address the effects of green M&A in general, the role of ESG performance, and the specific impacts of cross-border green M&A transactions.

5.1 Event Study

The event study findings, displayed in table 3 and 4, demonstrate the average abnormal returns (AAR) and cumulative average abnormal returns (CAAR) across multiple event windows for green and non-green M&A deals. The results show that both green and non-green M&A deals see beneficial abnormal returns during the announcement period, supported by statistically significant t-test results. In particular, both green and non-green M&A deals experience notable rise in abnormal returns on the day of announcement (Day 0), indicating a positive market reaction to M&A announcements. Additionally, the cumulative average abnormal returns within different event windows demonstrate positive and statistically significant outcomes for both types of deals. The findings indicate that green M&A deals are viewed favorably by investors, similar to non-green M&A deals, showing that the market believes in the value-generating abilities of these transactions.

Table 3. Abnormal Returns

Abnormal Returns				
Day	Green		Non-Green	
	AAR	t-test	AAR	t-test
-2	-0.001%	-0.553	0.001%	1.147
-1	0.001%	0.605	0%	0.297
0	0.005%	3.182***	0.004%	9.369***
1	0.003%	1.817*	0.004%	7.862***
2	0.002%	1.524	0.001%	0.705
Observations	1,000		14,627	

*Notes: Table 3 shows the average abnormal returns over five days and the t-tests for green and non-green sample. The levels of significance are *** p<0.01, ** p<0.05, * p<0.1.*

Table 4. Cumulative Abnormal Returns

Cumulative Abnormal Returns				
Event Window	Green		Non-Green	
	CAAR	t-test	CAAR	t-test
CAR [-1, 1]	0.008%	3.53***	0.007%	11.475***
CAR [-2, 2]	0.009%	3.483***	0.008%	9.438***
CAR [-3, 3]	0.009%	3.396***	0.008%	8.959***
CAR [-5, 5]	0.009%	2.883***	0.007%	7.713***
Observations	1,000		14,627	

*Notes: Table 4 shows the cumulative average abnormal returns over four event windows, namely [-1, 1], [-2, 2], [-3, 3] and [-5, 5] and the t-tests for green and non-green sample. The levels of significance are *** p<0.01, ** p<0.05, * p<0.1.*

5.2 Cross-Sectional Regression Models

Each hypothesis in my analysis is tested using its own model, and the results are presented in separate tables. Each table contains three columns corresponding to different model specifications. Column 1 represents the baseline model. Column 2 adds deal-specific and acquirer-specific control variables. Column 3 further includes industry and year fixed effects along with the control variables.

The results show pooled ordinary least squares (OLS) regressions and incorporate clustered standards errors by acquirer. This addresses potential correlations within firms across different time periods. By clustering the standard errors, I ensure that the statistical inference remains robust to within-firm correlation and heteroskedasticity. Thus, it provides more reliable and accurate estimates of the standard errors.

5.2.1 Model 1 Green M&A

Table 5 presents the results that evaluate the influence of green mergers and acquisitions (M&A) on cumulative abnormal returns (CARs) over the event window [-1, 1], which is the first hypothesis of this study.

The key variable of interest in this analysis is the green M&A variable. In the baseline model (1), the coefficient for the green variable is equal to 0.0007. This suggests that when the M&A deal is green compared to non-green, the cumulative abnormal return (CAR) of the acquiring firm increases by 0.07 percentage points. However, this effect is not statistically significant at the 10% level, as indicated by the standard error. This implies that green M&A announcements do not have a statistically significant impact on short-term cumulative abnormal returns of the acquiring firm when considered alone.

In the second specification (2), the coefficient for the green variable increases, suggesting a 0.13 percentage point increase in CAR when the M&A transaction is green compared to non-green, ceteris paribus. Despite this increase, the effect remains statistically insignificant at the 10% level. This indicates that even after accounting for several factors, green M&A does not significantly influence the cumulative abnormal returns of the acquiring firm in the short term.

In the final specification (3), the coefficient for the green variable further increases, indicating a 0.17 percentage point increase in CAR for green M&A compared to non-green M&A deals, ceteris paribus. However, this effect is still not statistically significant at the 10% level. The inclusion of fixed effects helps isolate the effect of green M&A from industry trends and macroeconomic conditions, suggesting that while there might be a more pronounced positive impact when these broader factors are considered, it still does not reach statistical significance. Therefore, I reject my first hypothesis.

While most control variables align with expectations, Ln(FCF), Leverage, and Deal Size do not. The natural logarithm of the free cash follow has a negative coefficient, contrary to my expectations of a positive sign. This unexpected result might be explained by firm with high free cash flow overinvesting or engaging in less profitable ventures, which could negatively impact their stock returns following a green M&A. The leverage ratio shows a positive and significant coefficient, contrary to the expected negative sign, suggesting that higher leverage might be seen as bold strategic moves. Similarly, Deal Size has a positive and significant coefficient, contrary to the expected negative sign, indicating that larger deals might be viewed favorably due to potential synergies and market impact.

Table 5. Green M&A

VARIABLES	(1) CAR[-1, 1]	(2) CAR[-1, 1]	(3) CAR[-1, 1]
Green	0.0007	0.0013	0.0017
	(0.0016)	(0.0020)	(0.0020)
Ln(Market Value)		-0.0020***	-0.0019***
		(0.0004)	(0.0004)
Market-to-Book		0.0001	0.0001
		(0.0003)	(0.0003)
ROA		0.0051	0.0028
		(0.0044)	(0.0044)
Ln(FCF)		-0.0007***	-0.0008***
		(0.0002)	(0.0002)
Leverage		0.0052*	0.0074**
		(0.0027)	(0.0031)
Homogeneity		0.0002	0.0001
		(0.0010)	(0.0010)
Deal Size		0.0360***	0.0367***
		(0.0066)	(0.0068)
Cash Payment		0.0014	0.0012
		(0.0015)	(0.0015)
Stock Payment		-0.0038*	-0.0017
		(0.0022)	(0.0022)
Mixed Payment		0.0020	0.0019
		(0.0016)	(0.0017)
Private Target		0.0124***	0.0128***
		(0.0018)	(0.0018)
Constant	0.0063***	0.0288***	0.0152
	(0.0004)	(0.0052)	(0.0169)
Observations	15,627	10,862	10,827
R^2	0.003	0.0206	0.0348
Industry FE	N	N	Y
Year FE	N	N	Y

*Notes: Table 5 contains pooled OLS estimated coefficients and the dependent variable is the CAR[-1,1]. Clustered standard errors are given in parentheses under the coefficients. The levels of significance are *** p<0.01, ** p<0.05, * p<0.1.*

5.2.2 Model 2 ESG Performance Green M&A

Table 6 shows the findings of the second model that tests the second hypothesis whether the impact of green M&A on CARs is greater when the target firm has a higher ESG score.

The key variable of interest in the analysis are the green M&A variable, the ESG score, and the interaction term between green M&A and ESG score. In the baseline model (1), the coefficient for green M&A is positive and equals 0.0048. This suggests that green M&A deals result in an increase of 0.48 percentage points in the acquirer firm's CAR compared to non-green M&A deals, but this effect is not statistically significant at the 10% level. The ESG score equals 0.0002 and shows a small but statistically significant impact at the 5% level on the CAR of the acquiring firm. The interaction term between green M&A and ESG score of the target is equal to 0.0002, suggesting a positive interaction effect. This implies that higher ESG scores of the target could enhance the positive impact of green M&A on CARs. However, the impact is not statistically significant at the 10% level.

In the second specification (2), the variable of green M&A increases to 0.0105 but still shows a statistically insignificant impact at the 10% level. The ESG score, however, becomes insignificant after adding the controls. The interaction term shows a slight increase and equals 0.0004. This suggests that an additional point in the ESG score of the target increases the impact of green M&A compared to non-green M&A by 0.04 percentage points, ceteris paribus. However, the impact is not statistically significant at the 10% level. While most control variables align with expectations, Ln(FCF), Leverage, and Deal Size do not, as observed in the first model. The final specification (3) shows similar results when adding industry and year fixed effects. Thus, based on these results, I reject the second hypothesis.

Table 6. ESG Performance Green M&A

VARIABLES	(1) CAR[-1, 1]	(2) CAR[-1, 1]	(3) CAR[-1, 1]
Green	0.0048	0.0105	0.0088
	(0.0101)	(0.0121)	(0.0124)
ESG	0.0002**	0.0001	0.0002
	(0.0001)	(0.0001)	(0.0001)
Green x ESG	0.0002	0.0004	0.0003
	(0.0002)	(0.0003)	(0.0003)
Ln(Market Value)		-0.0003	-0.0019
		(0.0017)	(0.0018)
Market-to-Book		0.0008	0.0013
		(0.0011)	(0.0010)
ROA		0.0096	0.0035
		(0.0162)	(0.0170)
Ln(FCF)		-0.0013	-0.0029**
		(0.0013)	(0.0013)
Leverage		0.0127	0.0135
		(0.0088)	(0.0104)
Homogeneity		0.0032	0.0018
		(0.0029)	(0.0028)
Deal Size		0.0292	0.0282
		(0.0209)	(0.0219)
Cash Payment		0.0046	0.0051
		(0.0049)	(0.0051)
Stock Payment		-0.0078	-0.0079
		(0.0069)	(0.0070)
Mixed Payment		0.0026	0.0035
		(0.0055)	(0.0058)
Private Target		0.0102**	0.0123***
		(0.0046)	(0.0046)
Constant	0.0072**	0.0174	0.0096
	(0.0030)	(0.0235)	(0.0302)
Observations	1,433	1,010	1,005
R^2	0.0039	0.0224	0.0941
Industry FE	N	N	Y
Year FE	N	N	Y

*Notes: Table 6 contains pooled OLS estimated coefficients and the dependent variable is the CAR[-1,1]. Clustered standard errors are given in parentheses under the coefficients. The levels of significance are *** p<0.01, ** p<0.05, * p<0.1.*

5.2.3 Model 3 Cross-border Green M&A

Table 7 present the results of the ordinary least squares (OLS) regressions that analyze the impact of cross-border green mergers and acquisitions (M&A) on cumulative abnormal returns (CARs) over the event window [-1, 1]. This model includes an interaction term between the green M&A dummy variable and a cross-border dummy variable.

In the baseline model (1), the coefficient for the green variable is 0.0009. This suggests that when the M&A deal is green compared to non-green, the cumulative abnormal return (CAR) of the acquiring firm increases by 0.09 percentage points, ceteris paribus. However, this effect is not statistically significant at the 10% level. The effect of cross-border M&A deals is negative compared to domestic deals, although not statistically significant. The interaction term between green and cross-border is -0.0012, suggesting that cross-border green M&A deals have a slightly lower CAR compared to domestic green M&A deals, but this effect is not statistically significant either at the 10% level.

In the second specification (2), the coefficient for the green variable increases to 0.0018, but it remains statistically insignificant at the 10% level. The coefficient for cross-border M&As becomes positive at 0.0009, and the interaction term becomes -0.0025; however, these effects are still not statistically significant at the 10% level. The same set of control variables as models 1 and 2 do not align with expectations.

In the final specification (3), the coefficient for the green variable further increases, suggesting a 0.21 percentage point increase in CAR for green M&A deals compared to non-green M&A deals, ceteris paribus. However, this effect is still not statistically significant at the 10% level. The coefficient for cross-border remains positive, and the interaction term remains negative, although neither are statistically significant at the 10% level. Therefore, I reject my third hypothesis.

Table 7. Cross-border Green M&A

VARIABLES	(1) CAR[-1, 1]	(2) CAR[-1, 1]	(3) CAR[-1, 1]
Green	0.0009	0.0018	0.0021
	(0.0018)	(0.0022)	(0.0022)
Cross-Border	-0.0002	0.0009	0.0004
	(0.0009)	(0.0011)	(0.0011)
Green x Cross-Border	-0.0012	-0.0025	-0.0023
	(0.0037)	(0.0045)	(0.0046)
Ln(Market Value)		-0.0020***	-0.0019***
		(0.0004)	(0.0004)
Market-to-Book		0.0001	0.0001
		(0.0003)	(0.0003)
ROA		0.0051	0.0028
		(0.0044)	(0.0044)
Ln(FCF)		-0.0007***	-0.0008***
		(0.0002)	(0.0002)
Leverage		0.0053*	0.0074**
		(0.0027)	(0.0031)
Homogeneity		0.0002	0.0001
		(0.0010)	(0.0010)
Deal Size		0.0365***	0.0368***
		(0.0067)	(0.0068)
Cash Payment		0.0015	0.0012
		(0.0015)	(0.0015)
Stock Payment		-0.0038*	-0.0017
		(0.0022)	(0.0022)
Mixed Payment		0.0021	0.0019
		(0.0016)	(0.0017)
Private Target		0.0123***	0.0128***
		(0.0018)	(0.0018)
Constant	0.0063***	0.0288***	0.0151
	(0.0005)	(0.0052)	(0.0169)
Observations	15,627	10,862	10,827
R^2	0.003	0.0207	0.0348
Industry FE	N	N	Y
Year FE	N	N	Y

*Notes: Table 7 contains pooled OLS estimated coefficients and the dependent variable is the CAR[-1,1]. Clustered standard errors are given in parentheses under the coefficients. The levels of significance are *** p<0.01, ** p<0.05, * p<0.1.*

6 Robustness Checks

This section describes the robustness checks performed to validate the main analysis. I will perform three additional tests: one will vary the event windows, the second will utilize an alternative model, the Fama-French three-factor model, and the last one will have a different estimation window.

6.1 Event Window Variation

The main analysis uses the event window [-1, 1] to capture the instant market response to merger and acquisition (M&A) announcements. Nevertheless, to guarantee the strength of my findings, I broaden the examination by implementing three different event windows: [-2, 2], [-3, 3] and [-5, 5]. Expanding the event window can capture possible information leaks before the announcement and lasting impacts after the announcement. Brown and Warner (1985) suggest that adjusting the event window can lead to a more thorough comprehension of market response by incorporating days that could be impacted by the event as well. This method assists in confirming the consistency and stability of the observed abnormal returns over various time periods.

In table 5, the green variable coefficients within the main event window [-1, 1] range from 0.0007 to 0.0017 and do not show a statistically significance impact at the 10% level. Table 8 displays identical regressions; however, the event windows are extended. The green variable coefficients also stay positive and lack statistical significance. This uniform lack of statistical significance in various event windows indicate that green M&A does not affect the cumulative abnormal returns of the acquiring firm significantly regardless of the chosen event window.

Table 9 displays similar findings to table 6 from the main analysis when assessing the direction and significance of the coefficients. Nonetheless, the interaction term is statistically significant at the 5% and 10% level in column 1 and 2, respectively of table 6 but remains relatively small. This indicates that the impact of green M&A on CARs rises when the ESG performance of the target firms is better, ceteris paribus.

Table 10 shows identical regressions as table 7 but with larger event windows as the dependent variable. The variables in columns 1 and 2 have coefficients that are similar in terms of sign and significance, approximately. The coefficients in the third column show different signs for the cross-border variable and the interaction term but are still not statistically significant at the 10% level. This shows that even though there are differences in the signs of the coefficients, the general lack of significancy remains consistency across different event windows, confirming the strength of the initial findings regarding cross-border green M&A.

Table 8. Different Event Windows Model 1

	(1)	(2)	(3)
VARIABLES	CAR[-2, 2]	CAR[-3, 3]	CAR[-5, 5]
Green	0.0019	0.0012	0.0014
	(0.0024)	(0.0026)	(0.0030)
Ln(Market Value)	-0.0023***	-0.0020***	-0.0022***
	(0.0005)	(0.0005)	(0.0006)
Market-to-Book	0.0002	0.0005	0.0004
	(0.0003)	(0.0004)	(0.0005)
ROA	0.0089*	0.0076	0.0191***
	(0.0054)	(0.0058)	(0.0069)
Ln(FCF)	-0.0010***	-0.0013***	-0.0012***
	(0.0003)	(0.0003)	(0.0004)
Leverage	0.0094**	0.0119***	0.0102**
	(0.0037)	(0.0042)	(0.0050)
Homogeneity	0.0003	0.0007	0.0020
	(0.0012)	(0.0013)	(0.0016)
Deal Size	0.0371***	0.0356***	0.0305***
	(0.0079)	(0.0087)	(0.0106)
Cash Payment	0.0006	0.0018	0.0008
	(0.0018)	(0.0021)	(0.0025)
Stock Payment	-0.0010	-0.0013	-0.0007
	(0.0026)	(0.0031)	(0.0037)
Mixed Payment	0.0021	0.0031	0.0033
	(0.0020)	(0.0023)	(0.0027)
Private Target	0.0126***	0.0122***	0.0121***
	(0.0020)	(0.0023)	(0.0027)
Constant	0.0301	0.0392	0.0308
	(0.0234)	(0.0255)	(0.0309)
Observations	10,827	10,827	10,827
R^2	0.0307	0.0272	0.0260
Industry FE	Y	Y	Y
Year FE	Y	Y	Y

*Notes: Table 8 contains pooled OLS estimated coefficients and the dependent variable in column 1 is CAR[-2,2], in column 2 is CAR[-3,3] and in column 3 is CAR[-5,5]. Clustered standard errors are given in parentheses under the coefficients. The levels of significance are *** p<0.01, ** p<0.05, * p<0.1.*

Table 9. Different Event Windows Model 2

VARIABLES	(1) CAR[-2, 2]	(2) CAR[-3, 3]	(3) CAR[-5, 5]
Green	0.0192	0.0255	0.0216
	(0.0145)	(0.0172)	(0.0221)
ESG	0.0001	0.0002	0.0003
	(0.0001)	(0.0001)	(0.0002)
Green x ESG	0.0006**	0.0007*	0.0004
	(0.0003)	(0.0004)	(0.0004)
Ln(Market Value)	-0.0010	-0.0030	-0.0030
	(0.0021)	(0.0023)	(0.0028)
Market-to-Book	0.0008	0.0012	0.0020
	(0.0012)	(0.0019)	(0.0022)
ROA	0.0146	0.0013	0.0122
	(0.0201)	(0.0241)	(0.0275)
Ln(FCF)	-0.0029**	-0.0038**	-0.0043**
	(0.0015)	(0.0016)	(0.0019)
Leverage	0.0205*	0.0237*	0.0143
	(0.0117)	(0.0129)	(0.0152)
Homogeneity	0.0035	0.0037	0.0085*
	(0.0035)	(0.0037)	(0.0044)
Deal Size	0.0324	0.0153	0.0584*
	(0.0259)	(0.0294)	(0.0342)
Cash Payment	0.0074	0.0050	0.0025
	(0.0061)	(0.0062)	(0.0076)
Stock Payment	-0.0163*	-0.0088	-0.0059
	(0.0084)	(0.0088)	(0.0106)
Mixed Payment	0.0068	0.0013	0.0024
	(0.0067)	(0.0069)	(0.0085)
Private Target	0.0125***	0.0151***	0.0245***
	(0.0048)	(0.0054)	(0.0064)
Constant	0.0115	0.0335	0.0202
	(0.0339)	(0.0370)	(0.0443)
Observations	1,005	1,005	1,005
R^2	0.0922	0.0859	0.0935
Industry FE	Y	Y	Y
Year FE	Y	Y	Y

*Notes: Table 9 contains pooled OLS estimated coefficients and the dependent variable in column 1 is CAR[-2,2], in column 2 is CAR[-3,3] and in column 3 is CAR[-5,5]. Clustered standard errors are given in parentheses under the coefficients. The levels of significance are *** p<0.01, ** p<0.05, * p<0.1.*

Table 10. Different Event Windows Model 3

VARIABLES	(1) CAR[-2, 2]	(2) CAR[-3, 3]	(3) CAR[-5, 5]
Green	0.0029	0.0021	0.0013
	(0.0026)	(0.0029)	(0.0034)
Cross-Border	-0.0004	0.0005	-0.0014
	(0.0014)	(0.0015)	(0.0018)
Green x Cross-Border	-0.0058	-0.0045	0.0001
	(0.0056)	(0.0061)	(0.0069)
Ln(Market Value)	-0.0022***	-0.0020***	-0.0021***
	(0.0005)	(0.0005)	(0.0006)
Market-to-Book	0.0002	0.0005	0.0004
	(0.0003)	(0.0004)	(0.0005)
ROA	0.0089*	0.0076	0.0190***
	(0.0054)	(0.0058)	(0.0069)
Ln(FCF)	-0.0010***	-0.0013***	-0.0012***
	(0.0003)	(0.0003)	(0.0004)
Leverage	0.0094**	0.0120***	0.0101**
	(0.0037)	(0.0042)	(0.0050)
Homogeneity	0.0003	0.0007	0.0020
	(0.0012)	(0.0013)	(0.0016)
Deal Size	0.0366***	0.0358***	0.0297***
	(0.0079)	(0.0088)	(0.0107)
Cash Payment	0.0006	0.0018	0.0007
	(0.0018)	(0.0021)	(0.0025)
Stock Payment	-0.0010	-0.0013	-0.0008
	(0.0026)	(0.0031)	(0.0037)
Mixed Payment	0.0021	0.0031	0.0032
	(0.0020)	(0.0023)	(0.0027)
Private Target	0.0126***	0.0122***	0.0122***
	(0.0020)	(0.0023)	(0.0027)
Constant	0.0301	0.0390	0.0310
	(0.0234)	(0.0255)	(0.0309)
Observations	10,827	10,827	10,827
R^2	0.0308	0.0272	0.0261
Industry FE	Y	Y	Y
Year FE	Y	Y	Y

*Notes: Table 10 contains pooled OLS estimated coefficients and the dependent variable in column 1 is CAR[-2,2], in column 2 is CAR[-3,3] and in column 3 is CAR[-5,5]. Clustered standard errors are given in parentheses under the coefficients. The levels of significance are *** p<0.01, ** p<0.05, * p<0.1.*

6.2 Fama-French Three-Factor Model

The second robustness check includes utilizing the Fama-French three-factor model instead of the market model employed in the main analysis. The Fama-French model, created by Fama and French (1993), expands the capital asset pricing model (CAPM) by incorporating three factors. The factors include the market risk factor, comparable to the market model, the size factor, and the value factor. This model considers other potential risks that could impact stock returns, offering a more detailed examination of abnormal returns.

In the market model, expected returns are determined by analyzing the historical relationship between the firm's returns and the market's returns. This information is found in section 3.2.1 of this research. Still, the Fama-French three-factor model includes extra elements to account for size and value impacts:

$$E(R_{it}) = \alpha_i + \beta_i R_{mt} + s_i SMB_t + h_i HML_t + \varepsilon_{it}$$

where SMB_t is the size factor that equals small minus big, HML_t is the value factor that equals high minus low, and s_i and h_i are the coefficients corresponding to these factors. This model helps us determine if incorporating size and value factor influences the calculation of CARs, ensuring the reliability of my results across various modeling techniques.

The results of the Fama-French three-factor model are displayed in table 11, with each column representing a different model used in the analysis. Column 1 corresponding to model 1, column 2 to model 2 and column 3 to model 3. The results from the main analysis are largely supported by the Fama-French three-factor model. The coefficients for the green variable, ESG scores, cross-border, and their interactions stay mostly constant, and their statistical significance remains the same. The consistency seen in a different model enhances the validity of the main findings, showing that they are not influenced by the selection of modeling method.

Table 11. Fama-French Three-Factor Models

VARIABLES	(1) CAR[-1, 1]	(2) CAR[-1, 1]	(3) CAR[-1, 1]
Green	0.0018	0.0076	0.0023
	(0.0020)	(0.0110)	(0.0022)
ESG		0.0002	
		(0.0001)	
ESG x Green		0.0003	
		(0.0002)	
Cross-Border			0.0002
			(0.0011)
Green x Cross-Border			-0.0025
			(0.0046)
Ln(Market Value)	-0.0020***	-0.0022	-0.0020***
	(0.0004)	(0.0018)	(0.0004)
Market-to-Book	0.0011	0.0014	0.0012
	(0.0003)	(0.0010)	(0.0003)
ROA	0.0041	0.0003	0.0041
	(0.0045)	(0.0173)	(0.0045)
Ln(FCF)	-0.0007***	-0.0029**	-0.0007***
	(0.0002)	(0.0013)	(0.0002)
Leverage	0.0046	0.0097	0.0046
	(0.0031)	(0.0103)	(0.0031)
Homogeneity	0.0003	0.0020	0.0003
	(0.0010)	(0.0029)	(0.0010)
Deal Size	0.0363***	0.0170	0.0363***
	(0.0068)	(0.0224)	(0.0068)
Cash Payment	0.0007	0.0036	0.0007
	(0.0015)	(0.0051)	(0.0015)
Stock Payment	-0.0028	-0.0074	-0.0028
	(0.0022)	(0.0071)	(0.0022)
Mixed Payment	0.0009	0.0026	0.0009
	(0.0016)	(0.0059)	(0.0017)
Private Target	0.0127***	0.0105**	0.0127***
	(0.0017)	(0.0046)	(0.0017)
Constant	0.0214	0.0078	0.0213
	(0.0176)	(0.0292)	(0.0176)
Observations	10,919	1,003	10,919
R^2	0.0329	0.0834	0.0329
Industry FE	Y	Y	Y
Year FE	Y	Y	Y

*Notes: Table 11 contains pooled OLS estimated coefficients and the dependent variable is CAR[-1, 1]. Model 1 is shown in column 1, Model 2 in column 2 and Model 3 in column 3. Clustered standard errors are given in parentheses under the coefficients. The levels of significance are *** p<0.01, ** p<0.05, * p<0.1.*

6.3 Estimation Window Variation

The final robustness check involves changing the estimation window used to calculate the expected returns. In the main analysis, a 120-day estimation window before the event was used. To guarantee the robustness of the results, I also employ a different window of 250 days. This approach tests if the selection of the estimation window significantly impacts the observed cumulative abnormal returns (CARs) in the main analysis. Mackinlay (1997) discusses the importance of using different estimation windows, such as a longer time frame like 250 days, to ensure the robustness and reliability.

The results of the regression models using a different estimation window are shown in table 12. The columns correspond to the different models: column 1 replicates model 1, column 2 replicates model 2, and column 3 replicates model 3 from the main analysis but with alternative estimation window. The results are in line with those of the main analysis, suggesting that the choice of the estimation window does not significantly affect the findings.

In the first model (1), the coefficient for the green variable is positive and remains statistically insignificant at the 10% level with a different estimation window. This confirms that green M&A announcements do not lead to significant short-term cumulative abnormal returns for acquiring firms compared to non-green M&A announcements.

For the second model (2), the coefficient for the interaction between green and ESG scores remains positive and statistically insignificant. This indicates that the ESG performance of green target firms does not significantly influence the CARs of acquiring firms in the short term.

In the third model (3), the coefficients for the cross-border variable and the interaction term between green M&A and cross-border continue to be statistically insignificant. This suggests that cross-border green M&A do not generate different abnormal returns compared to domestic green M&A deals.

Overall, the reliability of the main findings is confirmed through the robustness check using a different estimation window. The results show that the conclusions about the impact of green M&A on abnormal returns are robust to variation in the estimation window used to calculate expected returns.

Table 12. Different Estimation Window

VARIABLES	(1) CAR[-1, 1]	(2) CAR[-1, 1]	(3) CAR[-1, 1]
Green	0.0015	0.0095	0.0022
	(0.0020)	(0.0124)	(0.0022)
ESG		0.0004	
		(0.0001)	
ESG x Green		0.0003	
		(0.0003)	
Cross-Border			0.0003
			(0.0011)
Green x Cross-Border			-0.0036
			(0.0046)
Ln(Market Value)	-0.0018***	-0.0018	-0.0018***
	(0.0004)	(0.0018)	(0.0004)
Market-to-Book	0.0010	0.0009	0.0011
	(0.0003)	(0.0009)	(0.0003)
ROA	0.0053	0.0059	0.0053
	(0.0043)	(0.0166)	(0.0043)
Ln(FCF)	-0.0008***	-0.0029**	-0.0008***
	(0.0002)	(0.0013)	(0.0002)
Leverage	0.0068**	0.0133	0.0068**
	(0.0031)	(0.0102)	(0.0031)
Homogeneity	0.0005	0.0018	0.0004
	(0.0010)	(0.0028)	(0.0010)
Deal Size	0.0368***	0.0231	0.0367***
	(0.0068)	(0.0222)	(0.0068)
Cash Payment	0.0008	0.0051	0.0008
	(0.0015)	(0.0051)	(0.0015)
Stock Payment	-0.0024	-0.0072	-0.0024
	(0.0022)	(0.0071)	(0.0022)
Mixed Payment	0.0013	0.0038	0.0013
	(0.0017)	(0.0058)	(0.0017)
Private Target	0.0128***	0.0123***	0.0129***
	(0.0018)	(0.0045)	(0.0018)
Constant	0.0141	-0.0106	0.0140
	(0.0165)	(0.0303)	(0.0165)
Observations	10,850	1,001	10,850
R^2	0.0344	0.0887	0.0344
Industry FE	Y	Y	Y
Year FE	Y	Y	Y

*Notes: Table 12 contains pooled OLS estimated coefficients and the dependent variable is CAR[-1, 1]. Model 1 is shown in column 1, Model 2 in column 2 and Model 3 in column 3. Clustered standard errors are given in parentheses under the coefficients. The levels of significance are *** p<0.01, ** p<0.05, * p<0.1.*

7 Discussion & Conclusions

This part outlines the implications and limitations of the study. It discusses how the findings add to the existing literature, compares empirical results with theoretical expectations, and highlights possible directions for future studies.

7.1 Implications

This research makes a substantial addition to current literature by offering a thorough examination of how green mergers and acquisitions (M&A) affect the cumulative abnormal returns (CARs) of firms making the acquisitions. The study offers new perspectives on how green initiatives impact financial performance and market reactions by differentiating between traditional and green M&A.

The research shows that when companies announce green M&A, it does not lead to any significant changes in short-term abnormal returns for the acquiring companies. This discovery questions the belief that green M&A would immediately result in more favorable market responses because of perceived strategic and environmental advantages. This aligns with the study of Han et al. (2022), indicating that green M&A may result in long-term cost savings and innovation rather than instant enhancements in market performance. Although the theoretical advantages of green M&A, such as improved sustainability and lowered environmental risks, are valid, they do not result in immediate financial profits. This indicates a possible delay in market recognition or the necessity for a more long-term evaluation.

Furthermore, the positive correlation between ESG scores and CARs supports the idea that higher ESG performance lead to improved financial results, as suggested by Filbeck et al. (2019) and Zhou et al. (2022). Yet, the absence of a notable impact in green M&A suggests that although ESG matters, the market might not fully recognize the benefits of green M&A in the short term.

This research also shows that cross-border green M&A transactions do not yield greater abnormal returns in comparison to domestic green M&A deals. This implies that the challenges and uncertainties linked to cross-border deals could cancel out any potential advantages. This discovery aligns with Moeller and Schlingemann (2005), who noted a decrease in abnormal returns for U.S. acquiring companies in international deals.

Finally, the study's economic relevance lies in its comprehensive analysis of the financial and strategic impacts of green M&A on acquiring companies. Showing how green initiatives and financial performance correlate positively, it supports the rise of sustainable investing, pushing companies to improve their ESG practices to attract investment (Filbeck et al., 2019; Zhou et al., 2022). Additionally, the results underscore significant implications for policymakers and investors. Policymakers need to prioritize the promotion of ESG reporting guidelines to increase transparency and mitigate greenwashing, ultimately helping investors in making well-informed choices. Moreover, aligning environmental regulations and providing incentives for cross-border green M&A could promote easier global deals and drive sustainable investments. It is important for investors to take a long-term view when assessing green M&A opportunities, considering the possibilities for saving costs, fostering innovation, and improving ESG performance in the future.

7.2 Limitations

While this study provides valuable insights into the impact of green mergers and acquisitions (M&A) on cumulative abnormal returns (CARs), several limitations must be acknowledged.

One of the primary limitations of this research is the relatively limited number of ESG observations in the sample. Companies are not required to disclose ESG scores, leading to a lack of thorough information. This small sample size may result in less dependable findings and might not completely represent the differences in ESG performance among various companies and sectors. Future studies need to focus on incorporating a larger sample of ESG observations. This will be possible as more countries require ESG reporting in the future, thus increasing data availability.

Additionally, the identification of green M&A is dependent on the precision of the green criteria employed. There is a potential for greenwashing, when companies might falsely declare or overstate their environmental attributes to seem more eco-friendly. If greenwashing is common among the companies in this study, it may influence the outcomes in a biased manner. Future studies need to create more extensive standards for recognizing green firms.

Even with the addition of numerous control variables to account for endogeneity, there is still potential for bias from omitted variables. Not including relevant variables could distort the study's estimated effects. For instance, variables like the regulation of a country and quality of management, which are not accounted for in this study, might impact the outcomes. Future research should aim to incorporate a wider range of control variables that may impact abnormal returns.

Moreover, the study could be lacking in external validity, thus restricting the generalizability of the results to wider settings. Findings are specific to the U.S. market and may not be applicable in other countries. This restriction indicates the need for careful consideration when applying the results to areas outside the U.S. Subsequent studies should strive include a more diverse set of firms from various geographical regions.

In conclusion, this research offers insights into the impact of green M&A on acquiring firms' abnormal returns. Although the potential advantages of green M&A and strong ESG performance are recognized in theory, empirical evidence indicates a more complicated and long-term connection to abnormal returns. These findings suggest that green M&A does not necessarily lead to significant short-term gains for acquiring firms. On the contrary, the advantages of these acquisitions, such as cost efficiencies and enhanced innovation, might become apparent over time. Identifying and acknowledging the limitations in future research can improve the understanding of the financial and strategic implications of green M&A, ultimately leading to better integration of sustainability in corporate strategies.

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9 Appendix

List A1. Search Terms Green Target

“alternative energy” or “alternative power” or “biomass” or “bioenergy” or “bio energy” or “bio-energy” or “biofuel” or “fuel cell” or “hydrogen” or “photovoltaic” or “renewable energy” or “reuseable energy” or “re-usable energy” or “solar” or “waste to energy” or “wind power” or “wind farm” or “wave power” or “geothermal” or “geo-thermal” or “hydropower” or “hydro-power” or “bio-diesel” or “biodiesel” or “energy resource management” or “electric vehicle” or “water purification” or “intelligent power” or “air quality” or “energy efficiency” or “thin film energy” or “thin-film energy” or “energy efficiency software” or “energy storage” or “battery power” or “water treatment” or “waste management” or “biogas” or “anaerobic digestion” or “wastewater” or “green construction” or “green buildings” or “smart meter” or “smart grid” or “energy monitoring” or “marine energy” or “solar thermal” or “algae” or “green energy” or “cleantech” or “clean tech” or “environmental technology” or “greentech” or “charging station” or “green infrastructure” or “clean energy” or “tidal power” or “tidal energy” or “biodegradable” or “alternative fuel” or "environment-friendly" or "organic" or "recycling" or "natural" or "renewable" or "sustainable" or “green”

Table A1. VIF Test and Pairwise Correlation

Variables	VIF	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1) Green	1.046	1.000													
(2) ESG	1.182	0.020	1.000												
(3) Cross-Border	1.052	-0.038	0.032	1.000											
(4) Ln(Market Value)	2.014	0.036	0.336	0.079	1.000										
(5) Market-to-Book	1.060	-0.011	-0.085	-0.012	-0.081	1.000									
(6) ROA	1.132	-0.012	0.052	0.027	0.336	-0.166	1.000								
(7) Ln(FCF)	1.772	0.006	0.317	0.106	0.681	-0.065	0.191	1.000							
(8) Leverage	1.141	0.019	-0.071	-0.057	0.069	0.096	-0.014	-0.044	1.000						
(9) Homogeneity	1.039	-0.050	-0.091	-0.023	-0.018	0.011	-0.035	-0.004	0.001	1.000					
(10) Deal Size	1.632	0.060	0.012	-0.091	0.418	-0.005	0.088	0.278	0.209	0.038	1.000				
(11) Cash Payment	4.296	-0.012	0.027	0.022	0.122	-0.044	0.126	0.086	0.030	-0.028	-0.095	1.000			
(12) Stock Payment	1.853	-0.004	0.014	0.003	-0.012	0.040	-0.133	-0.048	-0.043	0.008	-0.013	-0.272	1.000		
(13) Mixed Payment	4.438	0.022	-0.041	-0.054	-0.143	0.029	-0.071	-0.069	-0.026	0.034	0.146	-0.727	-0.249	1.000	
(14) Private Target	1.367	-0.061	0.028	0.054	-0.162	0.005	-0.009	-0.137	-0.028	-0.041	-0.341	0.096	-0.045	-0.115	1.000

Notes: Figure A1 shows a histogram for ROA with on the x-axis the values of ROA and on the y-axis the density before winsorizing.

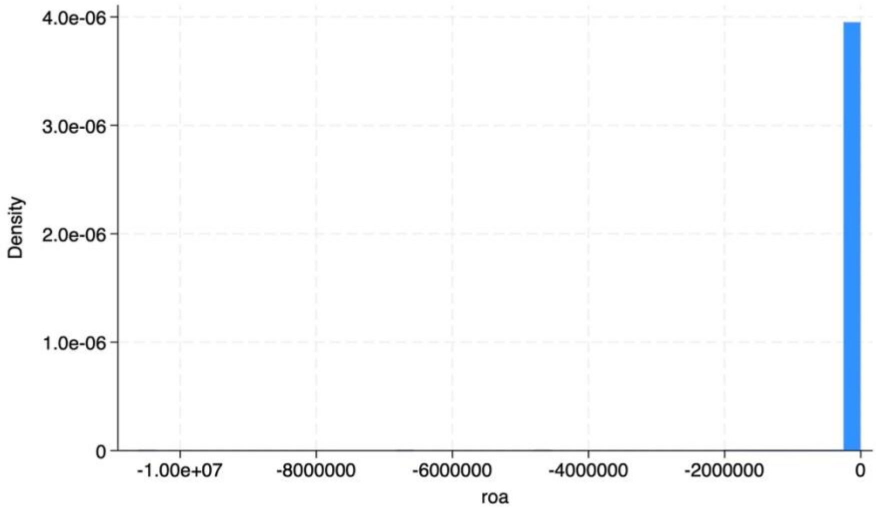

Figure A1. ROA before Winsorizing

Notes: Figure A2 shows a histogram for ROA with on the x-axis the values of ROA and on the y-axis the density after winsorizing.

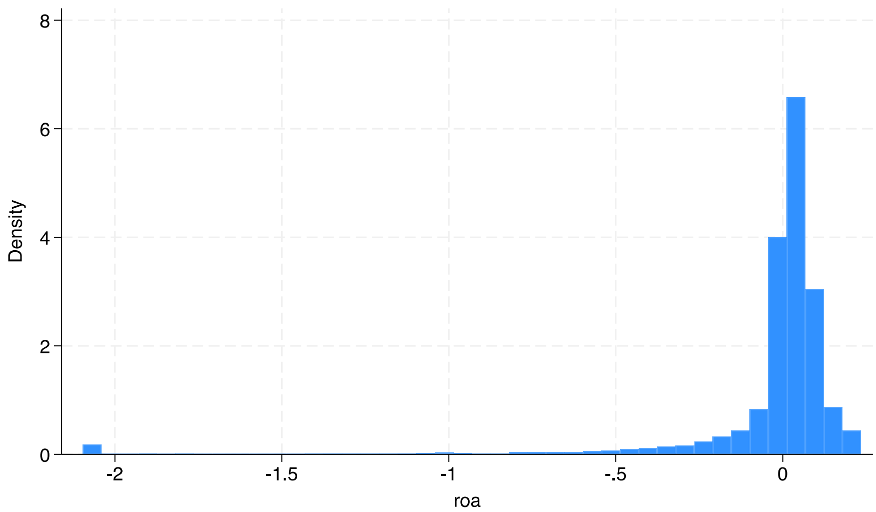

Figure A2. ROA after Winsorizing