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The Impact of Climate Action on the Financial Performance of Food, Grocery, and Supermarket Retailers in the UK

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Abstract: We examined the impact of climate action on the financial performance of eleven food, grocery, and supermarket retailers listed on the London Stock Exchange from 2013 to 2022. Our findings reveal a positive association between the climate mitigation efforts of these businesses and financial performance, particularly in terms of returns on assets (ROA). Through Ordinary Least Squares estimation, we identified that climate action practices such as renewable energy usage, waste reduction, adoption of energy-efficient technologies, eco-friendly packaging, and optimized transportation are significantly associated with the ROA of UK-based food, grocery, and supermarket retailers. This study is significant as these retailers often have extensive operations and supply chains that contribute to greenhouse gas emissions. It demonstrates that engaging in climate mitigation measures can still lead to a positive ROA.

Keywords: climate action; financial performance; sustainability; climate change; enterprises; food grocery; retail

Citation: Olarewaju, T.; Dani, S.; Obeng-Fosu, C.; Olarewaju, T.; Jabbar, A. The Impact of Climate Action on the Financial Performance of Food, Grocery, and Supermarket Retailers in the UK. *Sustainability* **2024**, *16*, 1785. https://doi.org/10.3390/su16051785

Academic Editor: Luigi Roselli

Received: 21 January 2024
Revised: 19 February 2024
Accepted: 20 February 2024
Published: 21 February 2024

Correction Statement: This article has been republished with a minor change. The change does not affect the scientific content of the article and further details are available within the backmatter of the website version of this article.

1. Introduction

In recent years, businesses have heightened their awareness of the environmental impact of their operations, leading to increased climate action efforts. Climate action involves endeavours to combat climate change and its repercussions [1–3]. These efforts broadly encompass climate mitigation to reduce greenhouse gas emissions and climate adaptations to prepare for anticipated future impacts [4,5].

Research on the UK retail sector indicates that firms in the country are somewhat ahead of their US counterparts in terms of addressing supply-chain-related emissions [2]. UK retailers exhibit greater ambition in terms of setting emission reduction targets and are more transparent about challenges related to energy consumption and emission improvements [2]. Recognizing the significant contribution of their operations and supply chains to carbon emissions, waste generation, and resource depletion, UK retailers have prioritized climate action. The British Retail Consortium (BRC) has facilitated collaborative efforts among UK retailers, leading to the development of a climate action roadmap which aims for a net-zero retail industry by 2040 [6].

Retailers in the UK have implemented several climate change initiatives by investing in renewable energy sources, adopting eco-friendly packaging, and optimizing transportation to reduce their carbon footprint. These sustainability initiatives form the basis of climate action in the retail industry, contributing to greenhouse gas emission reduction, enhanced energy efficiency, and waste reduction [7]. Beyond environmental benefits, embracing sustainable practices allows food, grocery, and supermarket retailers to attract environmentally conscious customers, thereby improving their reputation and market standing [8,9].

Despite the growing emphasis on climate action in the retail sector, there is limited research on its impact on the financial performance of food, grocery, and supermarket retailers listed on the London Stock Exchange. Understanding this relationship is crucial for retailers seeking to balance sustainability and profitability. Major financial indicators, including revenue growth, return on assets (ROA), and operational expenses, play a pivotal role in analysing retailers' financial performances.

Revenue growth, which indicate an increase in sales over time, is a key performance indicator for retailers [10]. Operational expenses, which represent the costs of running a business, are essential for business survival and sustainability [1,11,12]. ROA assesses the efficiency of a company's management in generating profit from its total assets. A higher ROA percentage signifies more effective asset management [13].

This study investigates the impact of climate action on the ROA of eleven food, grocery, and supermarket retailers listed on the London Stock Exchange from 2013 to 2022. The research addresses a critical gap in understanding the financial implications of climate action in the UK retail sector. The food, grocery, and supermarket retail sector holds significant economic and societal importance, playing a key role in meeting essential human needs, providing employment, and contributing to economic stability [14–16].

Supermarkets and grocery retailers serve as 'one-stop shops', enhancing consumer convenience and contributing to economic vibrancy. The sector's intricate supply chain ensures the efficient delivery of goods, connecting farmers, producers, distributors, and retailers. Additionally, the sector plays a crucial role in public health by offering a diverse range of food options and nutritional information. Its resilience during economic downturns further highlights its significance. This adaptability, coupled with its responsiveness to changing consumer preferences, underscores the sector's alignment with societal values, including sustainability [11,14,17].

The subsequent sections of this study include a literature review, presentation of hypotheses, data, methodology, results, discussion of implications and limitations, and a conclusion.

2. Literature Review

The impact of climate action on the financial performance of food, grocery, and supermarket retailers in the UK refers to how efforts to address climate change, such as implementing sustainable practices and reducing carbon emissions, affect the financial success and profitability of businesses in the food retail sector.

2.1. What Climate Mitigation Measures Can the Food, Grocery, and Supermarket Retail Sector Take?

Limited prior research has explored the link between climate change practices and corporate financial performance in other selected sectors, though it often indicates a positive association. For instance, some researchers have studied the utilities sector, reporting enhanced economic performance in segments like green electricity and water supply [18]. Similarly, some researchers have found positive excess returns for firms participating in the Chicago Climate Exchange, a voluntary greenhouse gas mitigation program, after accounting for market risk and industry-specific shocks [19].

This suggests that sustainability measures can positively impact a retailer's financial performance, primarily through cost reductions and operational efficiency. Utilizing energy-efficient devices can cut utility costs [1,20,21]. Additionally, waste reduction and optimized supply chain procedures can result in significant savings [1,21–23]. Sustainability programs focusing on resource conservation may improve operational efficiency and financial success conservation.

Beyond cost savings, sustainability practices can contribute to increased revenue and market share via some consumers who prefer retailers that prioritize sustainability and may be willing to pay a premium for sustainable items [24–26]. Thus, sustainability activities can

enhance brand reputation, enable differentiation between retailers, attract environmentally conscious customers, and foster customer loyalty [18,27].

Risk management is another aspect of financial performance influenced by climate change. Risks such as supply chain disruptions, legislative changes, and reputational loss can be mitigated through sustainability practices [28]. Implementing sustainable procurement practices and diversifying suppliers can reduce vulnerability to supply chain interruptions caused by climate-related disasters [21,29,30]. Climate-risk-averse retailers are better positioned for sustainable operations and their financial performance is also improved [30].

It is crucial to note that the impact of sustainable practices on financial performance varies based on industry, firm size, and market conditions. Although some studies show an immediate positive association, others suggest that financial benefits may require time and initial investments [1,31–33]. However, the long-term benefits, including cost savings, improved brand reputation, and consumer loyalty, often outweigh the initial costs.

With the limited existing literature on the food, grocery, and supermarket retail sector in the UK, there is a need for further research in this area, and this study aims to contribute to this knowledge. The food, grocery, and supermarket retail sector can adopt various climate mitigation measures to diminish environmental impact. These measures include supply chain sustainability efforts, such as prioritizing local sourcing and engaging with suppliers to promote eco-friendly practices. Energy efficiency measures involve investing in renewable energy sources and upgrading equipment for reduced energy consumption [1,34,35].

Regarding logistics and transportation, optimizing routes, transitioning to electric or hybrid vehicles, and collaborating with other retailers to share transportation resources can lower emissions. Waste management initiatives could include comprehensive recycling programs, the reduction of single-use plastics, and the introduction of composting could also be beneficial [34,35]. Water conservation efforts could entail implementing water-efficient practices in stores and distribution centres. Sustainable practices within stores could also involve the installation of energy management systems, green building design, and exploration into carbon offset programs.

Consumer education and engagement initiatives aim to promote sustainable choices, reduce meat consumption, and incentivize eco-friendly practices [23,36,37]. Furthermore, certifications such as Fair Trade and organic standards can also be pursued, and the adoption of technology, including smart inventory systems and blockchain for traceability, can enhance sustainability. By integrating these measures, the sector can significantly contribute to climate mitigation and foster a more sustainable future.

2.2. Overview of Current Climate Actions of the Food, Grocery, and Supermarket Retail Sector of the UK

To attain a net-zero retail industry by 2040, the British Retail Consortium (BRC) has formulated a climate action roadmap to expedite progress toward this objective. This initiative stems from the acknowledgment by UK retailers that their operations and supply chains play a substantial role in carbon emissions, waste generation, and resource depletion. Supporters of the BRC Climate Action Roadmap pledge to collaborate with fellow retailers, suppliers, the government, and other stakeholders, and they aim to collectively realize the industry's net-zero ambition [6]. As a result, many supermarkets and retailers in the UK have been taking steps to reduce their carbon footprint and promote environmental sustainability. This often involves initiatives such as:

1. Renewable Energy Adoption: Embracing renewable energy sources, such as solar and wind power, to reduce reliance on fossil fuels and reduce GHG emissions.
2. Supply Chain Sustainability: Implementing sustainable and ethical sourcing practices to reduce the environmental impact of the supply chain, including efforts to source local and responsibly produced products.

3. Energy Efficiency: Enhancing energy efficiency in stores and distribution centres through the use of energy-efficient lighting, heating, ventilation, and air conditioning (HVAC) systems.
4. Waste Reduction and Recycling: Implementing measures to minimize waste generation and promote recycling within stores, distribution centres, and through consumer education.
5. Sustainable Packaging: Adopting eco-friendly packaging materials and minimizing single-use plastics to reduce the environmental impact of packaging.
6. Carbon Offsetting: Exploring and investing in carbon offset programs to compensate for unavoidable emissions, contributing to a net-zero or carbon-neutral goal.

Incorporating climate change initiatives into business operations is essential for retailers aiming to enhance both their environmental and financial performance. This integration involves embedding sustainability considerations throughout the retail value chain, encompassing sourcing, store operations, and consumer engagement. Retailers are increasingly integrating sustainable design concepts into store layouts, implementing energy-efficient equipment, and adopting circular economy practices to minimize waste. Beyond internal operations, a comprehensive climate action strategy involves active engagement with suppliers to promote sustainable supply chain practices, reduce emissions, enhance resource efficiency, and ensure responsible sourcing. This not only helps retailers mitigate climate risks, but it also enhances their brand image as responsible corporate citizens [38–40].

Several factors contribute to the growing emphasis on climate action in the retail industry, with consumer demand for sustainable products and responsible corporate practices being a pivotal factor. Increasing consumer awareness of the environmental impact of their purchases has led to a greater willingness to support retailers prioritizing sustainability. Retailers proactively embracing climate action can tap into this consumer niche, gaining a competitive advantage in the market [41]. Additionally, legal frameworks and government initiatives have elevated the importance of climate action in the retail sector. Governments worldwide are enacting laws and regulations to incentivize sustainable practices, such as carbon pricing, energy efficiency standards, and reporting requirements. Retailers adhering to these regulations not only avoid penalties but also position themselves as industry leaders in sustainability.

The UK food, grocery, and supermarket retail sector actively participates in various initiatives to reduce environmental impact, driven by the imperative to address climate change. To achieve the BRC's goal of a net-zero industry by 2040, many retailers are adopting renewable energy, waste reduction techniques, energy-efficient technology, eco-friendly packaging, and optimized transportation. These climate change mitigation initiatives not only contribute to lowering greenhouse gas emissions, but they also align with business sustainability objectives, and they cater to consumer preferences for environmentally friendly products and practices, as further demonstrated in the following discussion.

2.2.1. The Use of Renewable Energy

As a pivotal measure in combating climate change, the adoption of renewable energy sources, such as solar and wind power, has gained momentum in the UK food, grocery, and supermarket retail sector. The utilization of renewable energy contributes to reducing greenhouse gas (GHG) emissions associated with both supply chain and operational energy use. Research has underscored the benefits of incorporating renewable energy into this sector [42–44]. For instance, the retail giant, Tesco, has significantly reduced its carbon footprint by investing in sustainable power sources. Despite the increasing use of renewable energy, challenges persist, including high initial costs, grid integration, and intermittency.

Embracing sustainable power in the food, grocery, and supermarket retail sector has become an effective strategy for mitigating climate change. Companies have recently made substantial investments in renewable energy sources like wind, solar, and hydropower to reduce dependence on fossil fuels [45]. Many retailers have successfully integrated

sustainable power into their supply chains, aligning with legislative policies to lower GHG emissions [23,34,46].

2.2.2. Waste Reduction

Reducing waste is a crucial strategy for enhancing sustainability, cutting costs, and positively impacting the environment. Numerous UK food, grocery, and supermarket retailers have adopted waste reduction techniques, including food waste prevention and recycling [47]. These retailers have implemented programs to minimize food waste, redistribute surplus supplies, and improve recycling practices. These initiatives contribute to resource efficiency, corporate responsibility, and emission reduction associated with waste disposal. They can also help to reduce poverty through generosity and the reduction of institutional voids [39,48–50]. However, challenges related to supply chain waste and shifting consumer behaviour remain areas of concern [51]. Research indicates that prominent supermarkets in the UK have set ambitious waste reduction targets, which particularly focus on reducing food waste in supply networks and operational processes. The use of technology for inventory tracking and control, along with collaborations with suppliers, have played crucial roles in achieving these objectives [47].

Furthermore, businesses are increasingly engaging with customers to promote responsible consumption. In addition to reducing food waste, a critical aspect of climate change mitigation in the food and grocery retail sector is the reduction of packaging waste. Businesses can transition to environmentally friendly and sustainable packaging materials, such as biodegradable plastics and reusable packaging solutions. Challenges include the adoption of waste management infrastructure and the need for defined metrics to measure the overall impact and long-term viability of these waste reduction programs. Initiatives to reduce waste in food, grocery, and supermarket retail are integral to the fight against global warming, emphasizing the importance of consumer engagement and behaviour in this context [52].

2.2.3. Energy-Efficient Technology

Embracing energy-efficient equipment stands as a crucial initiative in the UK's food, grocery, and supermarket retail sector's commitment to addressing climate change. As energy consumption constitutes a significant portion of greenhouse gas emissions, efficiency gains become imperative. Businesses are integrating energy-saving technologies, such as intelligent HVAC systems, LED lighting, and energy management systems, to curtail energy use, operational costs, and carbon emissions, which aligns with established targets [53]. The adoption of energy-efficient technologies is motivated by both financial benefits and environmental considerations. However, to ensure sustained adoption and impact, challenges like high initial costs, the need for ongoing technological advancements, and staff training, must be systematically addressed.

Numerous studies have highlighted the positive outcomes of employing energy-efficient technologies in the food and grocery retail sector. For instance, the installation of LED lighting systems in stores has the potential to reduce energy consumption by 30%, resulting in significant electricity cost savings [54]. Similarly, according to a Carbon Trust study, organizations implementing energy-saving measures achieved up to a 20% reduction in their energy expenditures [55]. The benefits of energy-efficient technologies extend beyond financial savings. Advanced refrigeration systems equipped with cutting-edge insulation and cooling technologies not only reduce energy consumption, but they also minimize food waste. These systems enhance the shelf life of perishable items by maintaining optimal storage conditions, thus aligning with sustainability goals and reducing environmental impact [52]. However, challenges persist when implementing energy-efficient technology in the UK's food and grocery retail sector, including high initial investment costs, technological complexity, and the need for skilled staff to manage and maintain these systems. Overcoming these obstacles will require strategic planning, financial incentives, and collaborative efforts within the industry.

2.2.4. Eco-Friendly Packaging

Reducing the environmental impact of packaging, a significant contributor to carbon emissions, involves adopting sustainable practices. Research highlights the adoption of recyclable and biodegradable packaging materials by major retailers [23,56]. These businesses implement initiatives to minimize plastic packaging, promote reusable alternatives, and invest in package innovation to align with sustainability goals. Consumer demand for eco-friendly products, which is consistent with business sustainability objectives, often drives the shift to environmentally conscious packaging. However, challenges such as the need for industry-wide standards, economic implications, and supply chain complexity, hinder the widespread adoption of eco-friendly packaging [1,37,49].

The UK's food, grocery, and supermarket retail sector recognizes eco-friendly packaging as a crucial strategy for climate change mitigation. Companies acknowledge the environmental impact of traditional packaging materials, which often involve resource-intensive production methods, increased carbon emissions, and plastic litter. The industry is transitioning to recyclable, biodegradable, or reusable alternatives, reducing dependence on non-renewable energy sources for plastic production and disposal [57]. Organizations are heavily investing in research and development to create innovative packaging materials using sustainable ingredients, such as plant-based plastics or biodegradable polymers, aligning with consumer demands for more environmentally friendly solutions and lowering carbon emissions.

Furthermore, industry-wide standards and recommendations for eco-friendly packaging have emerged through collaborative efforts within the sector. Adopting standardized packaging materials and procedures at scale has reduced the overall environmental impact of packaging. Businesses leverage eco-friendly packaging as part of their brand identity and commitment to sustainability, influencing customer behavior and preferences [1,22]. Collaborations within the industry have successfully disseminated best practices and coordinated collective efforts to reduce waste. Retailers frequently collaborate with charities and food banks to redistribute excess food, contributing to waste reduction and poverty alleviation [56]. The adoption of eco-friendly packaging is a key climate change mitigation strategy in the UK's food and grocery retail sector, fostering a more environmentally conscious industry that is resilient to climate change.

2.2.5. Optimized Transportation

The integration of electric vehicles (EVs) into the food and grocery sector in the UK represents a promising initiative to reduce greenhouse gas (GHG) emissions, it aligns with sustainability goals, and it serves as a fundamental strategy for environmental change mitigation. Carbon emissions from goods transportation significantly impact the industry, prompting many retailers to adopt EVs for a reduced carbon footprint [58]. EVs offer a more environmentally friendly alternative to traditional fossil fuel-powered vehicles, resulting in lower emissions and more economical operational costs. Government initiatives promoting clean mobility and imposing restrictions has further accelerated the widespread adoption of EVs. However, addressing challenges related to EV infrastructure development, including charging accessibility and fleet management complexity, is essential for achieving broader adoption.

Moreover, the utilization of EVs for last-mile delivery holds the potential to substantially reduce carbon emissions compared with conventional diesel-fueled trucks [59]. Additionally, EVs may entail lower maintenance expenses, making them a cost-effective and environmentally friendly choice. The widespread adoption of EVs is consistent with sustainability and corporate social responsibility initiatives, offering both environmental benefits and cost advantages [60]. Nevertheless, certain obstacles hinder the extensive use of EVs in the sector. Concerns over infrastructure limitations, including the availability and capacity of charging stations, persist. Moreover, some companies might be deterred by the significant initial capital investment required for the conversion of their fleet to EVs. Beyond EVs, exploring options such as ridesharing, collaborative purchasing and transportation,

and utilizing vehicles with lower GHG emissions, present additional opportunities for the industry.

2.3. Control Variables and Their Impact on Return on Assets

A company's capital structure, also known as the debt-to-equity ratio, represents the proportion of its debts to equity. This ratio, calculated by dividing total debt by total equity, indicates the percentage of funds contributed by both shareholders and lenders. A high debt-to-equity ratio suggests a heavier reliance on debt financing, whereas a low ratio indicates a greater dependence on equity. This ratio is a crucial indicator of a company's financial risk [11,12]. Companies strive to find a balance in their capital structure to optimize returns while managing financial risk. The optimal debt-to-equity ratio varies based on industry and business conditions. The connection between the debt-to-equity ratio and return on assets (ROA) reflects a trade-off between risk and reward. Although higher leverage can potentially enhance returns, it also raises financial risk. Therefore, the debt-to-equity ratio plays a pivotal role in influencing a company's financial risk, intertwined with its return on assets. Investors and analysts need to scrutinize both metrics carefully to comprehend how a company finances its operations and whether the chosen capital structure aligns with its overall financial objectives and risk tolerance.

The size of a firm is a crucial factor in this analysis, as large firms can leverage economies of scale to reduce operational costs [11]. Cost reduction contributes to increased profitability, and consequently, higher return on assets. Additionally, the level of economic development in the city where a company operates can impact profitability. Cities with high economic development tend to exhibit strong demand for goods and services due to the high purchasing power of consumers, leading to increased sales, profits, and investment in assets. Furthermore, firm growth, including market entry and diversification of product offerings, results in elevated sales and a higher ROA [61]. Economically developed cities often boast a skilled and educated workforce along with superior infrastructure. Access to a talented pool and essential resources enhances operational efficiency and innovation, thus influencing the ROA.

A skilled workforce contributes to effective cost management and operational streamlining, leading to cost savings, improved profitability, and a higher ROA. A higher growth rate typically corresponds with higher earnings if the firm can convert its growth initiatives into increased sales and profitability. Enhanced earnings contribute to a higher net income, thereby boosting the ROA. Ultimately, the vision and decisions of controlling shareholders regarding market positioning, expansion, and business focus can directly shape the firm's growth, profitability, and, consequently, its ROA.

2.3.1. Climate Action and Financial Performance

One of the primary positive outcomes of engaging in climate action is the potential for cost reduction, as seen through energy efficiency and waste reduction efforts, leading to significant savings for organizations [62]. Retailers can cut down on energy consumption and utility costs by adopting energy-efficient devices and practices. Similarly, implementing waste management and recycling measures can contribute to reducing expenses associated with trash disposal. These cost-saving measures have the potential to enhance retailers' financial performances and overall profitability. Climate action can also play a crucial role in improving brand reputation and shaping customer impressions. With consumers increasingly prioritizing environmentally conscious businesses, retailers can enhance their image and reputation by demonstrating a commitment to sustainability, attracting environmentally conscious customers in the process. A positive brand reputation can translate into increased consumer trust, loyalty, and advocacy, resulting in a larger market share and improved financial performance [63].

Consumers are often willing to pay premium prices for products and services from environmentally and socially responsible firms, making sustainability a key factor in purchasing decisions. Retailers that offer sustainable options or showcase their dedication

to climate action can tap into this growing consumer demand. Customer loyalty is another area where climate action can have a positive impact. By prioritizing sustainability, retailers may attract environmentally conscious customers who prefer brands with responsible environmental practices, fostering loyalty among this demographic. This loyalty can result in repeat sales, higher customer lifetime value, and positive word-of-mouth referrals, ultimately contributing to increased profit margins as loyal customers tend to be less price-sensitive [64].

Government laws and incentives play a crucial role in encouraging climate action and providing financial benefits to retailers. Governments often enact legislation to reduce carbon emissions, enhance energy efficiency, and promote environmentally friendly practices. Compliance with these standards not only shields retailers from penalties but also leads to operational improvements, cost savings, and overall improved financial performance [65]. Additionally, government incentives, such as grants, tax credits, and subsidies for sustainable initiatives, provide financial support and further incentivize retailers to invest in climate change measures.

2.3.2. Climate Action and Revenue

Revenue refers to the total amount of money generated by a business through its primary operations, such as sales of goods or services, during a specific period of time. It represents the top line of the income statement and is a key financial metric used to assess a company's financial performance [11,66]. Revenue is often categorized into different streams, including product sales, service fees, licensing, and other sources of income directly related to the core business activities of the company. It is crucial for businesses as it serves as a fundamental indicator of their ability to generate income and sustain operations [11,12].

The initial outlay needed for sustainable practices represents one of the biggest obstacles. Switching to renewable energy sources, adopting energy-saving technology, or restructuring supply chain procedures may be expensive. These initial outlays could put a financial burden on a business, perhaps resulting in shorter-term profitability declines. A manufacturing company may endure a period of diminished profitability during the transition phase if it chooses to replace its outdated, energy-intensive equipment with more energy-efficient ones [67,68]. It may be difficult for the business to start making money immediately if there are expenses involved in buying, installing, and training staff to operate new equipment effectively.

Furthermore, the financial effect of climate action may be affected by industry and market circumstances. Transitioning to sustainable practices in certain sectors, such as renewable energy, may result in significant revenue growth as governments and customers increasingly adopt clean energy alternatives. Sectors that rely significantly on carbon-intensive processes, such as fossil fuels, may have more significant hurdles in adapting to a shifting economic environment. Overall, both positive and negative aspects affect the effect of climate action on a company's revenue. Consumer preferences for environmentally friendly goods and services may result in greater sales and income, while a favourable public image linked with sustainability can attract additional consumers. However, the initial expenditures necessary for climate change measures may momentarily diminish profitability, and the magnitude of this effect varies depending on the sector and market circumstances. To make educated choices that align with their financial and environmental objectives, businesses must carefully analyze the long-term rewards and possible short-term obstacles connected with climate action.

2.3.3. Climate Action and Costs

Costs represent the total monetary outlay incurred by a business or an individual in the acquisition, production, or maintenance of goods, services, or assets. Encompassing a range of expenditures, including fixed and variable costs, as well as direct and indirect costs, these expenses accrue throughout the course of business operations. Costs play a

pivotal role in shaping a company's profitability and financial performance, influencing decisions related to resource allocation and pricing strategies [11,12].

The introduction of climate action may lead to changes in a company's cost structure, with significant impacts primarily arising from investments aimed at reducing greenhouse gas (GHG) emissions [69]. These investments often involve upgrading machinery, adopting energy-efficient technologies, and transitioning to renewable energy sources. Although such modifications may yield long-term cost benefits by curbing energy usage and emissions, they often entail substantial upfront expenses. It is crucial to recognize that the financial advantages of immediate climate change mitigation measures may take time to materialize, as these benefits typically unfold gradually, underscoring the importance of adopting a long-term perspective [70,71].

Furthermore, it is essential to acknowledge that climate action carries financial benefits beyond mere energy cost reduction. Organizations prioritizing sustainability may realize cost savings across various areas, thereby enhancing overall financial health. For instance, the implementation of waste reduction and recycling measures can lead to decreased waste disposal costs [47,52,72,73]. Embracing circular economy principles enables companies to trim resource consumption and waste production, thus contributing to further cost reduction. Engaging in sustainability efforts can also lower expenses associated with regulatory compliance. Proactively addressing environmental concerns may shield companies from hefty fines and legal penalties, particularly as global governments intensify their focus on environmental legislation. Moreover, companies can enhance their brand and credibility, potentially attracting additional clients and investors, by surpassing minimal compliance requirements and establishing higher environmental standards.

2.3.4. Climate Action and Liabilities

Liabilities, encompassing financial obligations and debts, are crucial components on a balance sheet, and they are classified as current or long-term based on their settlement timeline [11,12]. Climate change introduces new risks impacting a company's liabilities, notably through increased frequency and the severity of climate-related hazards. For example, a manufacturing firm in a flood-prone area may face substantial damage costs, constituting a climate-related liability.

Moreover, companies may be held accountable for environmental damage tied to their operations, incurring fines, legal penalties, and corrective action expenses. Climate-related lawsuits are on the rise, impacting financial stability and reputation. Non-compliance with evolving environmental regulations can lead to fines and legal action, emphasizing the need for accurate reporting and mitigation measures. Proactive risk management, environmental assessments, and sustainability commitments can mitigate climate-related liabilities. Investments in resilient infrastructure and disaster preparedness reduce financial risks. Strict emission reduction plans and accurate reporting help avoid regulatory penalties. Companies embracing sustainability foster stakeholder trust, resulting in enhanced financial performance, easier resource access, and favorable borrowing rates. Such practices help businesses to navigate climate change challenges and evolving market dynamics effectively.

2.3.5. Climate Action and Assets

Assets represent economic resources owned or controlled by an individual, business, or organization, with the potential to yield future economic benefits. These resources encompass a range of forms, such as cash, property, equipment, investments, intellectual property, and receivables. Classified as current or long-term on the balance sheet, assets play a pivotal role in evaluating financial position, liquidity, and overall value [12,70]. In the context of corporate operations, climate change significantly influences a company's asset portfolio, underscoring their crucial role in a company's value and sustainability, whether tangible or intangible.

Climate action can impact a company's assets in terms of their physical value, representing one of its more immediate and conspicuous effects. Climate change-induced

disasters, such as extreme weather events, rising sea levels, and altered precipitation patterns, pose a significant threat to a company's infrastructure and real estate assets. For example, an industrial site located near the coast may face increased vulnerability to storm surges and floods. Companies can preserve the value of their physical assets by recognizing these risks and proactively adapting to them [74]. This proactive approach may involve implementing advanced technological solutions, relocating operations to safer areas, or reinforcing infrastructure to withstand severe weather conditions. The potential benefits of preventing damage and operational disruptions often outweigh the costs of such solutions, even if they are substantial. Conversely, companies neglecting climate action and the vulnerability of their physical assets may face depreciation and impairment costs. Climate-related damages may necessitate recurring repairs and reconstruction, and it may deplete resources and diminish the long-term value of assets. Financial consequences may also include higher insurance premiums and difficulties in securing funding for at-risk assets.

Another aspect to consider in terms of the impact of climate action on assets is the transition risk associated with the shift to a low-carbon global economy. Businesses heavily invested in carbon-intensive assets, such as pollution-intensive processes, coal mines, or oil reserves, may encounter the risk of having stranded assets—assets that depreciate or become economically unviable in a low-carbon future. The demand for fossil fuels may decline as markets and governments prioritize carbon emission reduction, thus diminishing the profitability of these assets [75].

Conversely, in a low-carbon economy, investments in sustainable practices, green infrastructure, and renewable energy technology may enhance asset values [3,22]. Companies shifting their focus to clean energy options can mitigate risks associated with the transition and position themselves for growth in emerging green markets [69]. This strategic approach not only protects asset value but also aligns with environmental sustainability. Climate action can also influence a company's intangible assets, encompassing brand reputation and intellectual property. Companies that prioritize sustainability and adopt climate-friendly practices have the potential to enhance their brand's image as socially and environmentally responsible. This can translate into increased customer loyalty, positive media coverage, and heightened market value.

As consumers increasingly consider a company's environmental stance in their purchasing decisions, a robust commitment to climate change can confer a competitive advantage. Conversely, reputational damage stemming from environmental controversies or inaction may diminish the value of intangible assets. Instances of environmental irresponsibility, pollution issues, or failure to meet sustainability obligations can tarnish a company's reputation, triggering public outrage, boycotts, and legal consequences. The repercussions of such incidents may have enduring effects on a company's brand value, and consequently, its overall asset portfolio [34,40,42,76].

2.4. Challenges Related to the Climate Actions of the Food, Grocery, and Supermarket Retail Sector of the UK

The financial burden of climate actions poses a significant challenge for organizations implementing sustainability policies. Investing in energy-efficient technologies, renewable energy sources, and sustainable practices often requires substantial upfront costs, especially for small businesses with limited resources, thus impacting their short-term financial performance [37]. Despite these challenges, many sustainability measures can lead to long-term cost savings and improved financial performance by reducing energy usage, enhancing operating efficiency, and minimizing waste.

Retailers face another hurdle regarding the complexity of their multinational supply chains, making it difficult to ensure sustainable practices across the entire value chain. Overcoming this complexity involves connecting with suppliers, enforcing sustainability requirements, and investing in supply chain transparency. Addressing these challenges is crucial for achieving significant climate action and reducing risks associated with supply chain disruptions and reputational damage.

Consumer skepticism remains a barrier to effective climate action in the retail industry, with some customers unaware or doubtful about the environmental impact of their purchases. Affordability concerns, greenwashing, and limited product availability further hinder the adoption of sustainable products, affecting the financial performance of retailers, especially those heavily invested in sustainability [77]. To overcome consumer skepticism, comprehensive marketing and education efforts emphasizing the environmental benefits, cost, and accessibility of sustainable products are essential. Transparent labeling, certifications, and genuine third-party endorsements contribute to increasing consumer confidence and credibility.

Measuring and reporting the effects of sustainable programs pose challenges for retailers, requiring comprehensive systems and analytics. Accurately measuring and reporting environmental performance, including carbon emissions, energy usage, and waste reduction, are essential for transparency and credibility [78]. Investing in proper measuring methods, data collection tools, and standardized reporting frameworks can help retailers overcome these issues. Collaborations with suppliers and stakeholders is critical for addressing supply chain issues, with engagement in sustainable practices and the establishment of defined sustainability requirements contributing to a more sustainable value chain. Retailers can leverage their collective purchasing power to encourage suppliers to adopt sustainable practices [2].

Effective communication with consumers is likewise vital for dispelling skepticism and driving demand for sustainable products. Marketing and educational programs can emphasize the environmental benefits, cost, and quality of sustainable items, utilizing social media, influencers, and sustainability-focused events to increase customer awareness and involvement. Government support is also crucial for overcoming climate action challenges, encouraging organizations to participate in sustainable efforts and creating a level playing field for businesses of all sizes [79].

3. Materials and Methods

3.1. Development of Hypotheses

The literature reviewed so far has discussed pertinent issues related to the climate activities of businesses in the UK's food, grocery, and supermarket retail sector and their associations with returns on assets (ROA). We have demonstrated that climate action may enhance income by attracting environmentally concerned customers and investors. Although such action could result in cost savings, it may also involve substantial costs.

Furthermore, the UK food, grocery, and supermarket retail sector actively participates in several measures to reduce its environmental impact, recognizing the necessity of combating climate change to achieve the 2040 net zero goal of the BRC. The use of renewable energy, waste reduction techniques, energy-efficient technology, eco-friendly packaging, and optimized transportation are five important initiatives that UK retailers have undertaken to combat climate change. However, research has yet to investigate whether such climate action undertaken by the UK food, grocery, and supermarket retail sector has an impact on financial performance. This leads to the research hypothesis of this paper as a set of two alternatives:

Hypothesis 0 (H_0). *The climate action of the food, grocery, and supermarket retailers in the UK has no significant influence on the financial performance of these organizations.*

Hypothesis 1 (H_1). *The climate action of the food, grocery, and supermarket retailers in the UK has a significant influence on the financial performance of these organizations.*

3.2. Data

Environmental, Social, and Governance (ESG) and Corporate financial data on eleven of the biggest food, grocery, and supermarket retailers in the UK listed on the London Stock Exchange from 2013 to 2022 were collected from the Bloomberg Intelligence database [80].

City-level economic data on these organizations were also collected from the database of the Office for National Statistics [81]. The list of food, grocery, and supermarket retailers in the UK that form the data sample is shown in Table 1.

Table 1. Food, Grocery, and Supermarket Retailers Sampled.

1	ASDA Stores Ltd.
2	B&M European Value Retail
3	Co-Operative Group (Food Retail) UK
4	Greggs PLC
5	Iceland Foods UK
6	John Lewis Partnership PLC (Waitrose UK)
7	J Sainsbury PLC
8	McColl's Retail Group PLC
9	Marks & Spencer UK Foods
10	WM Morrison Supermarkets UK
11	Tesco PLC

3.3. Research Design

To test the research hypothesis, the study design employed a quantitative approach because the study seeks to explain if the climate action of the food, grocery, and supermarket retailers in the UK has a significant influence on the financial performance of these organizations. It does so by collecting numerical data and analysing them using statistical methods [82–84]. The STATA software (StataMP 18) was used for the regression analysis of our Ordinary Least Squares (OLS) model. The OLS model is the best model for understanding how one dependent variable is related to several independent variables in quantitative research [84–86]. This research designates Return on Assets (*ROA*) as the dependent variable. As we have discussed, ROA is a profitability measure that plays a guiding role in evaluating the financial performance of companies [11,14]. The various climate change mitigation initiatives employed by the UK retail industry enter the regression as independent variables via *REU*, *WRE*, *EFT*, *EFP*, and *OPT*. Control variables that could influence a company's financial performance are also introduced to produce the following OLS equation:

$$ROA = ß_0 + ß_1 REU + ß_2 WRE + ß_3 EFT + ß_4 EFP + ß_5 OPT + ß_6 Controls + e \quad (1)$$

The regression coefficients *REU*, *WRE*, *EFT*, *EFP*, and *OPT* represent climate change mitigation initiatives used by UK retailers, which are renewable energy usage, waste reduction systems, energy efficiency technology usage, eco-friendly packaging, and optimized transportation, respectively. The controls consist of corporate financial indicators and are the company's capital structure or debt-to-equity ratio, growth rate, size, controlling shareholder, human capital, and the level of economic development in the city in which the retailer's head office is located. To test for robustness, return on Equity (*ROE*) was also used as the dependent variable in an identical estimation to Equation (1). The descriptive statistics of all the variables are presented in Table 2, with the correlation matrix presented in Table 3. The variables are described in Table 4.

All the variables used in the study were scaled down to ratios in line with good practice [84,87,88]. Return on Assets (*ROA*) and Return on Equity (*ROE*) have a mean of 4.4 percent and 12.1 percent, respectively. The minimum return on assets and equity is −23.4 percent and −24.8 percent, respectively, whereas the maximum return is 52 percent and 48 percent, respectively. The average debt-to-equity ratio is 2.068. This means retailers in the sector typically have a debt of GBP 2.06 for every GBP 1.00 of equity. The minimum debt-to-equity ratio in the sector is GBP 0.41 of debt to every GBP 1.00 of equity and the maximum ratio is GBP 9.61 of debt to every GBP 1.00 of equity. The minimum and maximum growth rate in the sector is −8.8 percent and 9.8 percent, respectively, with an average growth rate of 5.7 percent. In the sector, the maximum percentage of shares owned

by majority shareholders is 54.1 percent, and the minimum is 25 percent, with an average of 45 percent. The maximum number of graduates employed by a retailer is 40 percent and the minimum number of graduates employed by a retailer is 12 percent. The sector average of graduate employees is 24.3 percent.

Table 2. Descriptive Statistics.

Variable	Number of Observations	Mean	Standard Deviation	Minimum	Maximum
Return on Assets	110	0.044	0.085	−0.234	0.520
Return on Equity	110	0.121	0.600	−0.248	0.480
Renewable Energy Usage	110	0.058	0.025	0.020	0.171
Waste Reduction	110	0.455	0.500	0	1
Energy Efficient Technology	110	0.818	0.387	0	1
Eco-Friendly Packaging	110	0.364	0.483	0	1
Optimized Transportation	110	0.273	0.447	0	1
Capital Structure	110	2.068	1.458	0.414	9.610
Firm Growth Rate	110	9.609	0.661	8.471	10.755
Size	110	0.057	0.194	−0.088	0.098
Controlling Shareholder Ratio	110	0.450	0.098	0.250	0.541
Human Capital	110	0.243	0.082	0.12	0.400
City-Level Economic Development	110	5.387	1.173	4.299	6.992

Table 3. Correlation Matrix.

	1	2	3	4	5	6	7	8	9	10	J b 11	12	13
1. Return on Assets	1.000												
2. Return on Equity	0.504	1.000											
3. Renewable Energy Usage	−0.180	0.021	1.000										
4. Waste Reduction	−0.043	0.129	0.223	1.000									
5. Energy Efficient Technology	−0.279	−0.118	0.430	0.260	1.000								
6. Eco-Friendly Packaging	−0.059	0.053	0.449	−0.031	−0.134	1.000							
7. Optimized Transportation	−0.181	0.076	0.261	0.255	0.289	−0.039	1.000						
8. Capital Structure	−0.296	−0.209	0.162	0.157	−0.102	−0.123	0.196	1.000					
9. Firm Growth Rate	−0.194	0.105	0.131	0.057	0.025	−0.117	−0.040	−0.117	1.000				
10. Size	−0.253	0.002	0.632	0.247	0.026	0.477	0.498	0.023	−0.236	1.000			
11. Controlling Shareholder Ratio	0.019	0.092	−0.119	0.129	0.267	−0.491	0.375	0.313	0.032	−0.325	1.000		
12. Human Capital	0.002	0.188	0.000	0.245	0.000	0.000	0.000	0.283	0.004	0.128	0.006	1.000	
13. City-Level Economic Development	0.228	−0.044	0.457	0.161	0.400	0.575	−0.022	0.086	−0.048	0.051	0.050	0.001	1.000

The waste reduction variable (*WRE*) has a mean of 5.8 percent, meaning the average reduction in waste generated by the operations of the study population per year is 5.8 percent. Moreover, 45.5 percent of the study population uses energy from renewable sources, as indicated in Table 2, via the renewable energy usage variable (*REU*). Furthermore, 81 percent of the study population make use of energy-efficient technology in their operations, as shown by the variable EFT's mean. The eco-friendly packaging variable (*EFP*) has a mean of 36.4 percent, whereas the optimized transport (*OPT*) variable has a mean of 27.3 percent. Both variables indicate the proportion of the sample that utilise these sustainability measures. The average total asset value of the study population is GBP 14.1 billion, with the minimum and maximum asset value being GBP 3.6 billion and GBP 46.8 billion, respectively. The GDP per capita of the city where the retailers' headquar-

ters are located has an average GDP per capita of GBP 2.1 million, and a minimum and maximum per capita GDP of GBP 19,000 and GBP 9 million, respectively.

Table 4. Description of Variables.

Variable	What It Measures	How	Source of Data
Dependent Variable			
Return on Assets	Retailers' financial performance	The ratio of current year's net profit to total assets (Net Profit ÷ Total Assets)	Bloomberg Intelligence Database
Return on Equity (Robustness Check)	Retailers' financial performance	The ratio of the current year's net profit to Shareholders' equity (Net Profit ÷ Shareholders' Equity)	Bloomberg Intelligence Database
Independent Variables			
Renewable Energy Usage	Use of renewable energy in retailers' operations	Dummy = 1 if the retailer uses energy from renewable energy sources	Bloomberg Intelligence Database
Waste Reduction	Reduction in the amount of waste generated by retailers' operations	Percentage difference between the previous year's total waste generated by the retailer and the current year's total generated waste	Bloomberg Intelligence Database
Energy Efficient Technology	Use of energy-efficient technology by retailer	Dummy = 1 if the retailer uses energy-efficient technology	Bloomberg Intelligence Database
Eco-Friendly Packaging	Use of eco-friendly packaging by retailer	Dummy = 1 if retailer uses eco-friendly packaging	Bloomberg Intelligence Database
Optimized Transportation	Use of electric vehicles by retailer	Dummy = 1 if retailer uses electric vehicles	Bloomberg Intelligence Database
Control Variables			
Capital Structure	Capital structure of retailers via debt-to-equity ratio	Total liabilities divided by total shareholders' equity	Bloomberg Intelligence Database
Firm Growth Rate	Growth rate of retailers	Total assets at the end of the year minus total assets at the beginning of the year	Bloomberg Intelligence Database
Size	Firm Size	The natural logarithm of total assets at the end of the year	Bloomberg Intelligence Database
Controlling Shareholder Ratio	Shareholding ratio of controlling shareholders	The number of shares owned by the largest shareholder divided by the total number of shares	Bloomberg Intelligence Database
Human Capital	The proportion of university graduates to the total employee population	Measured by the total number of university graduates divided by the total number of employees	Bloomberg Intelligence Database
City-Level Economic Development	Economic development of the city in which retailers' head office is located	Measured by the per capita GDP of the city in which retailers' head office is located	Office for National Statistics

4. Results

Table 5 presents the results of the estimation and indicates that renewable energy usage, waste reduction practices, the use of energy-efficient technology, eco-friendly packaging, and optimized transportation are significantly associated with the ROA of the food, grocery, and supermarket retailers in the UK. We can therefore reject the null hypothesis and agree that the climate action of the food, grocery, and supermarket retailers in the UK has a significant influence on the financial performance of these organizations. An increase in waste reduction is associated with an increase in ROA of 5.8 percent, and this is statistically significant at the ten percent level. According to this result, businesses that cut down on waste are more likely to have greater ROA, and this suggests that waste reduction has an important impact on a company's general financial health [89]. According to this finding, businesses could cut down on waste as part of their overall business strategy to increase both their operational and financial effectiveness. This finding could also be interpreted, in some sense, as agreeing with research that propounds that expenditure to limit the disposal

of hazardous solid waste may result in lower production costs; this is due to increased production efficiency and reduced expenses, as well as a reduction in future environmental liabilities [90]. It is also important to note that the volume of hazardous solid waste is usually correlated with production level, but efficiencies in the manufacturing process could minimize the need to dispose of hazardous solid waste and downtime, allowing the business to save on disposal costs [91].

Table 5. Regression Results; Dependent Variable: Return on Assets (ROA).

Variable	Coefficients	Standard Errors
Renewable Energy Usage	0.058 *	(0.107)
Waste Reduction	0.045 *	(0.008)
Energy Efficient Technology	0.073 **	(0.009)
Eco-Friendly Packaging	0.059 *	(0.010)
Optimized Transportation	0.018 *	(0.008)
Capital Structure	−0.019 ***	(0.002)
Firm Growth Rate	0.074 ***	(0.008)
Size	0.031 *	(0.012)
Controlling Shareholder Ratio	0.005	(0.039)
City-Level Economic Development	0.028 **	(0.004)
Human Capital	0.127 *	(0.031)
Constant	0.819 ***	(0.092)

Notes: R-Squared 0.347; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Furthermore, the results indicate that an increase in the renewable energy usage of the food, grocery, and supermarket retailers sampled is associated with increases in ROA by 4.5 percent, and this is statistically significant at the ten percent level. This is an indication that using energy from renewable sources could improve a company's financial performance. Firms that use renewable energy sources could have lower operating expenses, which could lead to higher profitability [92]. This result highlights the potential economic benefits of renewable energy adoption, highlighting that businesses which emphasize environmental sustainability alongside financial success are more likely to obtain a competitive advantage in the market and contribute favourably to society's general wellbeing. It is, however, important to note that renewable energy implementation is often costly when compared with conventional energy methods, and renewable energy equipment could also become outdated within a short period of time [45]. Renewable energy sources like solar and wind power not only help cut GHG emissions and battle climate change, but they also provide significant long-term cost benefits. Furthermore, advances in renewable energy technology are being developed, and this could make them more efficient and cost-effective over time.

The results further indicate that an increase in energy-efficient technology usage in the food, grocery, and supermarket retail sector is associated with an increase in ROA by 7.3 percent, and this is statistically significant at the five percent level. This is the strongest result of all the sustainability variables, and it is important because the use of energy-efficient technology by businesses has witnessed a significant surge in popularity in recent times. The primary objective of this technology is to mitigate energy consumption and foster sustainability via the incorporation of inventive ideas and practices [46]. Energy-efficient technology refers to the use of devices, systems, and processes designed to minimize energy consumption while maintaining or improving performance. The goal is to achieve the same or even better outcomes while using less energy, thereby reducing environmental impact and operating costs [22,44,93,94].

The results of the eco-friendly packaging variable show that it is associated with an increase in ROA by 5.9 percent, and this is statistically significant at the ten percent level. Companies are increasingly using eco-friendly packaging due to growing consumer awareness and a demand for sustainable practices, as well as due to government policies [55,64,86,95]. Companies that use biodegradable or recycled products not only reduce their environmental effect, but they also appeal to a broader client base that values environmentally conscientious decisions [96]. Eco-friendly packaging helps businesses distinguish themselves in a crowded market by demonstrating their commitment to sustainability and recruiting environmentally concerned customers [65,95].

Finally, the results indicate that an increase in the use of optimal transportation in the food, grocery, and supermarket retail sector is associated with an increase in ROA by 1.8 percent, and this is statistically significant at the ten percent level. In the food, grocery, and supermarket retail sector in the UK, optimal transportation practices play a vital role in enhancing operational efficiency and sustainability. Retailers leverage advanced route planning and optimization software to streamline delivery routes, as well as minimize travel time, fuel consumption, and environmental impact. Fleet management practices, including regular maintenance and the use of fuel-efficient vehicles, are implemented to ensure a reliable and sustainable transportation infrastructure. Collaborative distribution models, where retailers share transportation resources, contribute to cost savings and reduce the overall environmental footprint. Additionally, retailers explore modal shifts, incorporating alternative transportation modes such as rail or water transport for long-distance and bulk shipments, further aligning with energy-efficient and eco-friendly practices. Through the adoption of these optimal transportation strategies, the sector aims to meet consumer demands efficiently while mitigating the environmental impact associated with transportation operations [1,22,87].

5. Discussion

The findings affirm that climate action significantly impacts the financial performance of firms in the UK's food, grocery, and supermarket retail sector. Recall, that the research hypothesis of this paper is a set of two alternatives. The findings indicate that H_0 can be rejected. This is because of the statistically significant associations between financial performance (ROA) and the independent variables obtained by the estimations. Regarding the control variables, the results reveal a significant negative association between the capital structure (debt-to-equity ratio) variable and ROA. More specifically, a one-unit increase in the debt-to-equity ratio corresponds with a 1.9 percent decrease in ROA, and this relationship is statistically significant at the one percent level, as shown in Table 5. Additionally, the results indicate that firm growth rate and size have a significant positive influence on ROA, with increases of 7.4 percent and 3.1 percent, respectively. These relationships are statistically significant at the one percent and ten percent levels.

The controlling shareholder variable exhibits a positive coefficient, but the result lacks statistical significance. This suggests that controlling shareholders may influence the firm's investment decisions, but this influence does not have a significant impact on return on assets. Conversely, the city-level economic development variable significantly positively influences ROA at the five percent level, indicating a 2.8 percent increase in return on assets with a one-unit rise in city-level economic development. Lastly, the human capital variable also significantly positively influences ROA at the ten percent level, signifying a 12.7 percent increase in return on assets with a one-unit increase in human capital. These outcomes align with findings from previous studies [97–99].

5.1. Robustness Checks

Table 6 presents the results for the robustness test when the ROA is replaced with the ROE as the dependent variable for Equation (1). The results align with those observed when ROA is the dependent variable, except for the eco-packaging variable, which becomes insignificant. Additionally, the significance level of certain variables changes, particularly for

the capital structure (debt-to-equity ratio), energy-efficient technology, city-level economic development, and human-capital variables.

Table 6. Robustness Checks; Dependent Variable: Return on Equity (ROE).

Variable	Coefficients	Standard Errors
Renewable Energy Usage	0.041 *	(0.027)
Waste Reduction	0.019 *	(0.022)
Energy Efficient Technology	0.051 *	(0.024)
Eco-Friendly Packaging	0.024	(0.028)
Optimized Transportation	0.003 *	(0.023)
Capital Structure	−0.016 ***	(0.005)
Firm Growth Rate	0.027 *	(0.022)
Size	0.087	(0.032)
Controlling Shareholder Ratio	0.003	(0.010)
City-Level Economic Development	0.042 *	(0.010)
Human Capital	0.177 ***	(0.080)
Constant	2.068 ***	(0.238)

Notes: R-Squared 0.259; * $p < 0.1$, *** $p < 0.01$.

Return on Assets (ROA) and Return on Equity (ROE) are both financial metrics used to assess the profitability and efficiency of a company. However, they focus on different aspects of a company's operations. ROA measures how effectively a company utilizes its assets to generate profit, whereas ROE measures how effectively a company utilizes its equity to generate profit. ROA is calculated by dividing the net income of the company by its total assets, indicating the company's ability to generate profit from its investments in assets. On the other hand, ROE is calculated by dividing the net income of the company by its shareholders' equity, reflecting the return earned by the shareholders on their investment in the company.

5.2. Limitations and Future Research

Every study has its limitations, and despite the meticulous measures taken in this research to minimize bias, several limitations exist. The R-squared value of the study outcomes reveals that only 34.7 percent of the variations in the dependent variable can be explained by the independent variables. This implies that there may be unobserved factors impacting firm financial performance. Subsequent research could incorporate crucial factors such as market conditions, competitive dynamics, management strategies, and additional industry and endogenous elements that may influence financial success. Additionally, longitudinal studies could capture potential lag effects or changes in associations over time, providing a more comprehensive understanding of the link between climate mitigation actions and financial performance. Future investigations should also explore the impact of external variables, such as government or monetary policy, technological advancements, and other exogenous factors, on financial performance. To enhance the validity and robustness of the findings, examining the data through alternative statistical methods or models would be beneficial.

In addition, due to data limitations, most of the climate mitigation measures included in the estimated model were measured as dummies, except for waste reduction. In our estimation, a dummy value of 1 indicates the adoption of the climate mitigation measure. In the future, it would be beneficial to test for the degree of adoption (e.g., the percentage of the climate mitigation measure being used relative to the needs of the business). Finally, there is also a need for future research to assess the impacts of implementing sustainable and ethical sourcing practices on financial performance.

6. Conclusions

This study has shown that the impact of climate action on the financial performance of food, grocery, and supermarket retailers in the UK is significant. The link between sustainability and the climate actions of food, grocery, and supermarket retailers is profound and interconnected. Sustainability, in this context, pertains to the responsible management of resources and practices that support environmental health and societal well-being. This link relies on food, grocery, and supermarket retailers to minimize their environmental impact while maintaining economic viability. Thus, retailers are increasingly implementing sustainable practices such as reducing carbon emissions, minimizing food waste, using renewable energy sources, and adopting eco-friendly packaging. By taking these actions, they contribute to environmental preservation, mitigate climate change, and align with consumer preferences for environmentally responsible businesses. Additionally, retailers are increasingly striving to raise consumer awareness about sustainability issues and educate them on making environmentally conscious choices. By integrating sustainability into their business practices, food, grocery, and supermarket retailers demonstrate their commitment to environmental stewardship and contribute to a more sustainable future.

Moreover, such sustainability initiatives can enhance brand reputation, attract environmentally conscious customers, and drive long-term profitability for retailers. Therefore, the sustainability efforts of food, grocery, and supermarket retailers are closely intertwined with their climate actions, aiming to achieve both environmental and economic benefits.

This study reveals that the climate actions of food, grocery, and supermarket retailers in the UK significantly influence the financial performance of these organizations. The importance of this study lies in the fact that these retailers often operate extensive supply chains and operations that contribute to greenhouse gas (GHG) emissions [1,36,48,59]. These activities involve the transportation of products from farms and manufacturers to distribution centres and stores [36,92]. Supermarkets and grocery stores also generate considerable food waste, leading to methane production when it decomposes in landfills—a potent GHG. Additionally, these establishments consume substantial energy for refrigeration, lighting, heating, ventilation, and air conditioning (HVAC) systems, potentially resulting in significant carbon emissions, especially when fossil fuel-derived energy sources are used [35,92]. Moreover, their frequent use of excessive packaging, often non-recyclable or non-biodegradable, contributes to waste and environmental harm. Although individual companies within this sector may vary widely in their efforts to mitigate climate change, their actions can evolve over time.

The results further indicate that an increase in the use of energy-efficient technology in the food, grocery, and supermarket retail sector is associated with a 7.3 percent increase in Return on Assets (ROA)—a result statistically significant at the five percent level—which was the strongest outcome among all investigated climate mitigation variables. Energy-efficient technologies, applicable to buildings, transportation, and industrial processes, offer companies the potential to not only reduce operational expenses, but to significantly lower GHG emissions. These technologies encompass LED lighting systems, smart thermostats, and energy-efficient appliances. Smart thermostats, for instance, enable companies to enhance their heating and cooling systems, thereby mitigating energy inefficiencies [100–102]. The adoption of energy-efficient technology is often viewed as a commitment to social and environmental responsibility, enhancing a company's reputation and brand image, resulting in improved consumer loyalty and trust [93,103–105]. Additionally, the use of energy-efficient technology aids businesses with complying to government requirements, enabling them to avoid penalties or fines linked to environmental sustainability. These technologies reduce energy use and utility costs, allowing businesses to reinvest funds in other areas of growth and development. Moreover, adopting energy efficiency-related practices may help attract top talent and boost employee morale.

Based on the research findings, businesses should contemplate integrating climate change mitigation initiatives into their operations, as these could positively impact their financial performance. Implementing such initiatives offers several advantages, including

cost savings from energy efficiency measures and reduced risks from climate change effects. Companies prioritizing sustainability and environmental responsibility are more likely to attract socially aware investors and customers, further boosting their financial success. Incorporating renewable energy sources into operations can reduce carbon footprints while taking advantage of potential government subsidies and grants, which would also enhance the company's image. Companies can enhance resource consumption and reduce waste by implementing energy efficiency measures and sustainable practices, such as recycling, waste segregation, and the use of environmentally friendly products. These actions not only enhance reputation, but they also attract environmentally conscious clients and foster innovation for long-term success in a rapidly changing market [94,103,104].

Furthermore, adopting environmentally friendly and biodegradable packaging choices can help businesses reduce their carbon footprint and minimize the environmental impact of their products. Considering the mode of transportation for product delivery and raw materials is crucial, as the efficiency and environmental benefits of chosen transportation systems impact the overall operating efficiency and carbon footprint. Utilizing the best transit options can save costs, streamline operations, and ensure timely delivery, ultimately improving brand image and attracting environmentally conscious customers. Implementing sustainable transportation methods may also lead to long-term savings by reducing maintenance and fuel costs, benefiting the bottom line and the overall profitability of the business.

Although climate action could impact a firm's financial performance negatively, this study demonstrates that by engaging in climate action, firms can maintain a significant positive relationship with ROA. Given the increasing interest in climate mitigation practices among firms, this study suggests that it is possible to undertake climate action without risking negative impacts on financial performance.

Author Contributions: Conceptualization, T.O. (Tolu Olarewaju), C.O.-F. and T.O. (Tayo Olarewaju); Methodology, T.O. (Tayo Olarewaju), C.O.-F. and T.O. (Tayo Olarewaju); Formal analysis, T.O. (Tolu Olarewaju), C.O.-F., T.O. (Tayo Olarewaju), A.J. and S.D.; Investigation, T.O. (Tolu Olarewaju), C.O.-F. and T.O. (Tayo Olarewaju); Resources, T.O. (Tolu Olarewaju), C.O.-F. and T.O. (Tayo Olarewaju); Data curation, T.O. (Tayo Olarewaju) and C.O.-F.; Writing—original draft, T.O. (Tolu Olarewaju), C.O.-F. and T.O. (Tayo Olarewaju); Writing—review and editing, T.O. (Tolu Olarewaju), T.O. (Tayo Olarewaju) and S.D.; Supervision, T.O. (Tolu Olarewaju) and T.O. (Tayo Olarewaju); Funding acquisition, T.O. (Tayo Olarewaju), S.D. and A.J. All authors have contributed to this research. All authors have read and agreed to the published version of the manuscript.

Funding: T.O. (Tolu Olarewaju), S.D. and A.J. declare that they have received funding from Midlands Innovation—Inclusive Transformation.

Institutional Review Board Statement: This article does not contain any studies with human participants or animals performed by any of the authors.

Informed Consent Statement: Not applicable.

Data Availability Statement: No new data were created or analysed in this study. Data sharing is not applicable to this article.

Conflicts of Interest: The authors declare no conflict of interest.

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