



**Faculty of Economics and Business**

**The Impact of Corporate Carbon Footprint on Financial Performance of  
Manufacturing Industry in Malaysia**

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**Doctor of Business Administration  
2024**

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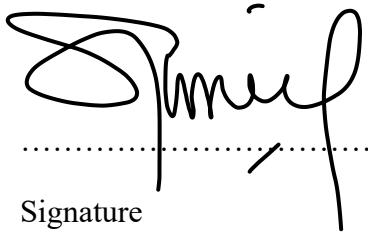
A dissertation submitted

In fulfillment of the requirements for the degree of Doctor of Business Administration

Faculty of Economics and Business  
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## DECLARATION

I declare that the work in this dissertation was carried out in accordance with the regulations of Universiti Malaysia Sarawak. Except where due acknowledgments have been made, the work is that of the author alone. The dissertation has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.



.....

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## ABSTRACT

Environmental sustainability has become a key concern for businesses worldwide, with expectations for them to take responsibility for their carbon emissions and environmental effects. The current study predominantly focuses on the energy sector, with less attention given to manufacturing in Malaysia. Reducing carbon emissions is critical for businesses due to both regulatory pressures and market expectations. Companies that proactively decrease emissions often see improved financial performance through greater sales, better access to finance, and increased efficiency. This study aims to provide significant insights into the sustainability practices of corporations and their influence on financial performance. Companies listed on Bursa Malaysia were chosen as the sample data in this study to evaluate and investigate the relationship between carbon footprint and financial performance. Approximately 18.97%, 269 of respondents are willing to disclose their carbon footprint information, suggesting a relatively low level of carbon footprint reporting. The results of the random effects model indicate that the null hypotheses for Return on Assets (ROA), Return on Equity (ROE), and Return on Investment (ROI) are accepted. The policymakers should provide incentives for investment in green technology and enact strict regulations to encourage more companies to engage in carbon reporting.

**Keywords:** Corporate Carbon Footprint, Financial Performance, Sustainability, Environmental Impact.

***Kesan Pelepasan Karbon Korporat Terhadap Prestasi Kewangan Industri Pembuatan di  
Malaysia***

***ABSTRAK***

*Kelestarian alam sekitar telah menjadi keprihatinan utama bagi perniagaan di seluruh dunia, dengan harapan mereka bertanggungjawab ke atas pelepasan karbon pada alam sekitar. Kajian semasa tertumpu kepada industri tenaga, dan kurang fokus kepada industri pembuatan di Malaysia. Syarikat yang proaktif dalam pengurangan perlepasan karbon sering dilihat peningkatan dalam prestasi kewangan seperti jualan meningkat, akses kewangan bertambah baik, dan peningkatan kecekapan. Kajian ini bertujuan untuk memberikan persepsi yang signifikan tentang kelestarian syarikat dan pengaruh mereka pada prestasi kewangan. Syarikat berdaftar di Bursa Malaysia dipilih sebagai data sampel dalam kajian ini untuk menilai dan mengkaji hubungan antara pelepasan karbon dan prestasi kewangan. Kira-kira 18.97% daripada 269 responden bersedia untuk mendedahkan maklumat pelepasan karbon mereka, dan menunjukkan tahap agak rendah. Dapatan daripada model kesan rawak menunjukkan bahawa hipotesis diterima untuk Return on Assets (ROA), Return on Equity (ROE), dan Return on Investment (ROI). Penggubal dasar perlu menyediakan insentif untuk pelaburan dalam teknologi hijau dan mengeluarkan peraturan ketat untuk menggalakkan banyak syarikat untuk terlibat dalam melaporkan pelepasan karbon.*

***Kata kunci:*** *Kesan Karbon Korporat, Prestasi Kewangan, Kelestarian, Impak Alam Sekitar.*

## TABLE OF CONTENTS

|                                            | Page |
|--------------------------------------------|------|
| <b>DECLARATION</b>                         | i    |
| <b>ACKNOWLEDGEMENT</b>                     | ii   |
| <b>ABSTRACT</b>                            | iii  |
| <b><i>ABSTRAK</i></b>                      | iv   |
| <b>TABLE OF CONTENTS</b>                   | v    |
| <b>LIST OF TABLES</b>                      | x    |
| <b>LIST OF FIGURES</b>                     | xi   |
| <b>LIST OF ABBREVIATIONS</b>               | xii  |
| <b>CHAPTER 1 INTRODUCTION</b>              | 1    |
| 1.1 Introduction                           | 1    |
| 1.2 Study Background                       | 7    |
| 1.3 Problem Statement                      | 15   |
| 1.4 Research Questions                     | 18   |
| 1.5 Research Objectives                    | 18   |
| 1.6 Scope of the Study                     | 19   |
| 1.7 Significance of the Study              | 19   |
| 1.7.1 Investor Confidence and Policymakers | 19   |
| 1.7.2 Entrepreneur & Business Practice     | 20   |

|                                    |                                                                          |           |
|------------------------------------|--------------------------------------------------------------------------|-----------|
| 1.7.3                              | Academics and Researchers                                                | 20        |
| 1.8                                | Organization of the Study                                                | 21        |
| <b>CHAPTER 2 LITERATURE REVIEW</b> |                                                                          | <b>23</b> |
| 2.1                                | Introduction                                                             | 23        |
| 2.2                                | Overview                                                                 | 23        |
| 2.2.1                              | Industrial Revolution in Manufacturing Industry                          | 26        |
| 2.2.2                              | Financial Performance Metrics                                            | 28        |
| 2.2.3                              | Trends                                                                   | 30        |
| 2.2.4                              | Positive Relationship Between Carbon Footprint and Financial Performance | 31        |
| 2.2.5                              | Negative Relationship Between Carbon Footprint and Financial Performance | 34        |
| 2.2.6                              | Theoretical Framework: Legitimacy, Stakeholder, and Signalling Theories  | 35        |
| 2.2.7                              | Empirical Evidence                                                       | 37        |
| 2.3                                | Hypothesis Development                                                   | 39        |
| 2.4                                | Chapter Summary                                                          | 43        |
| <b>CHAPTER 3 METHODOLOGY</b>       |                                                                          | <b>45</b> |
| 3.1                                | Introduction                                                             | 45        |
| 3.2                                | Conceptual Framework                                                     | 45        |
| 3.3                                | Research Methods                                                         | 46        |
| 3.4                                | Data Collection                                                          | 46        |
| 3.5                                | Method of Analysis                                                       | 48        |

|                                         |                                            |           |
|-----------------------------------------|--------------------------------------------|-----------|
| 3.5.1                                   | Variable Selection                         | 52        |
| 3.5.2                                   | Measurement of Financial Performance       | 53        |
| 3.5.3                                   | Measurement of Carbon Disclosure           | 55        |
| 3.5.4                                   | Control Variables                          | 56        |
| 3.6                                     | Chapter Summary                            | 57        |
| <b>CHAPTER 4 RESULT AND DISCUSSIONS</b> |                                            | <b>59</b> |
| 4.1                                     | Introduction                               | 59        |
| 4.2                                     | Descriptive Statistics                     | 59        |
| 4.3                                     | Correlation Result                         | 62        |
| 4.4                                     | Hausman Test Result                        | 66        |
| 4.5                                     | Random Effect Result                       | 67        |
| 4.6                                     | Chapter Summary                            | 74        |
| <b>CHAPTER 5 CONCLUSION</b>             |                                            | <b>77</b> |
| 5.1                                     | Introduction                               | 77        |
| 5.2                                     | Discussion                                 | 79        |
| 5.3                                     | Implications and Recommendations           | 79        |
| 5.3.1                                   | Investor Confidence and ESG Considerations | 80        |
| 5.3.2                                   | Policymaker                                | 81        |
| 5.3.2.1                                 | Incentive for Green Technology Investment  | 80        |
| 5.3.2.2                                 | Stringent Environmental Regulations        | 80        |

|                   |                       |     |
|-------------------|-----------------------|-----|
| 5.3.3             | Entrepreneur          | 82  |
| 5.3.4             | Academic and Research | 82  |
| 5.3.5             | Business Practice     | 83  |
| 5.4               | Future Research       | 84  |
| 5.5               | Limitations of Study  | 85  |
| 5.6               | Conclusion            | 86  |
| <b>REFERENCES</b> |                       | 87  |
| <b>APPENDICES</b> |                       | 111 |

## LIST OF TABLES

|                                                                                    | Page |
|------------------------------------------------------------------------------------|------|
| <b>Table 4.1:</b> Results of the Descriptive Analysis                              | 63   |
| <b>Table 4.2:</b> Correlation Result                                               | 66   |
| <b>Table 4.3:</b> Hausman Test                                                     | 67   |
| <b>Table 4.4:</b> Random Effect Regression Analysis (ROA)                          | 69   |
| <b>Table 4.5:</b> Random Effect Regression Analysis (ROE)                          | 71   |
| <b>Table 4.6:</b> Random Effect Regression Analysis (ROI)                          | 72   |
| <b>Table 4.7:</b> Summary of Hypotheses and Result                                 | 73   |
| <b>Table 4.8:</b> Summary of Listed company carbon footprint reporting in Malaysia | 74   |

## LIST OF FIGURES

|                                                                                        | Page |
|----------------------------------------------------------------------------------------|------|
| <b>Figure 1.1:</b> World Greenhouse Gas Emissions (World Map)                          | 4    |
| <b>Figure 1.2:</b> World Greenhouse Gas Emissions (Graph)                              | 5    |
| <b>Figure 1.3:</b> Greenhouse Gas Emissions Among G20 Economies by Sectors             | 6    |
| <b>Figure 1.4:</b> Greenhouse Gas Emissions in Malaysia                                | 11   |
| <b>Figure 1.5:</b> Carbon Dioxide Gas Emission by Sector, Malaysia                     | 12   |
| <b>Figure 1.6:</b> Greenhouse Gas Emissions by Sector, Malaysia 2019 (Split by Metric) | 13   |
| <b>Figure 1.7:</b> Greenhouse Gas Emission by Sector, Malaysia 2020                    | 14   |
| <b>Figure 3.1:</b> Conceptual Framework                                                | 46   |

## **LIST OF ABBREVIATIONS**

|                   |                                           |
|-------------------|-------------------------------------------|
| CGS               | Centre for Graduate Studies               |
| CH <sub>4</sub>   | Methane                                   |
| CO <sub>2</sub>   | Carbon dioxide                            |
| CO <sub>2</sub> e | Carbon dioxide equivalent                 |
| ESG               | Environmental, social, and governance     |
| GHG               | Green House Gas                           |
| GWP               | Global Warming Potential                  |
| IPCC              | Intergovernmental Panel on Climate Change |
| N <sub>2</sub> O  | Nitrous oxide                             |
| ROA               | Return on Assets                          |
| ROE               | Return on Equity                          |
| ROI               | Return on Investment                      |
| UNIMAS            | Universiti Malaysia Sarawak               |

# CHAPTER 1

## INTRODUCTION

### 1.1 Introduction

The impacts of corporate carbon footprints in the manufacturing industry in Malaysia will be briefly discussed in this chapter. Additionally, this chapter contains information regarding the background and objectives of the study, research questions, problem statements, significance, scope, limitations, and the organizational structure of the dissertation.

A person, organization, event, or product's total greenhouse gas (GHG) emission, both directly and indirectly, is measured as their 'carbon footprint' (Product Carbon Footprint Label, 2024). When greenhouse gases such as carbon dioxide, methane, and nitrous oxide are present in adequate quantities, they can have a net positive impact by contributing to the control of Earth's temperature. The problem is that, as a result of human activity, greenhouse gas emissions have greatly increased, overheating and trapping heat inside the atmosphere, causing Earth's average temperature to rise. This rise in Earth's temperature is called global warming. Different greenhouse gases absorb different amounts of heat, and they do not all stay in the atmosphere for the same length of time. As a result, some greenhouse gases are more potent than others (Education, 2023).

The emissions from each stage of production, manufacturing, use, and disposal of raw materials that go into a good or service determine its environmental impact. Several GHGs, including carbon dioxide (CO<sub>2</sub>), nitrous oxide (N<sub>2</sub>O), and methane (CH<sub>4</sub>), may be emitted throughout a product's life cycle. These GHGs can trap heat in the atmosphere to varying degrees. The differences in their impact are explained by the global warming potential (GWP) of each gas, which is expressed in terms of mass carbon dioxide equivalents (CO<sub>2</sub>e). The increase in global temperatures, known as 'global warming,' is primarily caused by an increase

in the number of greenhouse gases in the atmosphere. The term ‘climate change’ refers to the changing climatic patterns observed over time.

Sustainability reporting is now a prerequisite for doing business, as companies are under pressure to demonstrate a commitment to corporate social responsibility amidst calls for increased transparency from stakeholders (CorporateRegister, 2008). Businesses are being urged to adopt more sustainable practices and minimize their carbon impact, not only in Malaysia but also in many other nations. While some companies have made significant strides in this area, others are still lagging. Therefore, it is critical to understand how an organization’s carbon footprint affects its financial success.

The principal GHG Protocol corporate standard uses three categories to categorize a company’s greenhouse gas emissions. Reporting is necessary for scopes 1 and 2, whereas monitoring is optional and more challenging for scope 3. However, companies that successfully report on all three scopes will continue to have an advantage over their competitors. Emissions under scope 1 are those that directly come from resources owned and controlled by the company. Emissions falling under scope 2 are those produced using energy obtained from a utility supplier. In essence, all greenhouse gas emissions (GHG) are discharged into the environment as a result of using purchased energy, steam, heat and cooling. Scope 3 emissions encompass all indirect emissions that occur both upstream and downstream in the reporting entity’s value chain and are not covered by Scope 2. Emissions are, therefore, a by-product of manufacturing. According to the GHG Protocol, Scope 3 emissions are broken down into 15 categories (Academy, 2022).

The first category includes emissions from purchased goods and services, followed by emissions from capital goods. The third category covers fuel- and energy-related activities not already accounted for in Scope 1 or 2. The fourth category involves upstream transportation

and distribution, while the fifth deals with emissions from waste generated in operations. Business travel emissions form the sixth category, and the seventh encompasses emissions from employee commuting. Upstream leased assets constitute the eighth category. The ninth category includes downstream transportation and distribution emissions, and the tenth involves emissions from the processing of sold products by third parties. The eleventh category pertains to emissions from the use of sold products, while the twelfth covers the end-of-life treatment of sold products. Downstream leased assets form the thirteenth category, with franchises being the fourteenth. Lastly, the fifteenth category includes emissions associated with the company's investments, whether in the form of equity or debt. These categories collectively provide a comprehensive framework for organizations to account for and report their indirect emissions, offering a more complete understanding of their carbon footprint.

Figure 1.1 and Figure 1.2 illustrate the greenhouse gas emissions from all sectors over a century, starting from the First Industrial Revolution, denoted as Industry 1.0. The Industrial Revolution began in England during the 18th century and later expanded to the United States. Countries with the highest carbon emissions predominantly have large populations and extensive industrial activities. China, with a population of over 1.4 billion people, is followed by the United States of America, India, Russia and Japan. The countries with the least CO<sub>2</sub> emissions were Wallis and Futuna Islands, Montserrat, Saint Helena, Tuvalu and Niue, with 0.0 MtCO<sub>2</sub>e recorded in 2022.

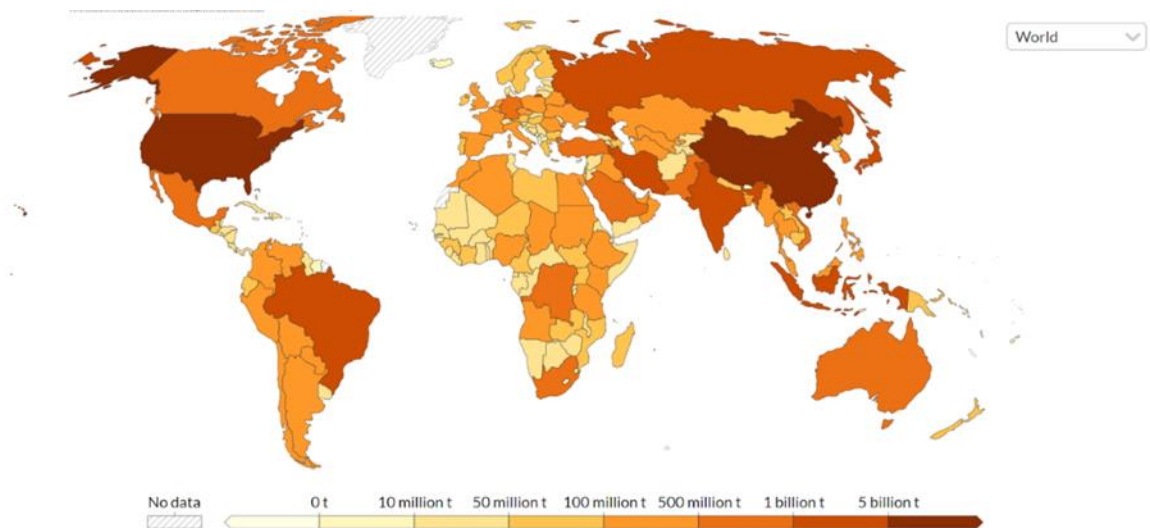


**Figure 1.1:** World Greenhouse Gas Emissions (World Map)

Source: Ritchie et al. (2023)

Figure 1.2 depicts global statistics based on emissions data from Ritchie et al. (2023). The information shows that inventions such as the steam engine, the spinning wheel, and the water wheel changed the face of manufacturing and set its path to an innovation that is present in our days. These advantages became increasingly clearer when coal was employed as a secondary source of fuel in many manufacturing processes (Simon, 2023). The highest yearly level ever recorded for GHG was 58 gigatonnes (GT) in 2022. If current demographic, economic, and emissions trends continue, the level of emissions will increase until it reaches 62 GT in the year 2030 ((Kharas et al., 2022). The United States, Saudi Arabia and Russia are the top three fossil fuel producers globally. Data on sector decompositions indicate that these countries have some of the highest emissions per capita from this industry. Saudi Arabia and Russia are major energy exporters, while the United States primarily uses its energy within its borders (Kharas et al., 2022). South Africa generates more greenhouse gases per capita than Japan due to frequent power outages and limited electrical access. India and Indonesia have low per capita electricity consumption, but the demand is rising quickly due to urbanisation

and economic growth. The AFOLU sector is another significant area where net emissions can be quickly decreased.

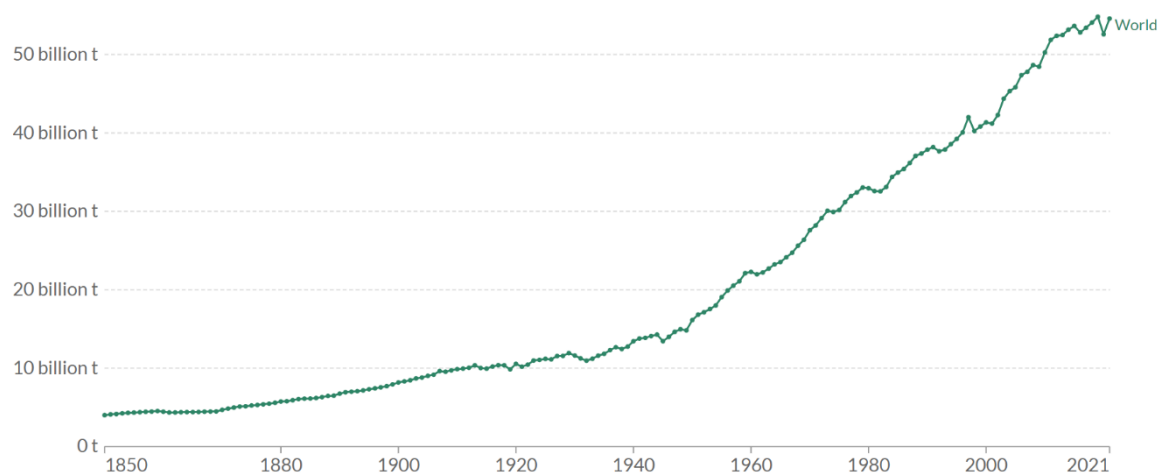


**Figure 1 2:** World Greenhouse Gas Emissions (Graph)

Source: Ritchie et al. (2023)

Figure 1.3 depicts high per capita emissions in Brazil and Indonesia in this sector, primarily caused by deforestation. South Korea is currently a net carbon sink in the agriculture, forestry, and land-use (AFOLU) sector due to reforestation programs dating back to the 1960s and implementing climate-smart agriculture methods (Kharas et al.,2022). Environmental sustainability and corporate social responsibility are becoming increasingly crucial for global businesses. One of the most significant hazards to life on Earth has been identified as GHG emissions. Excessive GHG emissions can harm ecosystems and contribute to climate change or global warming (Liu et al., 2015). According to Climate Change (2013), the global average temperature and carbon dioxide concentration will rise by 2100, and sea levels will increase by 26 to 81 cm. The Intergovernmental Panel on Climate Change (IPCC) recently published special research that argues that companies must now reduce GHG emissions to achieve sustainable growth. As a result, the need for carbon disclosure in society is expanding.

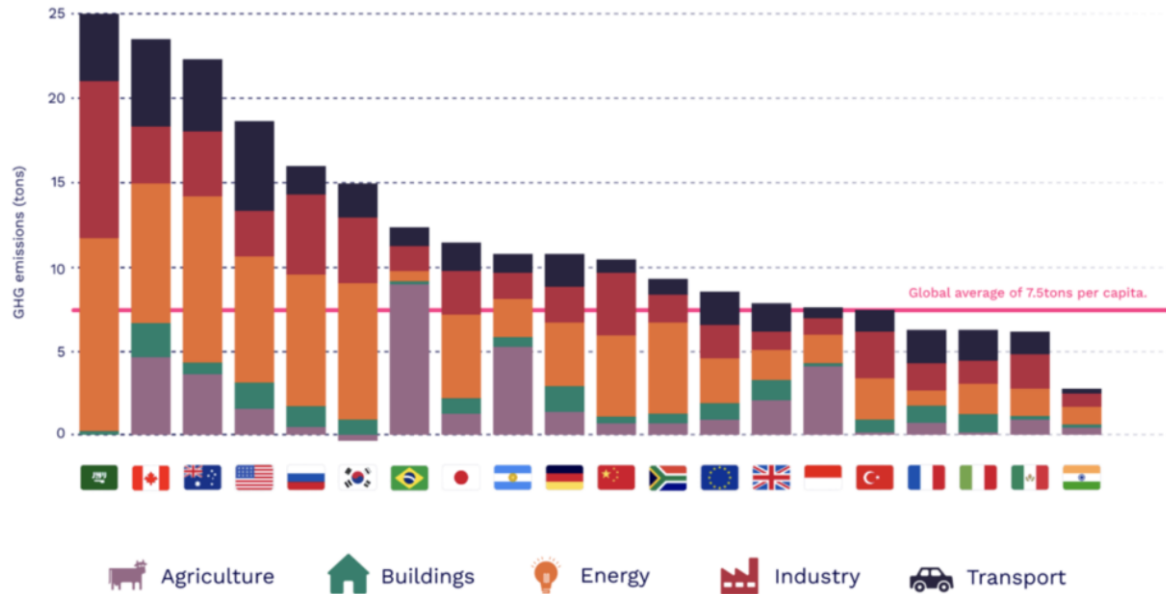


**Figure 1.3:** Greenhouse Gas Emissions Among G20 Economies by Sectors

Sources: Kharas et al. (2023)

Climate-related subjects, which impose a substantial influence on the economic progress of numerous nations worldwide, are increasingly gaining prominence in media coverage. By analysing the carbon data that companies provide, one can investigate the relationship between information quality and company success. For businesses to thrive, there must be a connection between the caliber of corporate information provided and their success.

Research on the impact of carbon footprint on financial performance has predominantly focused on developed countries such as the US and Europe, leaving a significant gap in understanding this dynamic within the context of Malaysia. The Malaysian manufacturing industry, a crucial sector for the nation's economy, lacks targeted analysis regarding how reducing carbon emissions affects financial outcomes. Existing studies often generalize across various industries without delving into the specific challenges and opportunities within manufacturing. Additionally, the influence of local environmental regulations and policies on this relationship remains underexplored. Moreover, there is a lack of studies examining how

technological adoption and innovation in reducing carbon emissions impact financial performance within the Malaysian manufacturing context. Addressing these gaps can provide valuable insights into the specific dynamics of the Malaysian manufacturing industry, helping businesses, policymakers, and investors understand the financial implications of carbon footprint reduction and fostering more effective sustainability activities. This focused research can also contribute to the broader global understanding of sustainability in emerging economies. Some businesses will fail if they are unable to adjust to the current climate (Kharbanda & Stallworthy, 1988).

## **1.2 Study Background**

According to the World Bank Collection of Development Indicators, manufacturing is the second-largest business sector in Malaysia, accounting for 23.46% of the country's GDP in 2022. The importance of the manufacturing sector to Malaysia's economy is further underscored by the fact that it continues to propel the economy forward through synergistic relationships with other key industries, such as trading, financial, transportation, and services sectors (Ismail et al., 2015). In 2022, the Malaysian manufacturing sector continued to play a significant role in the economy. The sector's gross output value reached RM1,435.6 billion, nearly doubling from 2013. The electrical and electronics sub-sector remained a major contributor, reflecting the industry's ongoing importance in Malaysia's export market and overall economic performance (Economic Performance and Outlook, 2023).

Environmental sustainability has become a key concern for businesses worldwide in recent years. Companies are now expected to take responsibility for their carbon emissions and environmental effects as public awareness of the need for sustainability grows. The concept of a carbon footprint, which measures the amount of greenhouse gas emissions produced by a corporation, has gained importance as a fundamental indicator for analysing a company's

environmental impact. Simultaneously, financial performance remains a crucial factor in business success. Companies are obligated not only to fulfil their environmental responsibilities but also to maintain profitability and market competitiveness. Consequently, comprehending the relationship between a business's carbon footprint and its financial success is critical to ensuring that sustainable practices do not compromise economic growth (Pham et al., 2021).

Companies in Malaysia, like those in many other nations, are under pressure to decrease their carbon footprint and implement more sustainable practices. Malaysia has pledged to cut greenhouse gas emissions by 45% by 2030 and achieve carbon neutrality by 2050 as part of the Paris Climate Agreement (Bursa Malaysia, 2024). To meet this goal, businesses must take considerable actions to reduce carbon emissions and enhance environmental performance. Governments, like that of Malaysia, have vowed to reduce emissions, and they have put rules and regulations in place to control and compel businesses to reduce their carbon emissions.

The Kyoto Protocol was a global treaty designed to mitigate carbon dioxide emissions and the concentration of greenhouse gases in the atmosphere. Its fundamental principle was that developed countries were required to reduce carbon dioxide (CO<sub>2</sub>) emissions (Plan A, 2023). Developed, industrialized countries pledged under the Kyoto Protocol to decrease their annual hydrocarbon emissions by an average of 5.2% by 2012. Targets were contingent upon the individual country. While the Kyoto Protocol had some successes in establishing a foundation for international climate action, it ultimately fell short of its goals due to limited participation and insufficient emissions reductions. The experience with the protocol informed the development of the Paris Agreement, which aimed to address some of these shortcomings. Key issues included the lack of participation from major developing countries, the withdrawal of the United States, and the failure to achieve meaningful emissions cuts globally (Ferrey,

2011). By 2002, the Kyoto Protocol only covered about 30% of global emissions, and even if extended, it was projected to have little impact on global temperature change (Nordhaus, 2006).

As a result, each nation had a different target to meet by that year. The Paris Climate Agreement, a landmark environmental pact adopted by nearly every nation in 2015 to address climate change and its negative effects, includes commitments from all major GHG emitting countries to cut their climate-altering pollution and to strengthen those commitments over time. A major directive of the deal calls for reducing global GHG emissions to limit the Earth's temperature increase in this century to 2 degrees Celsius (with a preference for a 1.5-degree increase) above preindustrial levels. The Paris Agreement also offers a mechanism for developed nations to support developing nations in their endeavours to adapt to climate change. Additionally, it establishes a framework for transparently monitoring and reporting countries' climate goals (United Nations Framework Convention on Climate Change, 2023).

As of July 2023, there are 269 manufacturing-related companies listed on Bursa Malaysia. Most of these companies are being honest by disclosing their carbon footprint in their yearly reports. Although many countries, including Malaysia, have passed various carbon emission laws, regulations and programs to promote carbon emission reduction, some people have doubts about the validity of this data due to the inherent ambiguity in carbon emission measurement. They argue that with a standardised and universally accepted method of measuring carbon emissions, it would be easier to compare and verify the accuracy of the reported data. Additionally, some companies may engage in greenwashing, which is the practice of misleading consumers about a product's environmental impact or benefits (Hayes, 2024), presenting themselves as environmentally friendly without reducing their carbon footprint. Examples of greenwashing include companies advertising their products as 'eco-friendly' or 'sustainable'. There is a growing need for international collaboration and the development of a standardised framework for measuring and reporting carbon emissions to

address these concerns. This would ensure transparency and accountability in the fight against climate change.

Despite the growing interest in the causal connection between a company's carbon footprint and its financial success, Malaysia has not seen much research on the topic, especially concerning high- and low-carbon firms. This study aims to fill this knowledge gap by evaluating the causal link between corporate carbon footprint and financial performance and by contrasting the financial results of high and low-carbon firms in Malaysia. High-carbon firms are characterized by significant greenhouse gas (GHG) emissions from their operations. These companies often rely heavily on fossil fuels and traditional manufacturing processes, contributing to a larger carbon footprint. In contrast, low-carbon firms actively seek to minimize their carbon emissions through various strategies and practices (Davies, 2017)

As firms can now educate their stakeholders about their environmental disclosure efforts to combat climate change, research on carbon disclosure has become more crucial (Uyar et al., 2020). By examining these enterprises' financial performance and carbon disclosure practices, the study aims to contribute to the existing literature on sustainability reporting and provide valuable insights.

According to the Malaysian Department of Statistics (DoSM, 2023), the manufacturing sector would grow by 16.61% year-on-year (y-o-y) in 2021 compared to 2020. Malaysia's overall economic growth rate was 10.57%. Given the worldwide economic slowdown, this was quite remarkable. The Malaysian economy expanded by 8.9% in the second quarter of 2022 (2Q 2022; 1Q 2022: 5.0%), according to estimates from the central bank. Sector-level development was still predominantly driven by services and manufacturing. The GDP increased by 3.5% quarterly after seasonal adjustment (1Q 2022: 3.8%).

Figure 1.4 illustrates Malaysia's continuous increase in greenhouse gas emissions from Industrial Revolution 1.0 until 2022. However, there was a decline in emissions in 2020 due to the COVID-19 outbreak, which temporarily halted production activities globally. In 2022, Malaysia's total GHG emissions were reported at approximately 330,358.21 Gg CO<sub>2</sub>e. The manufacturing industry heavily relies on fossil fuels and continues to be a contributor to these emissions, mainly through energy consumption (78%) and industrial processes (10%) (UNFCCC, 2024). The increase in carbon emissions poses significant threats to Malaysia, including heightened risks of climate-related disasters such as flooding and droughts. Despite efforts to transition to cleaner energy, emissions are expected to rise due to economic recovery from the COVID-19 outbreak and increased industrial output. The heavy reliance on oil and gas, which remains subsidized, poses challenges to reducing emissions effectively. These events can disrupt economic activities, threaten food security, and impact public health. Malaysia's performance in climate action has been rated poorly, ranking 59th in the Climate Change Performance Index (CCPI), indicating a need for more robust policies and actions to address GHG emissions effectively (Bosse, 2023).

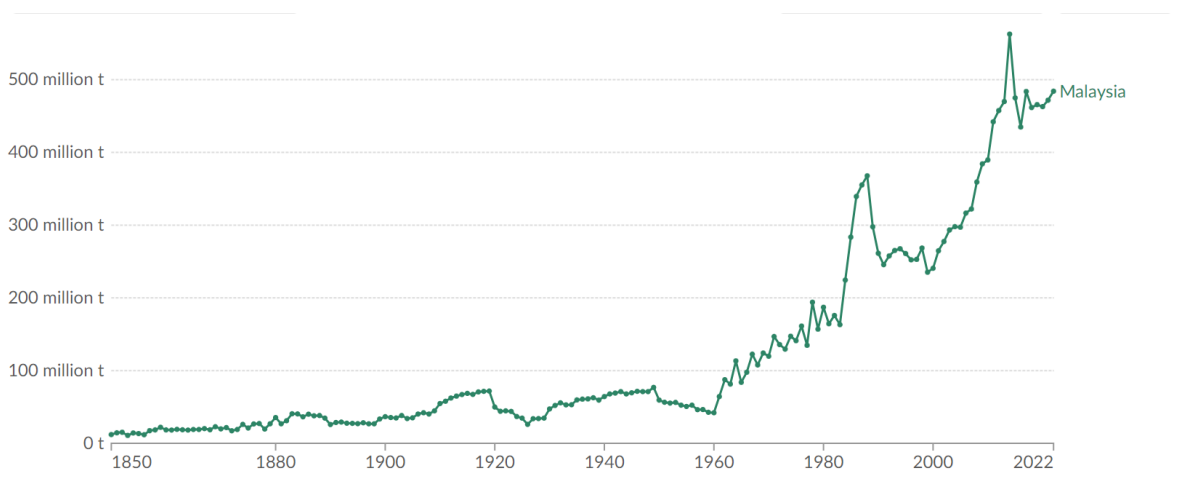


**Figure 1.4: Greenhouse Gas Emissions in Malaysia**

Source: Ritchie et al. (2023)

Figure 1.5 shows the breakdown of total greenhouse gases (the sum of all greenhouse gases, measured in tonnes of carbon dioxide equivalents) by industry. Various sectors are colour-coded and labelled on the right side of the chart, including manufacturing and construction. Figure 1.5 presents a multi-line graph illustrating the percentage change in greenhouse gas (GHG) emissions across multiple sectors from 1990 to 2020. The vertical axis reflects the percentage increase in emissions relative to the 1990 baseline, while the horizontal axis denotes the timeline. Each sector is represented by a distinct colour, facilitating direct comparison of emission trends between sectors. The data reveal substantial increases in emissions from the electricity and heat and industry sectors, which exhibit the steepest and most consistent growth over the period. This trend underscores the significant contribution of energy production and industrial activities to the overall rise in global emissions. In contrast, sectors such as manufacturing and construction show more moderate increases, indicating relatively smaller contributions to emissions growth.

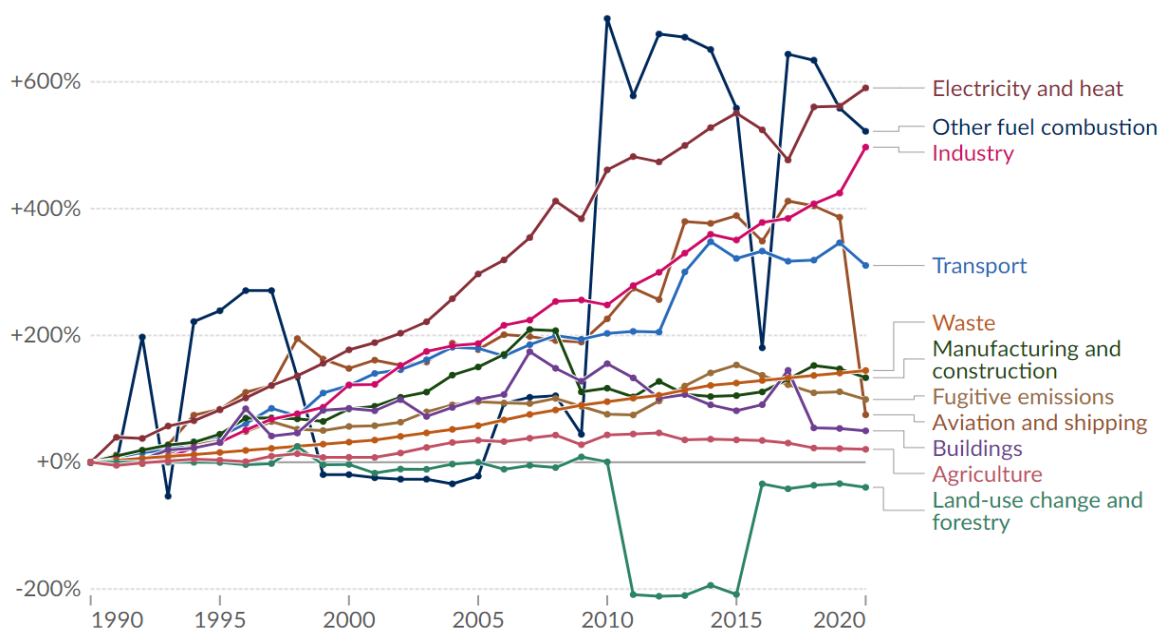


**Figure 1.5:** Carbon Dioxide Gas Emission by Sector, Malaysia

Source: Ritchie et al. (2023)

Figure 1.6 shows the breakdown split in metric. Focuses more on detailed intra-sector trends, making it easier to identify changes over time within each sector. The progression of carbon emissions in Malaysia's manufacturing industry has been a subject of concern, with ongoing efforts to address the challenges and transition towards a low-carbon future. In 2020, the manufacturing sector contributed approximately 32.89 million tonnes as compared to 34.86 million tonnes in year 2019. As a major player in Malaysia's manufacturing industry, PETRONAS reported operational emissions of 546.11 million tCO<sub>2</sub>e, up from 44.12 million tC<sub>2</sub>e in 2021 (Net Zero Readiness Index: Malaysia, 2021). The manufacturing sector's emissions are projected to continue rising due to economic growth and increased industrial output unless significant mitigation efforts are undertaken. Overcoming barriers such as high costs, technological limitations, and public acceptance will be crucial for the successful deployment of emissions-reducing technologies like CCU in order for the nation to achieve a carbon net zero initiative in the year 2050.

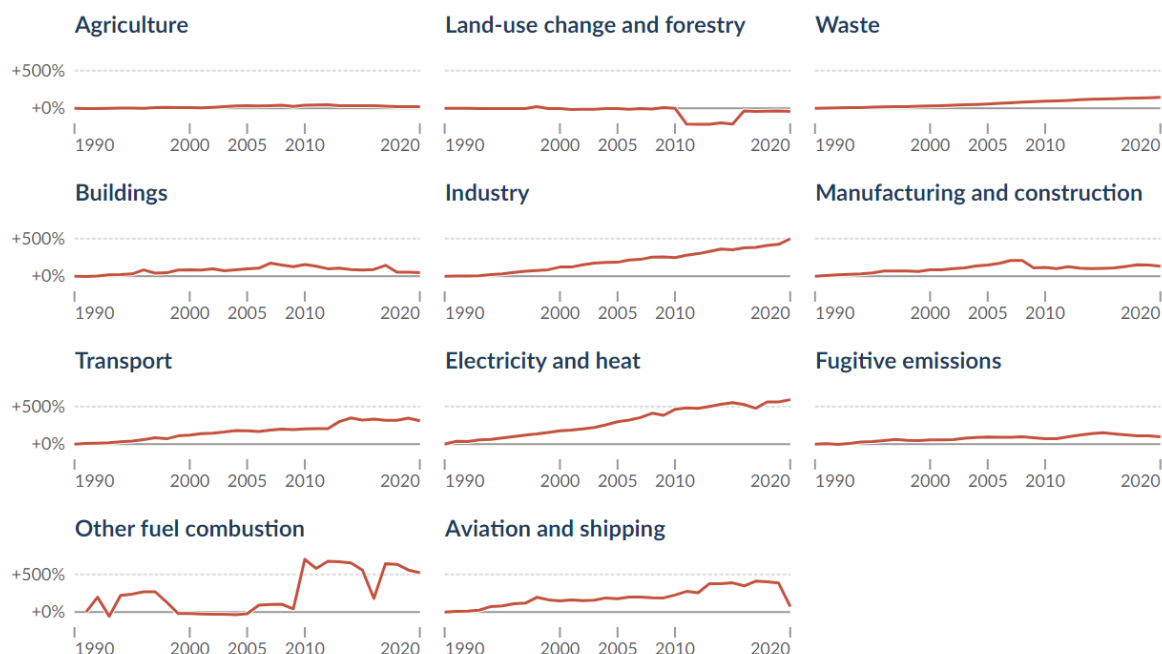


**Figure 1.6:** Greenhouse Emissions by Sector, Malaysia (Split by Metric)

Source: Ritchie et al. (2023)

Figure 1.7 outlines the top four sectors contributing to greenhouse gas emissions in Malaysia, which are electricity and heat (130.03 MtCO<sub>2</sub>e), land use change and forestry (83.09130.03 MtCO<sub>2</sub>e), transportation (65.31130.03 MtCO<sub>2</sub>e), and manufacturing (37.11130.03 MtCO<sub>2</sub>e). Other sectors remained unchanged or experienced less drastic changes. Malaysia has experienced significant economic growth, leading to increased energy consumption, which has been linked to rising carbon dioxide (CO<sub>2</sub>) emissions. A study covering the period from 1997 to 2020 indicates a strong correlation between energy use and CO<sub>2</sub> emissions in the manufacturing sector, particularly in industries such as electrical and electronics, which are major contributors to emissions due to their intensive energy requirements (Perumal et al., 2019).

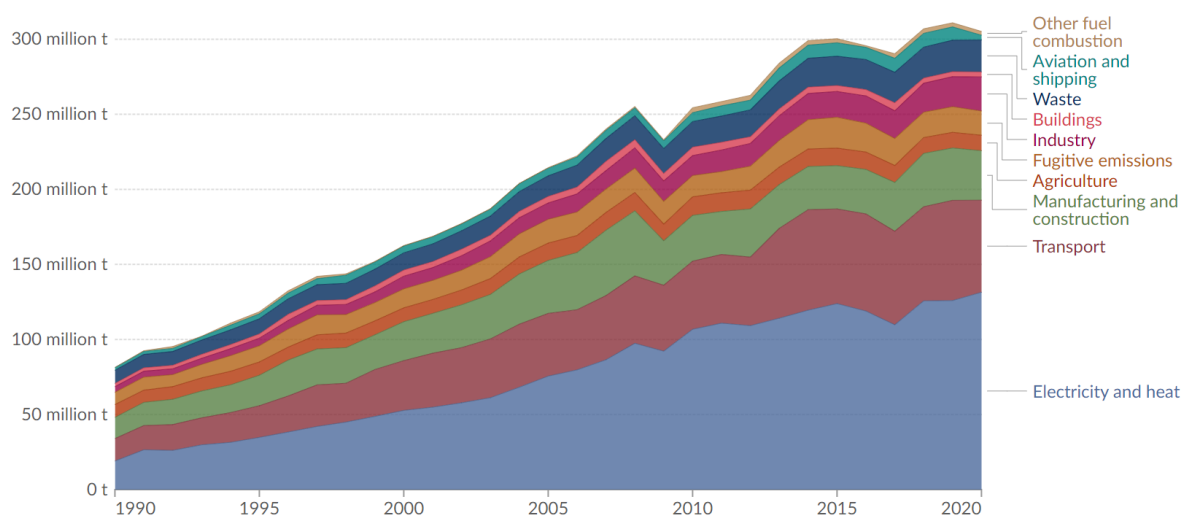


**Figure 1.7:** Greenhouse Gas Emissions by Sector, Malaysia (2020)

Source: Climate Watch (2023)

The manufacturing sector is often called the "engine of growth" for the Malaysian economy. It has been instrumental in attracting Foreign Direct Investment (FDI), which further stimulates economic development and job creation. The sector's growth has led to increased productivity and innovation, which is essential for maintaining competitiveness in the global market (Perumal et al., 2019). The manufacturing sector is a major employer in Malaysia,

providing jobs for millions of people. It is estimated that the industry employs around 3 million workers, which accounts for approximately 20% of the total workforce in the country. This includes a mix of skilled and semi-skilled labour, reflecting the industry's diverse needs and capabilities (Yusoff & Nabilah, 2015). Small and Medium Enterprises (SMEs) within the manufacturing sector play a vital role, constituting about 84% of total manufacturing establishments. However, they contribute only 28% of the total value added and provide about 33% of employment in the manufacturing sector. This indicates that while SMEs are numerous, their impact on overall employment and productivity remains an area for improvement (Foong, 1999). The manufacturing industry is a significant driver of Malaysia's economic growth, contributing approximately 23% to the national GDP. This contribution has been pivotal in transforming Malaysia from an agriculture-based economy to a more industrialized one since the late 20th century (Yusoff et al., 2015).

As businesses strive to inform stakeholders about their efforts to combat climate change through environmental disclosures, the significance of carbon disclosure research has recently surged (Uyar et al., 2020). Making more informed investment decisions can prove advantageous for stakeholders, including creditors and shareholders, as creditors can mitigate their risk regarding the borrower's ability to repay, and shareholders can alleviate agency conflicts. Monitoring and regulating a company's carbon emissions can be enhanced by stakeholders such as regulatory bodies, institutional investors, and the general public, thereby improving its carbon performance. Once a company has improved its carbon performance, its financial performance will be affected (Shen et al., 2019). This underscores the importance of thoroughly exploring the topic of carbon disclosure.

According to Shen et al. (2019), comprehending the connection between carbon disclosure and financial success is essential for environmental sustainability. Despite the significance of the link between carbon disclosure and performance, much research has not

been conducted, even though the results are thorough. There is still much to explore and understand about how carbon disclosure practices impact various aspects of corporate performance. According to He et al. (2013), there is evidence that financial performance and the disclosure of carbon emissions are positively correlated. Disclosure of carbon emissions can benefit stakeholders. The data presented helps evaluate a firm's exposure to carbon risk, its commitment to addressing climate change, and its performance in this regard.

### **1.3 Problem Statement**

The manufacturing industry in Malaysia is currently grappling with several significant challenges, particularly in the realms of environmental sustainability and financial performance. One of the most pressing issues is the management of carbon footprints, driven by escalating regulatory pressures and heightened public awareness about environmental sustainability (Ismail & Imran, 2024). As one of the largest contributors to carbon emissions in Malaysia, the manufacturing sector's environmental impact is under intense scrutiny.

This study aims to bridge a knowledge gap by examining how the corporate carbon footprint influences the financial performance of Malaysian manufacturing businesses. By studying the financial data and sustainability practices of companies operating in the manufacturing sector from 2020 to 2022, it also intends to provide significant insights into the potential benefits and problems connected with sustainability activities in the industry.

Firstly, regulatory pressures have intensified, with the Malaysian government enacting various environmental regulations, such as the Environmental Quality Act, to ensure compliance with emission standards. However, the enforcement of these regulations has been inconsistent, prompting calls for more stringent measures to effectively address the environmental challenges (Ismail & Imran, 2024). In addition to regulatory pressures, there is a growing expectation for corporate responsibility. Companies are increasingly required to

disclose their carbon emissions and adopt sustainable practices. Research suggests that companies actively managing their carbon footprints and engaging in corporate social responsibility (CSR) initiatives often enjoy enhanced financial performance due to improved reputations and greater customer loyalty (Kristari & Teruna, 2022). This aligns with government initiatives that Malaysia wants to reduce carbon emissions by 45% from 2005 to 2030. Furthermore, to reach carbon net zero in the year 2050.

The market demand for sustainability is also influencing the manufacturing industry. Consumers are becoming more environmentally conscious, and their purchasing decisions reflect this shift. Manufacturers that can demonstrate a commitment to reducing their carbon footprints may gain a competitive edge in the market, appealing to the growing segment of eco-conscious consumers (Ramasamy & Husin, 2023).

Financial performance is closely linked to environmental sustainability. While implementing sustainable practices can initially be costly, these investments often lead to significant long-term savings through improved efficiencies and waste reduction. There is a notable trend among manufacturers to invest in green technologies and processes that reduce carbon emissions, seen as a strategy to future-proof their businesses against regulatory changes and market shifts toward sustainability (Kristari & Teruna, 2022).

Studies have shown a positive correlation between effective carbon management and financial performance. Companies that disclose their carbon emissions and take proactive steps to reduce them often see improvements in profitability and market valuation. Thus, the dual focus on environmental sustainability and financial performance is becoming increasingly critical for the manufacturing industry in Malaysia, as it navigates these complex and intertwined challenges (Zahari et al., 2023).

Studies specifically geared towards the distinctive features of the Malaysian manufacturing scene are still scarce, notwithstanding some research that has examined the broader relationship between business sustainability practices and financial outcomes. Additionally, as the manufacturing industry assumes a substantial role in the nation's economic landscape, it is important to carefully consider how corporate carbon footprint management strategies affect financial metrics such as profitability, return on assets, and market valuation (Faizal & Zaidi, 2014).

Businesses operating in this area encounter challenges in both academic understanding and practical decision-making due to the absence of empirical evidence in the Malaysian setting. Addressing this research gap can help understand the effectiveness of various carbon reduction strategies, potential trade-offs between environmental initiatives and financial performance, and the overall business case for sustainable practices within the manufacturing sector in Malaysia.

#### **1.4 Research Questions**

A few questions that may arise leading to the conduct of this study are:

- i. What is the extent of carbon footprint disclosure among manufacturing companies in Malaysia?
- ii. How does carbon footprint emissions disclosure influence the corporate financial performance of manufacturing industries in Malaysia?

## **1.5 Research Objectives**

The main goal of this study is to determine how carbon footprint affects corporate financial performance in manufacturing companies in Malaysia. Specifically, this study aims to adhere to the following objectives:

- i. To examine the extent of carbon footprint disclosure among manufacturing companies in Malaysia.
- ii. To investigate the relationship between carbon emissions and the performance of manufacturing companies in Malaysia.

## **1.6 Scope of the Study**

The term ‘carbon footprint’ highlights the total amount of greenhouse gas (GHG) emissions for which a person, business, event, or product is responsible. This study investigated how the financial results of Malaysia’s manufacturing industry are impacted by their carbon footprints.

This study focuses specifically on the manufacturing industry in Malaysia. The analysis covers the period from 2020 to 2022 to evaluate historical trends and changes in Malaysia. The study’s scope is limited to manufacturing firms listed on Bursa Malaysia, which amounts to about 269 companies; however, only around 70 companies disclose their carbon footprint information. The manufacturing sector in Malaysia is diverse, encompassing industries such as electronics, automotive, chemicals, and food processing. The study period spans three years, from 2020 to 2022. This timeframe was selected because carbon footprint reporting in Malaysia is still relatively new, and the dataset’s information availability is primarily from 2020 onwards.

## **1.7 Significance of the Study**

The importance of this study is rooted in its theoretical contributions and practical implications for the Malaysian telecommunications industry. The following are the key aspects.

### **1.7.1 Investor Confidence and Policymakers**

Environmental factors, such as greenhouse gas emissions, present significant challenges in environmental, social, and governance (ESG) issues that are increasingly critical to investors. Evaluating the impact of carbon footprints on financial performance can improve accountability and transparency, enabling more informed investment decisions and supporting stakeholders and creditors in fostering a more sustainable economy (Uyar et al., 2020). The findings of this study can also inform Malaysian policymakers and regulators about the financial implications of carbon footprints in the manufacturing industry. By understanding the relationship between carbon emissions and financial success, policymakers can create targeted regulations and incentives to promote sustainable practices, enhancing corporate financial performance (Shen et al., 2019). This research can aid in developing effective policies for transitioning to a low-carbon economy and support evidence-based decision-making, helping businesses reduce their carbon footprint while maintaining financial viability.

### **1.7.2 Entrepreneur & Business Practice**

This research offers valuable insights for firms seeking to develop strategies for managing their environmental footprint to enhance both ecological and financial performance. Investors and financial institutions increasingly incorporate environmental, social, and governance (ESG) criteria into their investment decisions. The research provides empirical data on how carbon emissions influence financial metrics such as profitability, market valuation, and operational efficiency. Understanding this correlation helps companies identify the

financial benefits of reducing emissions. Companies demonstrating a robust commitment to sustainability are more likely to secure access to capital, attract investments, and benefit from favourable lending conditions (Bousselmi et al., 2019). With a clear understanding of the financial benefits of lower emissions, companies are more likely to invest in green technologies and sustainable practices that reduce their carbon footprint. This includes adopting renewable energy sources, energy-efficient machinery, and waste-reduction techniques. This strategic focus can confer a competitive advantage within the marketplace. Concurrently, consumers are becoming progressively aware of their purchasing decisions' environmental and societal impacts (Islam, 2023). Consequently, businesses prioritizing sustainability are poised to attract a larger customer base and foster enhanced brand loyalty (Timotius, 2023). Furthermore, governmental regulations and incentives to promote sustainable practices support businesses that emphasize ESG factors.

### **1.7.3 Academics and Researchers**

Researchers and academics alike would be interested in the findings. The study's findings might add to the body of information about how a business footprint affects financial performance. The study might potentially act as a guide for similar investigations in other sectors or nations. However, several factors complicate the relationship between a company's presence and financial performance (Delmas & Nairn-Birch, 2011). In order to manage corporate footprint in a way that is beneficial for the environment and business financial performance, further research is required to understand this relationship better.

## **1.8 Organization of the Study**

This study comprises five sections: an introduction, a review of the literature, research methodology, data analysis and findings, and a summary with suggestions for improvement.

The introduction of Chapter 1 describes the overall context of the study, the issue statement, the research questions, and the research objectives. It also outlines the study's scope, significance, and organizational structure.

In Chapter 2, the literature review delves into an extensive exploration of relevant scholarly works, theories and empirical studies pertaining to the subject matter. Specifically, this chapter focuses on the manufacturing industry in Malaysia, offering an in-depth analysis of its historical development, current status, challenges and opportunities.

Chapter 3 provides a comprehensive elucidation of the complexities of data collection and the research methodology employed in this study. This chapter serves as a detailed roadmap outlining the systematic approach and procedures utilized to gather, organize, and analyze the necessary data to address the research objectives effectively. It offers a thorough explanation of the research design, including the rationale behind the chosen methodology, sampling techniques, data collection instruments, and ethical considerations.

In Chapter 4, a comprehensive analysis and interpretation of the collected data is presented, shedding light on the outcomes and insights derived from the study. Furthermore, it provides critical insights into the significance of the findings in addressing the research questions and objectives, thereby contributing to the advancement of knowledge in the field.

Chapter 5 presents a comprehensive summary encapsulating the study's key findings, along with a thoughtful examination of its limitations, impacts, and implications for future research directions.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

The literature on the variables will be covered in this chapter. We will also discuss the fundamental theories behind these factors. The analysis will then be described, along with the creation of hypotheses based on the conceptual framework. The primary objective of this literature review is to examine the current body of research regarding the interaction between carbon footprint and financial success within the specific context of manufacturing firms in Malaysia. Given the mounting pressure on companies to implement sustainable practices and respond to environmental issues, understanding this relationship is essential.

#### **2.2 Overview**

The industrial sector is crucial to Malaysia's economic development, but it also contributes to the nation's carbon footprint. In Malaysia, the manufacturing sector is a significant source of carbon emissions, accounting for around 20% of the nation's overall emissions. Understanding how the carbon footprint affects the financial performance of industrial firms is crucial as the Malaysian government works to minimise greenhouse gas emissions.

Socially responsible investors evaluate potential investments using a set of criteria called environmental, social, and governance (ESG) investing. Environmental concerns encompass a range of issues within corporate operations, including climate policies, energy consumption, waste management, pollution control, conservation of natural resources, and the ethical treatment of animals. ESG elements serve as a means of evaluating a company's susceptibility to environmental hazards and its strategies for mitigating these risks. The

interactions between a firm and its internal and external stakeholders are examined through social components (Clarke, 2007). The implementation of accurate and transparent accounting procedures, the selection of leaders who exhibit integrity and diversity, and shareholder accountability are all ensured by ESG governance principles.

On a global scale, carbon emissions are a pressing concern, as they contribute to climate change. This reality has prompted executives and leaders to re-evaluate their vision and purpose, placing greater emphasis on sustainability. It is imperative to recognise that sustainability should not be considered merely a component of corporate social responsibility; rather, it is a fundamental business necessity. Enterprises must strive to minimise their environmental impact. One of the most crucial methods to achieve this is by reducing their carbon footprint, which begins with monitoring carbon emissions.

According to McKinsey & Company (2020), climate change may lead to a decrease in worker productivity, which would have a detrimental effect on the growth of the world's gross domestic product (GDP). Businesses, as the primary producers of greenhouse gases (GHG), have always had a substantial impact on climate change issues to Heede (2014) and Wijen (2014). In order to stabilize climate change, stakeholders are expected to apply pressure on companies to reduce their GHG emissions (Comyns, 2016; Luo, 2019).

Carbon performance analysis has gained significance as a tool used by businesses to inform stakeholders of their climate change initiatives through environmental disclosures in recent years (Uyar et al., 2020). The prevalence of climate-related news articles in media outlets is exerting significant influence on the economic development of numerous nations across the globe. Innovative ideas and initiatives, such as the 'low-carbon economy' and the 'low-carbon city', have evolved in this context. The Fourth Industrial Revolution is primarily propelled by low-carbon economies and business models that prioritise low energy consumption. These

variables are critical in various areas, including the preservation of non-renewable energy sources, the mitigation of global warming, the promotion of sustainable economic growth and the creation of sanitary residential settings.

In its 2022 annual report, Bank Negara Malaysia stated that Malaysia aims to achieve net-zero greenhouse gas emissions as soon as 2050, emphasising that carbon accounting is a crucial enabler for an orderly transition to a low-carbon economy. The 12th Malaysia Plan states that Malaysia currently accounts for 0.7% of global GHG emissions. Notably, the industry and building sectors rank third among the main sources of emissions (Malaysia BUR3 UNFCCC Report, 2020). The Long-Term Low Emission Development Strategies (LT-LEDS) aid in identifying potential growth regions for various sectors. Therefore, the LT-LEDS is a critical policy tool that enables companies and financial institutions to coordinate their individual GHG emission reduction plans. The manufacturing industry in Malaysia has faced increasing pressure to address its environmental impact and improve sustainability practices (Ong et al., 2020). In recent years, there has been a growing emphasis on the adoption of long-term low-emission development strategies and the extension of carbon reporting among these companies. (Amran, 2012) and (Ong et al., 2020).

The integration of environmental considerations at the strategic level is crucial for manufacturers to remain competitive in the global market. Collaboration with suppliers, customers, and the local community can also lead to the development of environmental solutions. Additionally, investing in environmental technological capabilities can contribute to improved environmental performance. Malaysia's environmental performance index has declined from the 51<sup>st</sup> position in 2014 to the 63rd position in 2016, indicating the need for more effective environmental management practices (Ong et al., 2020). To address this, companies in Malaysia are recognizing the significance of demonstrating and effectively

communicating their Environmental, Social, and Governance practices to their stakeholders (Rosman et al., 2023). The trend of sustainability reporting has notably grown in Malaysia, largely driven by initiatives from Bursa Malaysia, the country's stock exchange, which requires listed companies to disclose their sustainability activities in annual reports.

### **2.2.1 Industrial Revolution in Manufacturing Industry**

During the Industrial Revolution, when machines were used to complement human work in the production of goods, societies transitioned from an agrarian to an industrial economy. Consequently, there was an important improvement in productivity and efficiency, accompanied by a corresponding rise in the production of products and services. With the introduction of steam power and the automation of industry, the First Industrial Revolution got underway in the 18th century. The steam engine, the spinning wheel, and the water wheel all changed and enabled production (Admin, 2023). IR1 established the use of mechanization in production, leading to increased output but also higher carbon emissions due to reliance on fossil fuels and non-renewable energy sources.

The Second Industrial Revolution (also known as Industry 2.0), which occurred between 1871 and 1914, was the following important advancement in manufacturing (Jha, 2023.). The second industrial revolution (IR2), which occurred in the late 19th and early 20th centuries, was characterized by the introduction of electricity, mass production techniques, and the assembly line. This period significantly transformed manufacturing processes, leading to increased productivity and economic growth. IR2 introduced significant technological innovations, such as electric power and mechanized production, which increased efficiency but also led to higher energy consumption and carbon emissions.

The third industrial revolution (IR3), which began in the late 20th century, was characterized by the widespread adoption of digital technologies, automation, and computerized production. This period marked a significant shift in manufacturing practices, enabling increased efficiency, flexibility, and productivity. However, the integration of IR3 technologies also has implications for carbon reporting in Malaysian manufacturing companies. IR3 introduced advanced automation and robotics, which reduced manual labor and increased efficiency in manufacturing processes. However, the implementation of these technologies may also lead to higher energy consumption and potential increases in carbon emissions.

The Fourth Industrial Revolution, which is also referred to as Industry 4.0, is driven by a combination of advanced digital and physical technologies such as the Internet of Things (IoT), artificial intelligence (AI), robotics, drones, autonomous vehicles, 3D printing, and cloud computing (Admin, 2023). Recent studies indicate a growing trend toward carbon emissions disclosure among Malaysian manufacturing companies, influenced by factors such as company size, leverage, and profitability. For instance, larger firms tend to have more resources to invest in IR4 technologies and are more likely to engage in comprehensive carbon reporting practices. Additionally, profitability has been shown to positively affect sustainability reporting, suggesting that financially stable companies are more inclined to adopt transparent carbon reporting practices. To strengthen the relationship between the Industrial Revolution (IR4) and carbon reporting, Malaysian manufacturing firms can focus on investing in training and awareness. This is where educating employees about the benefits of carbon reporting and how IR4 can facilitate this process. Next is leveraging government support. Utilizing government programs aimed at promoting IR4 adoption and sustainability initiatives. Developing a Structured Reporting Framework where establishing clear guidelines and frameworks for carbon reporting that align with IR4 capabilities.

The first environmental information study linked environmental information with social responsibility data in order to conduct relevant investigations (Mobley, 1970; Grey et al., 1997). At the theoretical and descriptive levels, the majority of the revelation of environmental knowledge took place. In 1970, Friedman investigated the relationship between productivity and corporate social responsibility. Studies on the disclosure of social responsibility and environmental information have developed recently (Hoi et al., 2013). Most of the research on the subject found a poor correlation between firm financial performance and disclosure of carbon emissions, supporting the neoclassical and traditional economic schools of thinking. Griffin et al. (2017) found that businesses lose money as a result of disclosing carbon information because of the high expense of doing so.

### **2.2.2 Financial Performance Metrics**

The eco-efficiency principles emphasize the productivity gains made possible by reducing production materials, streamlining manufacturing procedures, and utilizing both products and waste (Kuo et al., 2011). Data on corporate carbon emissions are accessible through two different reporting mechanisms, both of which are required. The Carbon Disclosure Project (CDP), a non-profit with its main office in the United Kingdom (UK), offers the most popular reporting system. Each year, firm emissions are measured using questionnaires. Perrault and Clark (2010) argue that voluntarily collected data has faced criticism for its bias and lack of external validation. They suggest that companies with better performance are more likely to disclose and report, leading to a bias in the voluntary data due to self-selection (Chen & Gao, 2012). The required data is obtained from specific guidelines for calculation and reporting, as outlined by Sullivan and Gouldson (2012). This process enables the development of standardised and comparable metrics for benchmarking and identifying best practices, as highlighted by Perrault and Clark (2010). A previous study

investigated the relationship between carbon disclosure and financial performance in Malaysian manufacturing firms.

There are numerous definitions of corporate financial performance in the literature. A comprehensive review of an organisation's assets, liabilities, equity, revenues, expenses and overall profitability constitutes its financial performance. There is substantial evidence supporting the claim that market-based financial performance is better than accounting-based variables in explaining carbon emissions (Dixon-Fowler et al., 2013). Market-based accounting in carbon emissions is a method of calculating a company's greenhouse gas (GHG) emissions based on the specific energy sources that the company has purchased or contracted for. Market-based accounting for carbon emissions involves several key variables that companies must consider when calculating their emissions, particularly in relation to purchased electricity (Scope 2 emissions). The variables are such as electricity consumption, time of use and so forth. While for accounting-based, also referred to as traditional accounting or financial statement analysis, relies primarily on financial statements and accounting data (Brander & Bjørn, 2023). The accounting variables such as revenue, assets, equity and so forth. For market-based accounting, normally, it is useful for long-term study in which the data availability is more than 5 years. While for accounting-based, it can measure for the short term, which means less than 5 years of data availability. In this study, the accounting based is appropriate due to the data availability being less than 5 years.

Investors cannot utilise this information to make investments or decisions, even though more companies are sharing this information (Sullivan & Gouldson, 2012), and the transparency and quality of emission data are still deficient (Matisoff et al., 2013). Financial performance metrics provide a comprehensive picture of a company's operational efficiency, profitability, and growth potential. Investors use these metrics to make informed decisions

about where to allocate their capital, balancing the potential for returns against the associated risks. By analysing these metrics, investors can identify companies that align with their investment strategies, whether they are seeking growth, income, or stability. Financial performance metrics provide a comprehensive picture of a company's operational efficiency, profitability, and growth potential. Investors use these metrics to make informed decisions about where to allocate their capital, balancing the potential for returns against the associated risks. By analysing these metrics, investors can identify companies that align with their investment strategies, whether they are seeking growth, income, or stability.

### **2.2.3 Trends**

Acknowledging the increasing significance of reducing carbon emissions and the potential benefits of a society focused on environmental sustainability, the Malaysian government has implemented significant efforts to address greenhouse gas (GHG) emissions by committing to the global community. Under the National Determined Contribution (NDC) commitment made during COP26 and confirmed during COP27, the government has pledged to achieve net-zero emissions by 2050 and decrease CO<sub>2</sub> intensity in relation to GDP by 45% by 2030. With carbon pricing, Malaysia can steer its economy towards a path of carbon-neutral growth, improving resource efficiency, stimulating investment in clean energy, and reducing emissions (Susskind et al., 2020).

The introduction of carbon tax schemes may be seen as one of the most significant direct steps towards cutting national emissions. Thus, the proposed carbon tax project represents a pertinent method intended to send critical price signals to modify consumer anti-green behavior. Establishing a carbon tax in developing nations such as Malaysia can be difficult since it demands a careful balance of economic development, environmental protection, social equality, and poverty reduction. One critical step is to examine and rationalize

fossil fuel subsidies, which can help level the playing field for renewable energy sources (Susskind et al., 2020).

#### **2.2.4 Positive Relationship Between Carbon Footprint and Financial Performance**

Khojastehpour and Johns (2014) investigate the impact of environmental Corporate Social Responsibility (CSR) on corporate reputation and profitability. Their findings reveal that effective environmental CSR initiatives significantly enhance corporate reputation, which in turn positively influences profitability. The study establishes a strong positive correlation between environmental CSR activities and corporate reputation, aligning with findings from Etikan's (2024) research, which emphasizes that CSR enhances stakeholder trust and organizational reputation (Etikan, 2024). Companies that actively engage in environmental CSR not only improve their reputation but also experience increased profitability, supporting Goyal and Sharma's assertion that CSR initiatives shape brand reputation and consumer behaviour (Sharma, 2024).

Yu and Ting (2012) examined the interplay between financial market development, investor protection mechanisms, and corporate sustainability practices. The study's findings indicate that robust financial systems and strong investor protection laws significantly enhance corporate commitment to sustainability. This relationship is driven by the increased pressure from well-informed investors, who are empowered by strong legal frameworks to prioritize and demand sustainable business practices. The research underscores the importance of financial and legal institutions in fostering sustainable corporate behaviour. Positive connections have also been discovered in European studies. Doran and Ryan (2012) investigate the interplay between regulation, firm perception, eco-innovation, and firm performance. Their findings highlight that regulatory frameworks significantly influence firms' eco-innovation efforts, which in turn enhance overall performance. Doran and Ryan (2012) assert that eco-

innovation leads to improved firm performance, corroborated by Mansour et al. (2022), who demonstrated a strong positive relationship between eco-innovation and corporate performance, especially in larger firms. It aligns with Zhao et al. (2021), who found that various types of environmental regulations positively affect green innovation, particularly voluntary regulations.

Menzel et al. (2010) explored the profitability of greener manufacturing practices, emphasizing the potential for companies to benefit economically while adopting environmentally friendly methods. Their findings align with broader research on green innovation and sustainable practices in manufacturing. Delmas et al. (2015) contributed to understanding the relationship between corporate social and financial success. Based on their findings, higher carbon emissions are associated with higher ROA. Companies with higher carbon emissions tend to be more financially successful in terms of their return on assets (ROA). As shown by Lu et al. (2021), there is a positive correlation between the quality of carbon information disclosure and financial performance. This association also has an impact over time. Highlight the need for assessment frameworks to measure the effectiveness of sustainable practices, similar to frameworks developed in other studies that evaluate socio-economic impacts alongside environmental benefits (Lee & Kazakova, 2024).

The study conducted by Luo et al. (2012) examined the response of Fortune 500 organisations to climate change concerns by analysing their carbon disclosure methods. The analysis was based on a report submitted to the Carbon Disclosure Project (CDP) in 2009 by Fortune 500 companies. The investigation revealed that economic factors played a notable role in determining the choice to reveal carbon-related information. In their study, Luo et al. (2012) performed a practical analysis, selecting a subset of 2,045 prominent corporations from 15 diverse nations and various sectors. They based their selection on records provided to the

Carbon Disclosure Project (CDP). The researchers assessed the accessibility of resources in companies through indicators such as profitability, leverage and growth. Additionally, the inclination of companies to disclose carbon-related information was evaluated by considering their corporate involvement with the CDP. The study revealed a significant positive association between the inclination to disclose carbon emissions and an indicator of resource availability in developing countries. This conclusion implies that a potential explanation for the limited commitment to carbon reductions and disclosure in these nations is the scarcity of resources.

During the period from 2010 to 2015, an empirical study conducted by Ganda (2018) examined a representative sample of firms in South Africa to investigate the impact of carbon emissions reporting on their financial worth. The researcher identified a positive correlation between carbon disclosure and accounting value while observing a negative correlation with market value added (MVA). This means increased transparency in carbon emissions reporting was associated with a decrease in the market-based measure of a firm's value. In a study conducted by Frost (2007), it was found that there is a positive correlation between the performance of companies and their tendency to share environmental information. This empirical examination involved a sample of 60 Australian enterprises, with a majority operating in the extractive services industry. In the study conducted by Clarkson et al. (2008), it was found that the dissemination of environmental knowledge had a positive impact on corporate performance, as evidenced by the analysis of two distinct indicators

For manufacturing companies in Malaysia, there is a strong relationship between carbon reporting and the carbon tax scheme. Accurate carbon reporting not only ensures compliance with tax obligations but also helps companies manage costs, mitigate risks, and enhance their competitive position in a market increasingly focused on sustainability. As Malaysia moves towards implementing a carbon tax, manufacturing companies must integrate

robust carbon reporting into their strategic planning to navigate the financial and regulatory landscape effectively.

### **2.2.5 Negative Relationship Between Carbon Footprint and Financial Performance**

Conversely, there is evidence suggesting that failure to address carbon emissions may lead to financial risks, such as increased operating costs, regulatory penalties, and reputational damage. Garcia-Sanchez and Prado-Lorenzo (2012) explore the relationship between greenhouse gas (GHG) emission practices and financial performance, revealing that effective GHG management can enhance a firm's financial outcomes. This finding aligns with broader research indicating that companies adopting low-carbon strategies often experience improved financial metrics. While the findings emphasize the benefits of GHG management, some studies suggest that the financial performance improvements may not be substantial for all firms, particularly those struggling with environmental innovation (Nishitani et al., 2017). In their study, Lee et al. (2013) discovered that there was no notable variation in the risk-adjusted performance of stocks with high sustainability and those with poor sustainability. Therefore, companies that integrate sustainability principles face identical challenges to those that fail to make investments in social, environmental and governance concerns.

The study by Busch et al. (2020) aims to replicate and extend the research conducted by Delmas et al. (2015) by examining longer periods and employing a different set of control variables. The research findings by Busch et al. (2020) revisit the relationship between corporate carbon performance and financial outcomes, emphasizing the complexity of this interaction. The authors argue that while carbon performance can enhance financial performance, the relationship is not straightforward and varies across contexts. However, the study does not find support for a positive association between higher carbon emissions and financial performance.

### **2.2.6 Theoretical Framework: Legitimacy, Stakeholder and Signalling Theories.**

According to the legitimacy hypothesis, businesses with poor carbon performance would present their performance in a soft, unsupported manner in order to maintain their credibility and satisfy a variety of stakeholders (O'Donovan, 2002). This theory also suggests that, in order to survive, corporations are more likely to behave in accordance with social norms. However, legitimacy implies a negative connotation. Climate change is one of the most challenging moral problems that modern businesses and society must deal with (Dahlmann et al., 2019). Companies can manage risks to their credibility and shape public perception by using voluntary carbon disclosure as an image-management strategy (Cho & Patten, 2007). According to Ziegler et al. (2011), energy corporations intentionally publicize their attempts to adapt to climate change to improve their corporate image, gain recognition from authorities on global warming, and eventually boost stock performance. A sample of South African businesses called Ganda was utilised in a study to examine how reporting carbon emissions affects financial value. It was discovered that carbon disclosure had a negative relationship with market value added (MVA).

On the contrary, a multitude of research has yielded results indicating either a lack of correlation between environmental disclosure and business financial success or a negative association. Freedman and Jaggi (1988) conducted a study to investigate the relationship between a firm's extent of pollution disclosure, pollution performance and financial performance among industries characterised by high levels of pollution. In light of the circumstances, it was determined that there existed no discernible association between the two mentioned measurements. According to (Johnson & Greening, 1999) findings, it can be inferred that a company's engagement in unlawful or irresponsible behaviours will result in financial losses and impede its capacity to achieve financial success. This study argues that the financial benefits for the corporation are not solely derived from compliance with regulations

or sporadic acts of good corporate citizenship. Stanny and Ely (2008) contend that there is no empirical evidence to substantiate the assertion that carbon disclosure has a discernible influence on firm performance or investment decisions. Several studies, such as Judge and Douglas (1998), King and Lenox (2002) and Melnyk et al. (2003), have shown evidence supporting a positive relationship between environmental proactivity and financial performance. However, contrasting findings have been reported by other researchers, such as Cordeiro and Sarkis (1997), Gilley et al. (2000), and Link and Naveh (2006).

According to the stakeholder theory (Ansoff, 1965), managers bear significant responsibility for meeting stakeholder expectations and addressing their requests. They are also responsible for resolving conflicts with stakeholders to ensure the long-term sustainability of the company. According to the stakeholder theory, this process must also take into account the current perspectives of other stakeholders in addition to the enterprise's resource environment. Emphasizes the importance of addressing the needs and concerns of various stakeholders, which drives companies to enhance their sustainability disclosures (Aluchna et al., 2023). Hence, the notable influence of carbon disclosure on financial performance in the current period, irrespective of the industry, is unlikely to occur immediately and is, instead, more likely to manifest in the subsequent quarter (Tsabitah et al., 2023). The authors argue that effective sustainability reporting must consider the interests and influences of various stakeholders, which can drive corporate transparency and accountability (Aluchna et al., 2023).

Signalling theory states that the publication of carbon information can alleviate pressure on businesses and enhance recognition and support from corporate stakeholders, both of which improve financial performance. During this time, investors must determine whether the detected information is meaningful and, if so, whether it sends a signal advantageous to the investment and then take appropriate action. Early research generally found a negative

relationship between carbon disclosure and firm financial success, supporting the theories of classical and traditional economics. According to signalling theory, investors often respond to signals from companies. The theory posits that by disclosing carbon information, businesses can alleviate pressure, garner the attention and support of stakeholders, and consequently improve their financial performance. Organizations that possess an understanding of environmental concerns will promptly respond by implementing measures to mitigate potential hazards associated with environmental contamination. This proactive approach serves to protect their corporate reputation and brand integrity as they swiftly retracts any information that may contribute to such risks. Businesses possessing knowledge regarding environmental concerns will promptly respond to mitigate the potential for environmental contamination. They will swiftly withhold their information to safeguard their reputation and identity, thus potentially reducing financial vulnerability. The stream signalling theory has predicted a significant relationship in previous analyses.

### **2.2.7 Empirical Evidence**

Van der Laan et al. (2008) found a negative relationship between corporate social performance and short-term financial performance measured by return on assets (ROA). A study conducted by Yu et al. (2019) found no statistically significant correlation between environmental efficiencies (such as investments in emissions reduction, emissions savings, monetary savings, and direct and indirect emissions) and operational efficiencies (including research and development expenses, total assets, sales, net income, number of employees and cost of goods sold) across all six industrial sectors examined.

However, this contradicts the findings by Dhaliwal et al. (2011), who found that businesses with higher carbon performance have lower capital costs, a higher market value, and attract more investors (de Villiers & Marques, 2015). In a previous study, Richardson and

Welker (2001) investigated a sample of Canadian companies from 1990–1992. They discovered an interesting positive correlation between social disclosure and the cost of equity capital. However, this positive relationship was weakened among companies with stronger financial performance. It is worth noting that companies may face some financial penalties for disclosing socially responsible information.

In a previous study, Stanny and Ely (2008) discovered that there was no notable association between carbon disclosure and investment. Furthermore, they concluded that carbon disclosure did not enhance firm performance. Hsu and Wang (2013) discovered that the high cost of environmental stewardship means that disclosing greenhouse gas emissions by corporations does not lead to immediate economic advantages and could potentially diminish company competitiveness. Based on a study conducted by Plumlee et al. (2015), which examined the impact of heavily polluting industries and general industries on environmental disclosure and financial performance, the findings revealed a negative association between polluting sectors and both environmental disclosure and firm financial performance. Conversely, general businesses exhibited a favourable link with these factors.

Rokhmawati et al. (2015) conducted a study to examine the influence of carbon emissions, environmental performance (EP) and social performance (SP) on financial performance (FP) in Indonesian enterprises. The findings revealed a positive relationship between carbon emissions and Return on Assets (ROA). A significant number of studies have established a direct correlation between the disclosure of environmental information and financial performance, indicating a favourable relationship. The positive correlation has been attributed to the phenomenon of the ‘innovation offset’ surpassing the ‘cost of compliance’ (Porter & Van Der Linde, 1995), the presence of robust managerial capabilities (Aragon-

Correa, 1998), the establishment of business legitimacy (Hart, 1995), and alignment with the interests of stakeholders (Freeman & Evan, 1990).

Hassel et al. (2005) conducted a comprehensive study that concurred with the cost-related theory, asserting that the expense of disclosing carbon information to maintain business credibility outweighs the benefits. The study investigates the value relevance of environmental performance in corporate reporting. The key finding indicates that environmental performance significantly influences market valuation, suggesting that investors increasingly consider sustainability metrics when assessing firm value. The study highlights that firms with strong environmental performance tend to have higher market valuations, reflecting a growing investor preference for sustainability (Migliavacca, 2024). This aligns with findings from other research indicating that environmental performance can enhance financial performance, particularly in environmentally sensitive industries (Choi et al., 2020). Furthermore, they argued that the level of detail and comprehensiveness in disclosing carbon information directly correlates with the associated costs. Moreover, the disclosure of carbon information is posited to harm the enterprise's interest goals, and the quality of disclosure is negatively associated with the enterprise's value. Additionally, the disclosure of carbon information will have a detrimental impact on the financial performance of businesses. There is a negative association between the quality of disclosure and the value of the corporation. This is due to the high cost of disclosure.

### **2.3 Hypothesis Development**

The most significant issue to be investigated is determining whether there is a relationship between a company's carbon footprint and its financial performance. In this section, hypotheses are developed based on the information gathered from the literature review and theories.

Null Hypothesis ( $H_0$ ):

There is no relationship between corporate carbon footprint and Return on Assets (ROA) in the manufacturing industry in Malaysia.

Alternative Hypothesis ( $H_1$ ):

There is a relationship between corporate carbon footprint and Return on Assets (ROA) in the manufacturing industry in Malaysia

This hypothesis is grounded in the conflicting findings from previous studies. While some research suggests a positive relationship between carbon disclosure and financial performance (Kristari & Teruna, 2022), others have found negative or no significant relationships (Bedi & Singh, 2024). The hypothesis aligns with legitimacy theory, as it allows for the possibility that carbon footprint disclosure may be driven by legitimacy concerns rather than direct financial benefits. It also relates to stakeholder theory, as the lack of relationship could indicate that different stakeholders have varying expectations regarding carbon footprint, potentially neutralizing the overall effect on financial performance. Finally, the hypothesis connects to signalling theory by implying that carbon footprint disclosures may not be effectively signalling information that impacts financial performance as measured by ROA. By testing this hypothesis, the study aims to contribute to the ongoing debate on the financial implications of carbon footprint management in the manufacturing sector, specifically within the Malaysian context (Wahab et al., 2021). This is supported by a study done by Yuliana and Wedari (2023)

Null Hypothesis ( $H_0$ ):

There is no relationship between corporate carbon footprint and Return on Equity (ROE) in the manufacturing industry in Malaysia.

### Alternative Hypothesis (H<sub>2</sub>):

There is a relationship between corporate carbon footprint and Return on Equity (ROE) in the manufacturing industry in Malaysia.

Legitimacy theory suggests that companies engage in environmental practices and disclosures to maintain their social contract and legitimacy within society (Liao et al., 2024). In this context, manufacturing companies in Malaysia may manage and disclose their carbon footprint primarily to maintain their social license to operate rather than to enhance financial performance as measured by ROE directly. Stakeholder theory emphasizes the importance of balancing the interests of various stakeholders in corporate decision-making (Trisnani & Aminah, 2023). Applied to the current hypothesis, this theory suggests that while some stakeholders may value carbon footprint reduction, others may prioritize financial returns. The null hypothesis reflects the possibility that these diverse stakeholder interests may offset each other, resulting in no significant relationship between carbon footprint and ROE. This could indicate that companies are managing their carbon footprint to satisfy certain stakeholders without necessarily impacting their financial performance. Signalling theory proposes that companies use disclosures as signals to reduce information asymmetry between the firm and its stakeholders (Shrestha et al., 2023). In the context of carbon footprint and ROE, the hypothesis suggests that carbon footprint disclosures may not be effectively signalling information that impacts financial performance as measured by ROE. This could imply that investors and other stakeholders in the Malaysian manufacturing industry may not be interpreting carbon footprint information as a significant indicator of financial performance or that the market may not be efficiently pricing this information into stock valuations, which would affect ROE.

Null Hypothesis (H<sub>0</sub>):

*There is no relationship between corporate carbon footprint and Return on Investment (ROI) in the manufacturing industry in Malaysia.*

Alternative Hypothesis (H<sub>3</sub>):

*There is a relationship between corporate carbon footprint and Return on Investment in the manufacturing industry in Malaysia.*

Legitimacy theory posits that organizations strive to align their actions with societal norms and expectations to maintain their social license to operate (Ladista et al., 2023). In this context, manufacturing firms in Malaysia may manage and disclose their carbon footprint primarily to enhance their legitimacy rather than to directly improve their ROI. The absence of a significant relationship between carbon footprint and ROI could suggest that firms' environmental efforts are driven more by legitimacy concerns than by financial considerations. Stakeholder theory emphasizes the importance of balancing the interests of various stakeholders in corporate decision-making (Pham & Lam, 2024). Applied to this hypothesis suggests that while some stakeholders may prioritize environmental performance, others may focus on financial returns. The null hypothesis reflects the possibility that these diverse stakeholder interests may counterbalance each other, resulting in no significant impact on ROI. This could indicate that firms are managing their carbon footprint to satisfy certain stakeholders without necessarily affecting their financial performance as measured by ROI. Signalling theory proposes that firms use disclosures as signals to reduce information asymmetry between the company and its stakeholders (Song et al., 2023). In the context of this study, the null hypothesis implies that carbon footprint disclosures may not be effectively signalling information that influences ROI. This could suggest that investors and other stakeholders in the Malaysian manufacturing industry may not be interpreting carbon footprint information as

a significant indicator of financial performance or that the market may not be efficiently pricing this information into investment decisions that affect ROI. The relationship between carbon footprint and financial performance has been a subject of debate in existing literature. Some studies have found a positive relationship between environmental performance and financial indicators, while others have reported negative or no significant relationships (Lei et al., 2023). This inconsistency in findings underscores the importance of contextual factors, such as industry-specific characteristics and regional economic conditions, in determining the nature of this relationship.

## **2.4 Chapter Summary**

The literature review comprehensively explores the relationship between carbon footprint and financial performance within the manufacturing sector in Malaysia, drawing upon several theoretical frameworks, including stakeholder theory, legitimacy theory and signalling theory. It highlights the significant role of the manufacturing industry in contributing to greenhouse gas emissions and examines various methods for calculating and reducing carbon footprints, such as life cycle assessment (LCA) and carbon accounting. The review critically analyzes the mixed findings in existing studies regarding the impact of environmental performance on financial performance, with key financial indicators including profitability, return on assets (ROA), and return on equity (ROE). It underscores the influence of regulatory frameworks, such as the Malaysian Environmental Quality Act, and market pressures from stakeholders who prioritize sustainability in shaping corporate environmental strategies. Empirical evidence from case studies of Malaysian manufacturing companies is presented to illustrate the diverse experiences and strategies adopted in managing carbon emissions. The review also identifies significant challenges, such as measurement difficulties and high implementation costs, while highlighting opportunities for enhancing competitiveness through

sustainable practices and innovation. Additionally, it points out research gaps, advocating for more longitudinal studies, sector-specific analyses, and exploration of the interplay between various environmental and financial metrics. Thus, the literature review establishes a robust foundation for understanding the intricate dynamics between carbon footprint management and financial performance in Malaysia's manufacturing industry, emphasizing the crucial role of regulatory and market forces in driving sustainability.

## **CHAPTER 3**

### **METHODOLOGY**

#### **3.1 Introduction**

In order to achieve the research objectives of the present study, this chapter sheds light on how the study was conducted and what type of research philosophies, research designs, and approaches were followed. More specifically, this chapter entails a discussion on ontology, methodology, and research design elements such as the purpose of the study, type of study unit of analysis, time horizon of the study, population, and sample, sample size, sampling techniques, and data collection procedures used in the present study. Prior chapters emphasized the description of the establishment of the hypothesis and the rationale approach adopted to form a link with the suggested conceptual framework for this study.

#### **3.2 Conceptual Framework**

This research is based on financial performance data utilizing three identifiable accounting metrics of corporate financial performance as the dependent variables. The study employed Return on Assets (ROA), which informs management, investors, or analysts about how effectively assets are managed to generate profits. The next metric is Return on Equity (ROE), which can be utilized to forecast corporate shareholder returns (Artiach et al., 2010). The study utilised the ROI indicator, which considered both equity capital provided by shareholders and borrowed funds from investor groups (Montabon et al., 2006). The independent variable is the carbon footprint, while the control variables are firm size and age. These factors potentially influence the dependent measure of the impacts of carbon

footprint on financial performance within the manufacturing industry in Malaysia. The conceptual framework is presented below:

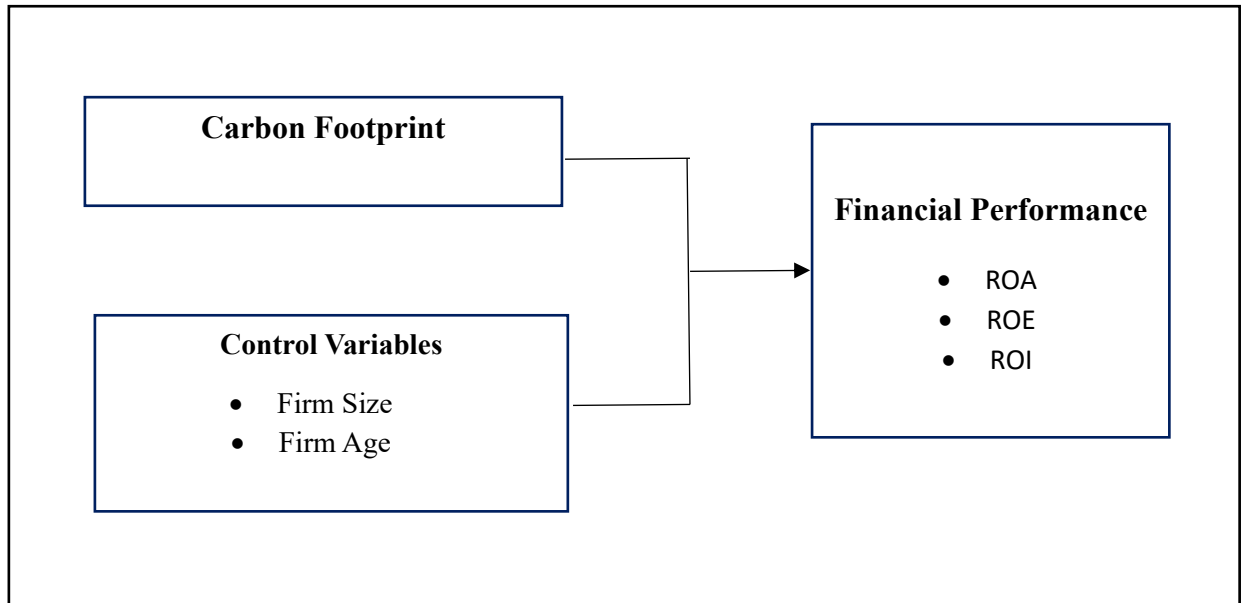


**Figure 3.1:** Conceptual Framework

### **3.3 Research Methods**

The research strategy adopted in this study was quantitative, entailing the process of gathering and analyzing numerical data to identify patterns, test causal relationships, and summarise results for larger populations. The primary source for this study is secondary data collection, obtained from manufacturing companies listed in Bursa Malaysia.

### **3.4 Data Collection**

The population of this study comprised all manufacturing companies listed on Bursa Malaysia, specifically in the manufacturing industry, from the years 2020 to 2022. The manufacturing sector is a key contributor to the Malaysian economy and is often associated

with substantial carbon emissions resulting from production processes, energy consumption and waste generation (Van, 2011).

This study employs purposive sampling, focusing solely on companies that disclose carbon footprint information. The initial sample comprised 1,107 firm-year observations. Out of these, 897 were excluded due to the unavailability of carbon footprint information or unwillingness to share responses publicly. Additionally, Malaysia is still new to this area. Consequently, the final sample comprises 210 firm-year observations (70 firms each in 2020, 2021 and 2022). This study utilised the content of voluntary carbon disclosure in these companies' annual reports. The selection of annual reports as the unit of analysis was due to their accessibility and their function in disclosure, which can serve as an essential tool (Tsang, 2011). Other reasons for choosing these firms included their public visibility and their role in responding to the climate change issue (Qian & Schaltegger, 2017). The annual reports of these companies were downloaded from Bursa Malaysia's website or the official company websites themselves.

Carbon emissions (CO<sub>2</sub>e) from the annual reports serve as proxies for carbon disclosure by the participating firms. Several studies, such as Luo (2019), have utilised this information as a measure for carbon disclosure. Sustainability reports are the primary way organisations publicly communicate their environmental risks, opportunities and practices to stakeholders, enabling them to make informed decisions. Sustainability reporting does not yet operate with the same transparency, consistency and interoperability. However, most companies follow sustainability reporting laws set out by their local governments where applicable or voluntarily select the standards they use for reporting, which is how the companies report their sustainability performance (Brightest, 2024).

### **3.5 Method of analysis**

Content analysis was used to analyse textual content. This method emphasizes counting and measuring specific elements within the content, such as CO<sub>2</sub> emissions, in the sustainability reports. This study reviews the reports of the listed manufacturing companies related to carbon footprint disclosure. This could involve categories of disclosure, such as Scope 1, Scope 2 and Scope 3. This method enables a comprehensive and transparent assessment of how companies disclose their carbon footprint, offering valuable insights into their environmental responsibilities and adherence to reporting standards.

Descriptive analysis can also be a valuable method to examine the extent of carbon footprint disclosure among manufacturing companies in Malaysia. Descriptive analysis involves summarizing and interpreting the data to provide a clear understanding of the trends and patterns in carbon footprint disclosures. This method allows for the identification of common practices, the level of detail provided in disclosures, and any variations among companies based on factors such as firm size, firm age or finances. Descriptive analysis thus provides a foundation for further exploration of the relationship between environmental transparency and financial success in the manufacturing sector.

The correlation coefficient is a numerical measure that ranges from -1 to 1. A coefficient of 1 indicates a perfect positive correlation, implying that the variables are perfectly related in a positive direction. A coefficient of 0 indicates no correlation, signifying the absence of a relationship between the variables. A coefficient of -1 indicates a perfect negative correlation, indicating a perfect negative relationship between the variables.

Panel data analysis was employed in this study, enabling researchers to generate a relatively higher level of statistically valid policy analysis and program evaluation using more sophisticated research designs and statistical techniques, which utilise time series and

cross-sectional data. Panel data include observations on N cross-section units (companies) over T periods. As panel data analysis uses variation in both these dimensions, it is one of the most efficient analytical methods for econometric data (Asteriou, 2006).

Multiple regression analysis was utilised to ascertain the impact of changes in specific assumptions or business drivers on revenue or expenses. The analysis was employed to understand how changes in this assumption affect the outcomes. It helps to quantify the effect of each independent variable on the dependent variable while controlling for the influence of other variables. It is fundamentally similar to the simple linear model, except that it incorporates multiple independent variables. The equation representation of multiple linear regression is as follows:

$$Y = a + bX_1 + cX_2 + dX_3 + \varepsilon \quad \text{Equation 3.1}$$

Where:

|                                                       |                         |
|-------------------------------------------------------|-------------------------|
| Y                                                     | – dependent variable    |
| X <sub>1</sub> , X <sub>2</sub> , X <sub>3</sub> .... | – independent variables |
| a                                                     | – intercept             |
| b, c, d                                               | – slope                 |
| ε                                                     | – residual (error)      |

$$ROA = a + b. \text{Log} (CO_2e) + c. \text{Log} (\text{Size}) + d. \text{Age} \quad \text{Equation 3.2}$$

$$ROE = a + b. \text{Log} (CO_2e) + c. \text{Log} (\text{Size}) + d. \text{Age} \quad \text{Equation 3.3}$$

$$\text{ROI} = a + b. \text{Log} (\text{CO}_2\text{e}) + c. \text{Log} (\text{Size}) + d. \text{Age} \quad \text{Equation 3.4}$$

Panel data analysis differs from regular time series or cross-section regression. Differs, rather it is conducted using fixed or random effect model estimation. These are competing models based on contradictory assumptions. Both models start from the general form:

$$y_{it+1} = \alpha_i + \beta_X + \mu_{it}, I = 1, \dots; t=1, \dots, T \quad \text{Equation 3.5}$$

$$\text{Financial Performance}_{it+1} = \alpha_i + \beta(\text{CO}_2\text{e}_{it}) + \mu_{it} \quad \text{Equation 3.6}$$

Where  $y_{it}$  is the financial performance of firm  $I$  in year  $t$ ,  $\alpha$  denotes the unobserved firm-level effect, and  $\beta$  the vector of estimated regression coefficients for each of the explanatory variables measured in the matrix,  $X$  (Woolridge, 2006). The models differ concerning the definition of unobserved effect. At the same time,  $\beta(\text{CO}_2\text{e}_{it})$  shows the impact of  $\text{CO}_2\text{e}$  emissions at the time on the financial performance at time  $t+1$ . The coefficient  $\beta$  represents how much the financial performance is expected to change for a unit change in  $\text{CO}_2\text{e}$  emissions. This is  $\mu_{it}$  the error term, capturing the effect of all unobserved factors that influence financial performance and vary over time and across entities.

Lütkepohl and Xu (2010) and Stevens (1946) emphasise that applying a log transformation to a series can stabilise its variance, leading to improved predictive accuracy and greater consistency in outcomes.

In this study, certain variables such as  $\text{CO}_2\text{e}$  and firm size were subjected to logarithmic (log) transformations to potentially enhance model accuracy, especially when

dealing with skewed data or residuals that do not follow a normal distribution. Logarithmically transforming a skewed variable like carbon emissions could enhance model accuracy by standardising the distribution of the data. This is essential as we aim to minimise prediction errors while avoiding overfitting the model. Overfitting occurs when there is an excessive number of dependent variables, which results in a lack of generalisability in the dataset, thereby impeding accurate predictions (Andy, 2019).

To estimate the parameters of a model with panel data, several techniques are suggested, such as Pooled Least Squares, Fixed Effect Method (FEM) and Random Effect Model (REM). The choice of model is determined by conducting Hausmann tests. To determine which approach fits the model's equation between a fixed effect or random effect, the specifications developed by Hausmann can be employed. In this study, the Random Effect Model (REM) was chosen after conducting the Hausmann test. This decision was based on the result showing  $p = 1.000$ , which is greater than 5%. Therefore, we accept the null hypothesis and conclude that the random effects model is appropriate (Yuliadi & Yudhi, 2021).

The Wald test is a statistical method frequently employed in regression analysis to evaluate the significance of individual coefficients within a model. In this study investigating the impact of carbon footprint on financial performance, the Wald test plays a crucial role in determining whether carbon emissions significantly affect financial metrics, such as profitability or return on investment. The primary function of the Wald test in this research is to test the null hypothesis that the coefficient associated with the carbon footprint variable is equal to zero. The Wald test helps to test the null hypothesis that a specific coefficient (e.g., for carbon footprint) in the regression model equals zero. This study helped to determine if there is a statistically significant relationship between the carbon footprint and

financial performance metrics like ROA, ROE, and ROI. The Wald test can often perform well even when the sample size is not very large, making it suitable for industry-specific analyses like in the manufacturing sector in Malaysia.

### **3.5.1 Variable Selection**

The variable selection process is a critical component that underpins the methodological framework of this study. Variable selection is pivotal in ensuring that the research accurately captures the relationship between carbon footprint and financial performance within the manufacturing sector in Malaysia. This section aims to identify and justify the key variables included in the analysis, considering both theoretical foundations and empirical evidence from prior literature. By meticulously selecting variables, this study strives to enhance the validity and reliability of the findings, thereby contributing to a deeper understanding of how environmental sustainability practices influence corporate financial outcomes. The chosen variables will reflect the multifaceted nature of both carbon emissions and financial performance, encompassing a range of quantitative measures that align with established research in the field.

### **3.5.2 Measurement of Financial Performance**

In this study, we utilize accounting measures due to data limitations, as only a few manufacturing companies in Malaysia have voluntarily disclosed their carbon reporting information for the past three years. This is because, during this data collection period, the requirement for all publicly listed companies in Malaysia to disclose their carbon reporting comes into effect for FYE after December 31, 2024 (Bursa Malaysia, 2024).

Financial performance indicators such as return on assets (ROA), return on investment (ROI), and return on equity (ROE) are widely acknowledged by academics

worldwide (Busch et al., 2020). These indicators measure the overall financial success of a business, and their high or low levels can be used to gauge the company's financial health. They remain unaffected by significant events that may have occurred within the company and possess qualities of objectivity, universality, and accessibility

For stakeholders in a company, return on assets (ROA) is one of the most crucial financial metrics because it is straightforward to compare (Lewandowski, 2015). ROA is defined by Misani and Pogutz (2015) as net income divided by total assets. A company's ROA tells management, investors, or analysts how well it can manage its assets to produce profits. ROA, indicated as a percentage, recognises a firm's carbon disclosure practices via its operational efficiency in generating revenues. ROA for public companies can vary substantially and is highly dependent on the industry in which they function. The better the company is, the higher its return on total assets. This is because it shows that the company is able to earn more money with a smaller investment (Hargrave, 2024). Magni and Peasnell (2012) support the use of total assets in calculating ROA as an effective measure of economic viability. In this study, ROA would help determine how effectively the manufacturing companies are utilizing their assets while considering their carbon footprint. A high carbon footprint might imply higher operating costs or regulatory fines, potentially affecting asset utilization. Chandra et al. (2021) highlighted that overall asset turnover significantly impacts ROA. ROA is calculated by:

$$\text{ROA} = \frac{\text{Net income for common stakeholders}}{\text{Total assets}}$$

Another measure of financial performance is the return on equity (ROE), calculated by dividing net income by shareholders' equity. Return on Equity (ROE) is a crucial metric that reflects a company's profitability and efficiency in utilizing shareholders' equity. A high

ROE suggests that a company is effectively generating profits from the capital invested by its shareholders (Waluyo & Widianingsih, 2020). ROE is important for understanding how the carbon footprint impacts the returns to investors. A higher carbon footprint could lead to increased costs or reduced revenues, impacting net income and thereby affecting returns to equity holders. It is calculated by dividing net income by average shareholders' equity, expressed as a percentage:

$$\text{ROE} = \frac{\text{Net Income}}{\text{Shareholders' equity}}$$

An effective indicator of an investment's profitability is the return on investment (ROI). The higher the ROI, the more profitable the investment is. ROI can be used to monitor an investment's progress over time, as well as to compare different alternatives and scenarios. ROI can be used to evaluate the financial returns of specific investments aimed at reducing the carbon footprint, such as investing in energy-efficient technologies or renewable energy sources. It provides insight into the cost-benefit analysis of these investments and their impact on overall financial performance. By calculating ROI, manufacturers can conduct cost-benefit analyses to determine if investing in new equipment, processes, or technologies is financially viable.

$$\text{ROI} = \frac{\text{Profit}}{\text{Cost of investment}} \times 100$$

### **3.5.3 Measurement of Carbon Disclosure**

Measuring the carbon footprint of an organization through its sustainability report involves a meticulous analysis of the data presented on greenhouse gas (GHG) emissions.

The process begins by identifying the relevant sections within the report that detail environmental impact, GHG emissions, carbon footprint, sustainability initiatives, and energy consumption. The total carbon footprint is then calculated by summing the emissions across all three scopes. The disclosure emissions for a full year, which are made available to the public in the company's ESG report, can be assessed in Bursa Malaysia's annual report. Sustainability reports are the primary way organizations publicly communicate their environmental risks, opportunities, and practices to stakeholders, enabling informed decisions. There are several top sustainability reporting standards, including The European Sustainability Reporting Program (EU CSRD), The International Sustainability Standards Board (ISSB), the Carbon Disclosure Program (CDP), the Task Force on Climate-related Financial Disclosures (TCFD), The Sustainability Accounting Standards Board (SASB), B Corp and the Global Reporting Initiative (GRI) (Brightest, 2024).

Sustainability reporting does not yet achieve the same levels of transparency, consistency and interoperability. However, most companies adhere to sustainability reporting laws set out by their local governments where applicable or voluntarily select the standards they use for reporting, which determines how companies report their sustainability performance (Brightest, 2024). Top sustainability reporting frameworks exhibit several key similarities that enhance their effectiveness and relevance in communicating sustainability efforts. These similarities include stakeholder engagement. Most sustainability reporting frameworks emphasize the importance of engaging stakeholders, including investors, customers, employees, and communities. This engagement helps organizations understand the expectations and concerns of various groups, ensuring that the reports address relevant issues. Besides that, there is transparency and accountability. Effective sustainability reporting frameworks promote transparency, encouraging organizations to disclose both

achievements and challenges. This practice fosters accountability and builds trust with stakeholders, enhancing the credibility of the reported information. Next is the integration of business strategy. Leading sustainability reports often integrate ESG considerations into the broader business strategy. This alignment shows how sustainability initiatives contribute to long-term value creation and risk management, reinforcing the importance of sustainability in overall business operations.

#### **3.5.4 Control Variables**

Firm size and firm age are included as control variables in this analysis to account for their potential impact on carbon disclosure and financial performance. Firm size is measured using total assets. The sum of all assets owned by the firm, including the current and fixed assets. It reflects the firm's capacity to generate revenue and its overall economic scale. In the majority of studies on voluntary disclosure, firm size has been considered as a control variable (Luo, 2019). Two main elements were chosen because they can explain the effects of firm size and firm age on profitability. Firstly, larger firms possess the material and financial resources required to disclose comprehensive non-financial information. Larger firms typically have more resources, both financial and human, which can influence their ability to invest in sustainable practices and manage their carbon footprint effectively. This can lead to varying financial performance outcomes compared to smaller firms. Secondly, intense public scrutiny is another common factor (Liu & Anbumozhi, 2009). Larger firms often have more market influence, which can affect their financial performance. They may also face greater scrutiny from regulators, investors, and consumers regarding their environmental practices. Including firm size as a control variable is essential because larger

firms often have more resources to manage their carbon emissions effectively. This can influence their financial performance independently of their carbon footprint.

The method measures the firm age was taken from years since incorporation. The number of years since the firm was officially registered or incorporated is because it provides a straightforward measure of how long the firm has been legally operating. De Villiers et al. (2015), as well as Huergo and Jaumandreu (2004), proposed that older companies are likely to engage in environmental initiatives because they have sufficient resources to do so at a reduced cost. Therefore, the age of the firm was employed as a control variable. Older firms may have more established processes and greater experience in managing both the financial and environmental aspects of their business. This experience can contribute to more stable financial performance, independent of their carbon footprint. Besides that, older firms have more historical financial data available, which can be useful for assessing long-term trends and the impact of environmental practices on financial performance. Similarly, firm age can affect financial performance due to established practices and market presence. Older firms might have different operational efficiencies and sustainability practices compared to newer firms.

### **3.6 Chapter Summary**

Chapter 3 outlined the research methodologies employed, encompassing various aspects such as describing data collection methods, clarifying research instruments used, specifying the unit of analysis, describing the target population, explaining the sampling techniques utilised and elucidating the detailed process of data analysis. Each facet of the technique was thoroughly examined and explained in detail to establish a robust framework for subsequent research. Furthermore, this chapter serves as a fundamental introduction to

the next chapter, wherein the results of the data analysis will be revealed, providing valuable information obtained through the rigorous implementation of the methodological framework outlined in this study.

## CHAPTER 4

### RESULTS AND DISCUSSION

#### 4.1 Introduction

This chapter discusses the results obtained from the study conducted. The interpretations of these findings are based on the research objectives and problems identified in earlier chapters. All the collected data are analyzed using EViews and presented in tabular form.

#### 4.2 Descriptive Statistics

Descriptive statistical analysis provides valuable insights into the characteristics and underlying patterns of the observed data for the research variables. Table 4.1 presents descriptive statistics, such as mean, maximum value, minimum value, and standard deviation, for the variables used in the equation evaluating the impact of carbon footprint on financial performance.

The average logarithm of CO<sub>2</sub> equivalent emissions, represented as Log (CO<sub>2</sub>e), is approximately 7.78. The median value is around 8.00, indicating a distribution skewed towards higher values. The range of values extends from 0.33 to 15.85. The variability of the data, as measured by a standard deviation of 3.93, suggests a roughly symmetric distribution with a slightly leftward skewness of -0.0816. The positive kurtosis indicates heavier tails. The Jarque-Bera test does not show a significant deviation from a normal distribution.

The dataset has an average (mean) firm age of 16.40 years. The median value is 16.00 years. The range of firm ages spans from nine to 23 years old. The dispersion of age data is

quantified by a standard deviation of 3.61 years. The data exhibits a slight right skew, with a skewness coefficient of 0.1538.

The mean logarithm of size, referred to as Log Size, amounts to 16.82 with a median value of 16.49. Log size varies from 10.41 to 23.46. The standard deviation, which measures the spread of the data, is 2.78. The data displays somewhat left skewness, indicated by a skewness coefficient of -0.0271. The positive kurtosis suggests that the distribution has heavier tails and a more peaked shape. The Jarque-Bera test yields a p-value of 0.0732, which exceeds the commonly used significance level of 0.05. This indicates that the data is not significantly different from a normal distribution.

The mean return on assets (ROA) is 10.31%, signifying an average yield of 10.31% on a company's assets. This is higher than the 8% value reported by Luo (2019) and supported by Cotter and Najah (2012), which represents reasonably good performance. The dataset's median ROA is 10.92%, implying that the middle value in the dataset is slightly higher than the mean, indicating a distribution that might have a minor leftward skew. This suggests that some companies in the dataset experience negative returns on their assets, with the range of ROA values varying from -13.21% to 38.04%. The standard deviation of 8.71 indicates substantial dispersion in ROA values, reflecting significant variation in the performance of different enterprises. The skewness value of 0.1517 indicates a modest rightward skew, while the positive kurtosis of 3.67 suggests heavier tails and a more peaked distribution compared to a normal distribution. The p-value of 0.0939 exceeds the commonly utilised significance threshold of 0.05, implying that the data is not significantly different from a normal distribution.

The average return on equity (ROE) is computed as 14.20%, signifying that the company achieves an average return of 14.20% on its equity. The dataset's median value stands at 13.78%, indicating a slightly right-skewed distribution. ROE ranges from 2.28% to 33.70%, and the standard deviation of 6.73 implies a substantial degree of variability in ROE values. A skewness value of 0.38 suggests a rightward skew, indicating the existence of companies with above-average ROE. The positive kurtosis of 2.77 denotes fatter tails and a more peaked distribution compared to a normal distribution. The p-value derived from the Jarque-Bera test for normality amounts to 0.0644, surpassing the generally adopted significance level of 0.05. This outcome implies that the data does not deviate significantly from a normal distribution.

In contrast, the mean return on investment (ROI) stands at 34.03%, indicating a superior average return compared to ROA and ROE. The median ROI quantifies at 32.65%. ROI ranges from 8.69% to 65.09%, and the standard deviation of 11.39 suggests a considerable dispersion of ROI values. The positive kurtosis of 3.16 indicates fatter tails and a more peaked distribution compared to a normal distribution. The p-value stemming from the Jarque-Bera test for normality is 0.05874, which, although larger than the commonly used significance level of 0.05, nevertheless indicates a lack of significant deviation from a normal distribution.

**Table 4.1:** Result of the Descriptive Analysis

|                    | <b>Log<br/>(CO<sub>2</sub>e)</b> | <b>ROA</b> | <b>ROE</b> | <b>ROI</b> | <b>Age</b> | <b>Log (Size)</b> |
|--------------------|----------------------------------|------------|------------|------------|------------|-------------------|
| <b>Mean</b>        | 7.7839                           | 10.3062    | 14.1999    | 34.0258    | 16.3969    | 16.8244           |
| <b>Median</b>      | 8.0015                           | 10.9212    | 13.7752    | 32.6536    | 16.0000    | 16.4875           |
| <b>Maximum</b>     | 15.8495                          | 38.0431    | 33.7006    | 65.0940    | 23.0000    | 23.4624           |
| <b>Minimum</b>     | 0.3293                           | -13.2132   | 2.2759     | 8.69246    | 9.0000     | 10.4103           |
| <b>Std. Dev.</b>   | 3.9332                           | 8.7122     | 6.732      | 11.3877    | 3.6137     | 2.7757            |
| <b>Skewness</b>    | -0.0816                          | 0.1517     | 0.3842     | 0.39726    | 0.1538     | -0.0271           |
| <b>Kurtosis</b>    | 2.9147                           | 3.6736     | 2.7657     | 3.16144    | 2.2679     | 2.2686            |
| <b>Jarque-Bera</b> | 4.7068                           | 4.7306     | 5.4862     | 5.66939    | 5.2284     | 16.8244           |
| <b>Probability</b> | 0.0950                           | 0.0939     | 0.0644     | 0.05874    | 0.0732     | 16.4875           |
| <b>Observation</b> | 210                              | 210        | 210        | 210        | 210        | 210               |

### 4.3 Correlation Result

The correlation analysis provides insights into the relationships between financial performance indicators (ROA, ROE, ROI) and variables such as carbon emissions (Log (CO<sub>2</sub>e)), firm size (Log (Size)), and firm age (Age). The results show that the correlations between these variables are generally weak, which means that they do not have strong linear relationships with financial performance.

For Return on Assets (ROA), there is a very weak positive correlation with carbon emissions (0.0457), indicating that higher carbon emissions are slightly associated with higher ROA, though the relationship is minimal. The correlation between ROA and firm size

is slightly negative (-0.0333), suggesting that larger firms might experience a marginal decrease in ROA. Similarly, the correlation between ROA and firm age is weakly negative (-0.0951), implying that older firms tend to have lower ROA, but this relationship is not strong. It shows that the firm has a decline in operational efficiency or adaptability. This finding is consistent with a previous study conducted by Siddique et al. (2021). The negative correlations indicate that larger firms may face challenges that hinder their financial performance, such as increased operational complexity, bureaucracy, or inefficiencies. This finding contrasts with some literature Trumpp and Guenther (2015) and Busch and Lewandowski (2017) that suggests larger firms typically benefit from economies of scale.

Return on Equity (ROE) also shows weak correlations with the variables. The correlation with carbon emissions is almost negligible (0.0148), indicating no meaningful relationship. The weak negative correlation between ROE and firm size (-0.0616) suggests that larger firms might have slightly lower ROE. Additionally, the weak negative correlation between ROE and firm age (-0.0716) suggests that older firms might experience a slight decline in ROE. It shows that older firms may also struggle to generate higher returns on equity. The negative correlations with firm age suggest that older firms may experience diminishing returns due to factors such as reduced innovation, increased bureaucracy, and a lack of agility in adapting to market changes.

For Return on Investment (ROI), the weak positive correlation with carbon emissions (0.0936) suggests a slight association between higher carbon emissions and higher ROI. However, the weak negative correlation with firm size (-0.0998) indicates that larger firms may have marginally lower ROI. The strongest negative correlation among the three metrics suggests that larger firms might be less efficient in generating returns on investments. The correlation between ROI and firm age is also weakly negative (-0.077), suggesting that older

firms might experience a slight decrease in ROI. Indicates that older firms might be less effective in generating returns on their investments.

The correlations among the independent variables (Log (CO<sub>2</sub>e), Log (Size), Age) are also weak, indicating minimal linear relationships between them. The very weak negative correlations between carbon emissions and both firm size (-0.0419) and firm age (-0.0311) suggest that larger and older firms might have slightly lower carbon emissions, though the relationships are negligible. The weak positive correlation between firm size and firm age (0.0512) indicates that older firms tend to be slightly larger, but this relationship is very small.

All three performance measures (ROA (0.0457), ROE (0.0148), and ROI (0.0936)) show positive correlations with Log (CO<sub>2</sub>e), a slight tendency for companies with higher CO<sub>2</sub> emissions to have better financial performance. All performance measures show negative correlations with Log (Size) and firm age because larger and older companies tend to have slightly lower financial performance metrics. Environmental performance and financial performance:

The positive correlation between CO<sub>2</sub> emissions and financial performance metrics might imply that companies with higher emissions are slightly more profitable. This could be due to several factors that include these companies might be in industries that are both carbon-intensive and profitable (e.g., energy, manufacturing). This phenomenon could be attributed to the greater production volumes and resource utilization characteristic of these firms, which drive financial gains despite the environmental costs. Conversely, the negative correlations between the control variables—company size (Log(Size)) and age and the financial performance measures indicate that larger and older firms tend to perform less

favourably financially. The correlations of Log(Size) with ROA (-0.0333), ROE (-0.0616), and ROI (-0.0998), along with those of age with ROA (-0.0951), ROE (-0.0716), and ROI (-0.077), suggest that as companies grow larger and older, they may face operational inefficiencies, increased maintenance costs, and management complexities that hinder their financial performance. Additionally, the slight negative correlations of Log(CO2e) with Log(Size) (-0.0419) and age (-0.0311) imply that larger and older companies are not necessarily the highest emitters of carbon, indicating that emission levels are influenced by factors beyond just company size and age.

These findings underscore a critical trade-off in the manufacturing industry between economic growth and environmental sustainability. The positive relationship between carbon emissions and financial performance highlights the need for strategies that balance industrial productivity with sustainable practices. The negative impact of size and age on financial performance suggests that younger and more agile companies may hold a competitive edge.

**Table 4.2:** Correlation Result

| Variable   | Log (CO2e) | Log (Size) | Age     |
|------------|------------|------------|---------|
| ROA        | 0.0457     | -0.0333    | -0.0951 |
| ROE        | 0.0148     | -0.0616    | -0.0716 |
| ROI        | 0.0936     | -0.0998    | -0.077  |
| Log (CO2e) | 1          | -0.0419    | -0.0311 |
| Log (Size) | -0.0419    | 1          | 0.0512  |
| Age        | -0.0311    | 0.0512     | 1       |

#### 4.4 Hausman Test Result

In addition to employing the Hausman test to differentiate between fixed effects and random effects models, we utilize it as a criterion to determine the appropriate model between fixed and random effects models. The decision criterion is to reject  $H_0$  if the probability value is less than 5%. Alternatively, it is to accept  $H_0$  if the probability value is more excellent than 5%. In this case, the p-value is 1.0000, greater than 5%; thus, we accept the null hypothesis and conclude that the random effects model is appropriate (Yuliadi & Yudhi, 2021). Therefore, we can infer that the unobserved individual-specific effects are not correlated with the included explanatory variables. This implies that the random effects model provides a better fit for the data than the fixed effects model. By accepting the null hypothesis, we can confidently utilize the random effects model to estimate the relationship between the dependent and independent variables in the analysis.

Table 4.3 shows that the p-value is 1.000 ( $p > 0.05$ ), indicating a failure to reject the null hypothesis. Consequently, the random effects model is deemed consistent and efficient compared to the fixed effects model. This suggests that there may be minimal variation in the random effects across different cross-sectional units, reinforcing the notion that a random effects model is appropriate.

**Table 4.3:** Correlated Random Effects- Hausman Test

| Correlated Random Effects - Hausman Test |                   |          |      |       |
|------------------------------------------|-------------------|----------|------|-------|
| Pool: Panel                              |                   |          |      |       |
| Test cross-section random effects        |                   |          |      |       |
| Test Summary                             | Chi-Sq. Statistic | Chi -Sq. | d.f. | Prob. |
| Cross-section random                     | 0.000             |          | 3    | 1.000 |

#### 4.5 Random Effect Result

The random-effects regression study conducted on the relationship between Return on Assets (ROA) and several independent variables yields valuable insights. This analysis examines the impact of Log (CO<sub>2</sub>e), firm size Log (Size) and the age of the company (Age) on ROA. The intercept (C) represents the predicted ROA when all independent variables are zero.

The findings yield several significant observations. As shown in Table 4.4 below, the intercept coefficient (C) of 14.6385 is strongly significant in statistical terms ( $p = 0.0000$ ), demonstrating a robust link between the intercept and ROA. This implies a fundamental return on assets, even when all other variables remain unchanged.

Upon analysing the various coefficients, it is observed that the coefficient for Log (CO<sub>2</sub>e) is positive (0.1045) but lacks statistical significance ( $p = 0.1495$ ). This implies that the logarithm of CO<sub>2</sub> emissions may not exhibit a significant linear relationship with ROA. This finding aligns with some past studies that have reported an insignificant or even positive relationship between carbon footprint and financial performance. For instance, a study by Trumpp and Guenther (2017) found that the relationship between carbon performance and financial performance is U-shaped, suggesting that both low and high-carbon performers can achieve superior financial results. Similarly, Busch and Lewandowski (2018) concluded that the impact of carbon performance on financial performance is industry-specific and depends on factors such as carbon intensity and regulatory pressures.

Similarly, the coefficient for Log (Size) is negative (-0.0832), though not statistically significant ( $p = 0.3546$ ), indicating that the log size may not significantly linearly influence ROA. This result contrasts with some previous studies that have found a positive relationship

between firm size and financial performance. A meta-analysis by Capon et al. (1990) suggests that larger firms often have access to more resources, economies of scale, and market power, which can contribute to better financial performance. However, the insignificant relationship observed in the current study may be due to the specific context or industry being analyzed.

In contrast, the coefficient for firm age is -0.2188, indicating a statistically significant ( $p = 0.0014$ ) and substantial negative linear relationship between the company's age and ROA. These findings indicate that, under similar circumstances, older companies generally exhibit a poorer return on assets (ROA) compared to younger enterprises. A study by Loderer and Waelchli (2010) suggests that older firms may experience reduced growth opportunities, increased bureaucracy, and a lack of strategic flexibility, which can lead to lower profitability. Similarly, Coad et al. (2010) found that the relationship between firm age and productivity follows an inverted U-shape, with older firms experiencing a decline in productivity.

**Table 4.4:** Random Effect Regression Analysis (ROA)

| Variable                | Coefficient | Std. Error | t-Statistic | Prob   |
|-------------------------|-------------|------------|-------------|--------|
| C                       | 14.6385     | 1.9702     | 7.4298      | 0.0000 |
| Log (CO <sub>2</sub> e) | 0.1045      | 0.0724     | 1.4442      | 0.1495 |
| Log (Size)              | -0.0832     | 0.0898     | -0.9261     | 0.3546 |
| Age                     | -0.2188     | 0.0685     | -3.1947     | 0.0014 |

Dependent Variable: Return on Assets (ROA)

As presented in Table 4.5, the intercept coefficient (C) is 18.5012, with a standard error of 1.5431. The t-statistic is 7.4298, indicating that the constant is statistically significant

at the 1% level. This suggests that even when all independent variables are zero, the expected value of ROE is 18.5012.

The variable coefficient for Log CO<sub>2</sub>e is 0.0201, with a standard error of 0.0567. However, the t-statistic is 1.4442, and the p-value is 0.7232, indicating that the coefficient is not statistically significant at conventional levels ( $p > 0.05$ ). Therefore, there is insufficient evidence to reject the null hypothesis that the coefficient is zero. This finding aligns with some studies that have reported an insignificant or mixed impact of carbon performance on financial metrics. Trumpp and Guenther (2017) found that the relationship between carbon performance and financial performance, measured by ROE, can be U-shaped. This implies that both low and high-carbon performers can achieve superior financial results, depending on the context. Busch and Lewandowski (2018) concluded that the impact of carbon performance on financial performance is industry-specific and depends on factors such as carbon intensity and regulatory pressures. Industry-specific characteristics may influence the insignificant result in this study.

This variable has a coefficient of -0.1399 for Log Size with a standard error of 1.9885. The t-statistic is -0.9261, and the p-value is 0.0470, suggesting that the coefficient is statistically significant at the 5% significance level. The negative coefficient implies a negative relationship between the logarithm of size and ROE. Capon et al. (1990) conducted a meta-analysis that found a generally positive relationship between firm size and financial performance, suggesting that larger firms often benefit from economies of scale and market power, which can enhance profitability and ROE. However, the current study's result may reflect specific industry dynamics or operational challenges faced by larger firms, such as increased complexity and bureaucracy, which can hinder their ability to generate returns for shareholders.

This variable has a coefficient of -0.1265 for Age, with a t-statistic of -3.1947 and a p-value of 0.0185, indicating statistical significance at a 5% significance level. The negative coefficient suggests a negative relationship between age and ROE. Loderer and Waelchli (2010) found that older firms may experience diminishing returns due to increased bureaucracy, reduced growth opportunities, and a lack of strategic flexibility, which can adversely affect their ability to generate returns for shareholders. Coad et al. (2010) indicated that the relationship between firm age and productivity follows an inverted U-shape, where younger firms may be more dynamic and adaptable, while older firms may struggle with declining efficiency and growth opportunities, ultimately impacting their ROE.

**Table 4.5:** Random Effect Regression Analysis

| Variable                | Coefficient | Std. Error | t-Statistic | Prob   |
|-------------------------|-------------|------------|-------------|--------|
| C                       | 18.5012     | 1.5431     | 7.4298      | 0.0000 |
| Log (CO <sub>2</sub> e) | 0.0201      | 0.0567     | 1.4442      | 0.7232 |
| Log (Size)              | -0.1399     | -1.9885    | -0.9261     | 0.0470 |
| Age                     | -0.1265     | -2.3577    | -3.1947     | 0.0185 |

Dependent Variable: Return on Equity (ROE)

The results unveil several significant insights in Table 4.6. Firstly, the intercept coefficient (C) of 42.0079 is statistically significant ( $p = 0.0000$ ), indicating a robust association between the intercept and ROI. This suggests a baseline ROI even when other factors are held constant.

Examining individual coefficients, the coefficient for Log (CO<sub>2</sub>e) is positive at 0.2920 and statistically significant with a p-value of 0.0024. This suggests that Log CO<sub>2</sub>e has a significant positive linear relationship with ROI.

Similarly, the coefficient for Log (Size) is negative, -0.3829, and statistically significant ( $p = 0.0013$ ), indicating that the logarithm of company size has a significant negative linear relationship with ROI.

Furthermore, the coefficient for Age is negative (-0.2194) and statistically significant ( $p = 0.0158$ ), implying a significant negative linear relationship between the age of the company and ROI. This suggests that older companies tend to have lower ROI compared to younger ones, all else being equal.

**Table 4.6:** Random Effect Regression Analysis (ROI)

| Variable                | Coefficient | Std. Error | t-Statistic | Prob   |
|-------------------------|-------------|------------|-------------|--------|
| C                       | 42.0079     | 2.6100     | 16.0948     | 0.0000 |
| Log (CO <sub>2</sub> e) | 0.2920      | 0.0959     | 3.0438      | 0.0024 |
| Log (Size)              | -0.3829     | 0.1190     | -3.2181     | 0.0013 |
| Age                     | -0.2194     | 0.0907     | -2.4177     | 0.0158 |

Dependent Variable: Return On Investment (ROI)

**Table 4.7:** Summary of Hypotheses and Result

| Hypotheses                                                                                                                                                  | Types of Data Analysis | Results       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------|
| <b>H1:</b> There is a significant relationship between corporate carbon footprint and Return on Equity (ROA) in the manufacturing industry in Malaysia.     | Regression             | Insignificant |
| <b>H2:</b> There is a significant relationship between corporate carbon footprint and Return on Equity (ROE) in the manufacturing industry in Malaysia.     | Regression             | Insignificant |
| <b>H3:</b> There is a significant relationship between corporate carbon footprint and Return on Investment (ROI) in the manufacturing industry in Malaysia. | Regression             | Significant   |

Table 4.8 represents the data from 2022 regarding listed companies in Bursa Malaysia, particularly within the manufacturing sector, disclosing notable insights into corporate transparency practices. Out of 991 listed companies, 269 were part of the

manufacturing industry, representing approximately 27.1% of the total. However, when examining information disclosure within this sector, only 70 of these companies, or about 26.02%, disclosed relevant information, while a significant 199 companies (73.98%) did not disclose information. This discrepancy highlights a potential issue in transparency within the manufacturing sector. The low rate of disclosure raises concerns about regulatory compliance and corporate governance standards, suggesting that a majority of these companies may not be adhering to best practices in transparency. This lack of disclosure could also impact investor confidence, as investors rely heavily on disclosed information to make informed decisions. The data indicates a need for further investigation into the factors influencing these practices, such as the enforcement of regulations or the perceived costs and benefits of transparency among firms. Additionally, this finding underscores the importance of comparing these trends over time or across different sectors to understand the dynamics at play better. Overall, the significant proportion of non-disclosing companies in the manufacturing sector suggests an area of concern that warrants closer scrutiny and possibly stricter regulatory oversight to ensure that corporate transparency is upheld across the industry.

**Table 4.8:** Summary of listed company carbon footprint reporting in Malaysia.

| Year | Listed companies in Bursa Malaysia | Listed in the Manufacturing industry | Listed Companies in Manufacturing |        |                             |        |
|------|------------------------------------|--------------------------------------|-----------------------------------|--------|-----------------------------|--------|
|      |                                    |                                      | Disclose Information              |        | Do not disclose information |        |
| 2022 | 991                                | 269                                  | 70                                | 26.02% | 199                         | 73.98% |

## 4.6 Chapter Summary

This chapter provides a detailed presentation of the study's findings, which are interpreted in the context of the research objectives and issues outlined in preceding chapters. The analysis uses descriptive statistical methods to elucidate the characteristics and rationality of the observed data, with a specific focus on the variables pertinent to the research on the impact of carbon footprint on financial performance.

The descriptive statistics reveal that the average logarithm of CO<sub>2</sub> equivalent emissions (Log (CO<sub>2</sub>e)) is approximately 7.78, with a median of 8.00, indicating a skew towards higher values. The range of CO<sub>2</sub> emissions varies significantly from 0.33 to 15.85, and the data exhibits a roughly symmetric distribution with slight leftward skewness. The positive kurtosis value suggests that the distribution has heavier tails. Additionally, the Jarque-Bera test results do not indicate a significant departure from normality.

Firm age in the dataset averages 16.40 years, with a median of 16.00 years, and spans from 9 to 23 years, indicating a standard deviation of 3.61 years. The age data displays a slight right skewness. Regarding firm size, measured as Log Size, the mean is 16.82 with a median of 16.49, ranging from 10.41 to 23.46. The data is slightly left-skewed with a significant positive kurtosis, suggesting a distribution with heavier tails and a more pronounced peak.

Overall, the chapter provides a comprehensive statistical overview, setting the stage for further analysis of the relationship between carbon emissions and financial performance measures such as Return on Assets (ROA), Return on Equity (ROE), and Return on Investment (ROI). The results indicate differentiation in the significance of carbon emissions' impact on various financial performance metrics. While carbon emissions do not

significantly affect ROA and ROE, they do have a significant positive relationship with ROI, highlighting the multifaceted nature of the interaction between environmental and financial performance in the manufacturing industry.

## **CHAPTER 5**

### **CONCLUSION**

#### **5.1 Introduction**

This chapter will present the findings of the study and summarise them. It will also discuss the limitations of the study. This study assesses the corporate carbon footprint's impact on the financial performance of the manufacturing industry in Malaysia.

#### **5.2 Discussion**

The manufacturing industry in Malaysia significantly contributes to the country's economic growth, job creation and improvement of livelihoods. However, it also contributes to greenhouse gas (GHG) emissions, with the manufacturing and construction industries being the third-largest sources of emissions in the country. This raises concerns about the impacts of carbon footprints on the financial performance of the manufacturing industry in Malaysia. This study advocates the perspective that carbon emissions from corporate activities can be reduced while simultaneously maintaining or enhancing the company's financial success. This is in line with the findings from this study where there is a relationship between carbon footprint and financial performance. Investing in eco-friendly technologies and processes can create new revenue streams and improve efficiency (Neeveditah et al., 2017). Transparent reporting of carbon emissions and reduction efforts can enhance stakeholder trust and potentially improve market performance (Herold, 2018).

This study examines the impact of carbon footprint on the financial performance of manufacturing companies in Malaysia. The data used in this study are derived from lagged data from the years 2020 and 2022 obtained from publicly listed manufacturing companies

on Bursa Malaysia. The initial sample consisted of 807 firm-year observations. Out of these observations, 597 were omitted due to either unavailability of carbon footprint information or lack of permission to access their responses publicly. Additionally, it is worth noting that Malaysia is still in the early stages of tackling carbon footprint issues. Consequently, the final sample size consisted of 210 firm-year observations (70 firms each in 2020, 2021 and 2022). Among the 269 companies listed on Bursa Malaysia under the Manufacturing industry, only approximately 26.02% were willing to disclose their carbon footprint information. This suggests a relatively low level of carbon footprint reporting among manufacturing companies in Malaysia. The absence of a statutory requirement mandating publicly listed companies to disclose carbon information, along with the embryonic stage of such practices, may be contributing factors to this low level of disclosure (Rahman, 2020).

Notably, the measurement of carbon emissions is a relatively new practice among Malaysian companies. As a result, only a few companies disclose their accounting systems for total greenhouse gas (GHG) emissions in metric tonnes of carbon dioxide (CO<sub>2</sub>), GHG emissions disaggregated by scope (Scope 1, Scope 2 and Scope 3), emissions data for each scope disaggregated by business units, facilities, sources, or activities, as well as information on worldwide emissions (Rahman, 2020). Furthermore, the findings are consistent with Ahmad and Mohamad's (2014) assertions that Malaysian companies tend to disclose basic, general and soft information. Most companies refrain from providing high-level detailed information in their annual reports, considering it immaterial or associated with a high degree of uncertainty. This finding is also in line with Adinehzadeh et al.'s (2018) observation that companies disclose carbon information primarily as a means of reputation and image building without offering stakeholders a comprehensive understanding of carbon-related issues from a strategic perspective. These findings support the legitimacy theory,

which suggests that the disclosure practices of Malaysian companies serve as symbolic behaviour aimed at creating an impression of environmental responsibility and fulfilling environmental accountability (Rahman, 2020). These findings align with the first research objective of this study.

Research Question 2 presents the findings on the impacts of carbon footprint on financial performance using panel data analysis. It provides a detailed analysis of the results, including a positive coefficient for CO<sub>2</sub> emissions, suggesting a positive relationship between carbon emissions and ROA. There is no statistically significant relationship between CO<sub>2</sub> emissions and ROE, suggesting that variations in CO<sub>2</sub> emissions do not significantly impact a firm's return on equity. However, a positive relationship is observed between CO<sub>2</sub> emissions and ROI, suggesting that firms with higher CO<sub>2</sub> emissions tend to have higher returns on investment.

### **5.3 Implications and Recommendations**

The implications and recommendations section is designed to synthesize the key findings of the research and explore their broader significance. This chapter will delve into the practical and theoretical implications of the study's results, particularly in relation to the impact of carbon footprint on financial performance in the Malaysian manufacturing sector. By interpreting these findings, the chapter will offer valuable insights for policymakers, industry practitioners, and scholars. The recommendations provided will be grounded in empirical evidence and aim to guide future actions and strategies for enhancing environmental sustainability while maintaining economic viability. The implications and recommendations are as follows:

### **5.3.1 Investor Confidence and ESG Considerations**

For investors, these findings underscore the need for a nuanced approach to evaluating investment opportunities in the manufacturing sector. While high carbon emissions are associated with better financial performance, it is crucial to consider the long-term sustainability and regulatory risks associated with such firms. Investors should weigh the potential financial returns against the environmental impact and the likelihood of future regulatory constraints that could affect profitability. This balance is particularly relevant in the context of increasing global emphasis on sustainability and the potential for stricter environmental regulations.

From an ESG perspective, the results highlight the importance of incorporating environmental performance into investment decisions. Investors are encouraged to prioritize firms that not only demonstrate strong financial performance but also commit to reducing their carbon footprint. This approach aligns with the growing trend of ESG investing, where environmental sustainability is a key criterion. Companies that proactively manage their carbon emissions and adopt sustainable practices are likely to be better positioned for long-term success, mitigating risks associated with regulatory changes and shifting market expectations.

In light of these implications, investors should advocate for greater transparency and accountability in environmental reporting. Encouraging firms to disclose their carbon emissions and sustainability initiatives can provide valuable insights for making informed investment decisions. Additionally, supporting companies that invest in green technologies and sustainable practices can enhance overall portfolio resilience and align with broader

ESG goals. By integrating these considerations, investors can contribute to promoting environmental sustainability while achieving favourable financial outcomes.

### **5.3.2 Policymaker**

#### **5.3.2.1 Incentive for Green Technology Investment**

The analysis reveals that higher carbon emissions are positively correlated with improved financial performance indicators (ROI), suggesting that more profitable firms within the manufacturing sector tend to have higher emissions. This finding presents a challenge for policymakers aiming to balance economic growth with environmental sustainability. Conversely, the negative correlations between financial performance and both firm size and age indicate that larger and older firms typically exhibit lower financial performance, likely due to operational inefficiencies and higher associated costs.

Given these insights, policymakers are encouraged to implement measures that foster environmentally responsible growth. Firstly, financial incentives such as tax credits, grants, or subsidies should be provided to firms investing in green technologies. Such incentives can help mitigate the initial costs of adopting environmentally friendly practices and stimulate innovation in the sector. Additionally, support for research and development (R&D) initiatives focused on green technologies is essential, as it can drive the creation of innovative solutions that enhance both environmental and operational performance.

#### **5.3.2.2 Stringent Environmental Regulations.**

Stringent environmental regulations are necessary to ensure long-term sustainability. Implementing carbon pricing mechanisms, such as carbon taxes or cap-and-trade systems, can internalize the environmental costs of carbon emissions, thereby incentivizing firms to reduce their emissions and invest in cleaner technologies. Setting clear emission reduction

targets for the manufacturing sector will also drive firms to adopt sustainable practices and align their operations with national and international climate goals. Moreover, enhancing reporting and transparency on carbon emissions and sustainability practices is crucial for enabling investors to make informed decisions and hold firms accountable for their environmental impact.

### **5.3.3 Entrepreneur**

The observed positive correlation between carbon emissions ( $\text{Log}(\text{CO}_2\text{e})$ ) and financial performance metrics such as Return on Assets (ROA), Return on Equity (ROE), and Return on Investment (ROI) suggests that elevated carbon emissions are currently associated with improved financial outcomes. This association indicates that firms with higher productivity and profitability tend to exhibit greater emissions, reflecting a potential link between operational scale and carbon footprint. Conversely, the negative correlations between financial performance and both firm size ( $\text{Log}(\text{Size})$ ) and age suggest that larger and older firms often experience diminished financial performance. This phenomenon may be attributable to operational inefficiencies, increased maintenance costs, and management complexities that escalate as firms expand and age, thereby adversely affecting their financial health.

To address these implications, entrepreneurs are advised to prioritize the adoption of sustainable practices. Implementing green technologies, such as energy-efficient machinery and renewable energy sources, alongside waste reduction processes, can mitigate carbon emissions without sacrificing productivity. Such investments not only contribute to long-term cost savings but also enhance operational efficiency. Furthermore, entrepreneurs should leverage available financial incentives, including government-provided tax credits, grants, and subsidies for green technology investments. Engaging in research and development

(R&D) initiatives focused on sustainability can offer a competitive advantage and support these efforts.

Smaller and younger firms, which typically demonstrate superior financial performance, are encouraged to harness their agility and capacity for innovation to sustain and augment their market position. By continuously innovating processes and products, these firms can remain competitive and adapt to evolving market conditions and regulatory environments. Additionally, enhancing transparency and reporting of environmental impacts and sustainability initiatives is crucial. Transparent reporting fosters trust among stakeholders, such as investors, customers, and regulators, and can attract investment from socially responsible entities that prioritize sustainability.

#### **5.3.4 Academic and Research**

The suggested directions include longitudinal studies and industry-specific analysis. These areas offer valuable insights into understanding and optimizing the relationship between the carbon footprint and financial outcomes. Future research should prioritize longitudinal studies to capture the long-term effects of carbon footprint reduction on financial performance. These studies should track companies over extended periods, comparing financial metrics before and after the implementation of carbon reduction strategies. By doing so, researchers can identify trends and evaluate whether the benefits of sustainability initiatives are sustained over time or if they merely provide short-term gains. Moreover, longitudinal studies can reveal lag effects, where financial benefits may become evident only several years post-implementation.

Conducting industry-specific analyses is crucial for uncovering sector-specific trends and best practices related to carbon footprint reduction. Each industry faces unique

challenges and opportunities in implementing sustainability initiatives. For instance, the manufacturing sector may focus on energy efficiency and waste reduction, while the technology sector might prioritize reducing electronic waste and using renewable energy. Future research should explore these differences in depth, developing tailored recommendations for each industry. By identifying industry leaders and laggards, researchers can establish benchmarks that other companies within the same sector can aspire to or avoid. This approach will facilitate the development of effective, industry-specific sustainability strategies that enhance financial performance.

#### **5.3.5 Business Practice**

Companies would need to enhance transparency in disclosing their carbon emissions. Given the significant impact on financial performance, stakeholders, including investors, regulators, and customers, would demand more comprehensive and accurate reporting of carbon footprints. With a proven link between carbon footprint and financial performance, investors would likely consider carbon disclosure as a critical factor in their investment decisions. Companies with better carbon management practices could attract more investment, potentially leading to higher stock valuations. Companies would need to engage more actively with stakeholders on their carbon management practices. Transparent communication regarding carbon reduction strategies and their financial implications would be crucial for maintaining stakeholder trust and support.

#### **5.4 Future Research**

This study has contributed to the understanding of the impact of carbon footprints on financial performance in the manufacturing industry in Malaysia. As the study progressed, a

few areas surfaced as suggested areas for future studies. The recommendations for future studies are as follows:

This study solely examined the impact of carbon emissions on firm performance. Further research could investigate the long-term impact of carbon footprints on financial performance. Future studies in this area could broaden the scope beyond the manufacturing industry in Malaysia to explore the effects of carbon footprint disclosure on financial performance in other sectors and countries. Additionally, further studies could explore the specific strategies and initiatives implemented by companies to reduce their carbon emissions and how these efforts translate into improved financial performance. It is crucial to investigate the potential trade-offs and synergies that exist between carbon performance and these indicators to inform sustainable investment strategies.

## **5.5 Limitations of Study**

Availability of data can be a significant limitation. Access to comprehensive, reliable, and up-to-date data on carbon emissions and financial performance for all relevant companies in the manufacturing sector may be challenging. Not all publicly listed companies in Malaysia participate in carbon emission disclosure.

The lack of standardized reporting frameworks for carbon emissions and financial performance metrics across companies may hinder the comparability and accuracy of the data collected. This study relied on self-reported data from companies, which may introduce bias or inaccuracies in measuring carbon footprint and financial performance. Additionally, the analysis was based on publicly available data and may not capture all relevant factors that could impact financial performance.

The study may have been limited due to a three-year timeframe, and the findings may not reflect the long-term effects of carbon footprints on financial performance. It is important to consider that the study's narrow timeframe of three years may limit the generalisability of its findings to different economic conditions or industry sectors.

## **5.6 Conclusion**

The findings of this dissertation offer crucial insights into the relationship between corporate carbon footprints and financial performance in Malaysia's manufacturing sector. The research confirms a significant connection between carbon emissions and financial metrics such as return on assets (ROA) and return on investment (ROI). Despite concerns about the environmental impact of greenhouse gas (GHG) emissions, the study found that companies with higher carbon footprints tend to perform better financially. This paradox underscores the complex dynamics between operational scale, environmental impact, and profitability in this sector.

One of the key contributions of this study is its emphasis on the low level of carbon footprint reporting among Malaysian manufacturing firms, with only 26% of companies disclosing this information. The findings align with legitimacy theory, indicating that many firms engage in symbolic reporting practices to enhance their public image rather than providing comprehensive data on carbon emissions. These results also reveal the lack of regulatory requirements for carbon disclosure in Malaysia, which has contributed to the slow adoption of sustainable practices.

The research has important implications for stakeholders. For investors, it stresses the importance of incorporating environmental considerations into decision-making processes, particularly given the potential long-term risks of regulatory changes. For

policymakers, the findings highlight the need for stronger environmental regulations and incentives for green technology investments to drive sustainable growth in the manufacturing sector. Entrepreneurs are encouraged to adopt sustainable practices to enhance efficiency and capitalize on financial incentives for eco-friendly technologies.

This study also opens pathways for future research, suggesting the need for longitudinal studies to assess the long-term financial impacts of carbon reduction strategies and industry-specific analyses to tailor sustainable solutions. While the study offers valuable contributions, it is limited by the availability of comprehensive carbon data and the relatively short three-year timeframe, which may not capture the full scope of the relationship between carbon emissions and financial performance.

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## APPENDICES

### Appendix A: Extraction from EViews Panel Regression Analysis

**Table 1:** Pooled Least Squares Result (ROA)

| Variable                | Coefficient | Std. Error | t-Statistic | Prob   |
|-------------------------|-------------|------------|-------------|--------|
| C                       | 14.639      | 1.9661     | 7.4455      | 0.0000 |
| Log (CO <sub>2</sub> e) | 0.1044      | 0.0723     | 1.4452      | 0.1487 |
| Log (Size)              | -0.0832     | 0.0896     | -0.9281     | 0.3536 |
| Age                     | -0.2188     | 0.0684     | -3.2014     | 0.0014 |

**Table 2:** Pooled Least Squares Result (ROE)

| <b>Variable</b>         | <b>Coefficient</b> | <b>Std. Error</b> | <b>t-Statistic</b> | <b>Prob</b> |
|-------------------------|--------------------|-------------------|--------------------|-------------|
| C                       | 18.501             | 1.5398            | 12.015             | 0.0000      |
| Log (CO <sub>2</sub> e) | 0.0200             | 0.0566            | 0.3549             | 0.7227      |
| Log (Size)              | -0.1399            | 0.0702            | -1.9927            | 0.0465      |
| Age                     | -0.1265            | 0.0535            | -2.3626            | 0.0183      |

**Table 3:** Pooled Least Squares Result (ROI)

| Variable                | Coefficient | Std. Error | t-Statistic | Prob   |
|-------------------------|-------------|------------|-------------|--------|
| C                       | 42.008      | 2.6045     | 16.128      | 0.0000 |
| Log (CO <sub>2</sub> e) | 0.2920      | 0.0957     | 3.0502      | 0.0023 |
| Log (Size)              | -0.3829     | 0.0119     | -3.2248     | 0.0013 |
| Age                     | -0.2194     | 0.0905     | -2.4228     | 0.0156 |

**Table 4:** Fixed Effect Regression Analysis (ROA)

| Variable                | Coefficient | Std. Error | t-Statistic | Prob   |
|-------------------------|-------------|------------|-------------|--------|
| C                       | 14.638      | 1.9702     | 7.4298      | 0.0000 |
| Log (CO <sub>2</sub> e) | 0.1045      | 0.0724     | 1.4421      | 0.1495 |
| Log (Size)              | -0.0832     | 0.0898     | -0.9261     | 0.3546 |
| Age                     | -0.2188     | 0.0685     | -3.1947     | 0.0014 |

**Table 5:** Fixed Effect Regression Analysis (ROE)

| Variable                | Coefficient | Std. Error | t-Statistic | Prob   |
|-------------------------|-------------|------------|-------------|--------|
| C                       | 18.501      | 1.5431     | 11.989      | 0.0000 |
| Log (CO <sub>2</sub> e) | 0.0201      | 0.0567     | 0.3542      | 0.7232 |
| Log (Size)              | -0.1399     | 0.0704     | -1.9889     | 0.0470 |
| Age                     | -0.1264     | 0.0536     | -2.3577     | 0.0186 |

**Table 6:** Fixed Effect Regression Analysis (ROI)

| <b>Variable</b>         | <b>Coefficient</b> | <b>Std. Error</b> | <b>t-Statistic</b> | <b>Prob</b> |
|-------------------------|--------------------|-------------------|--------------------|-------------|
| C                       | 42.008             | 2.6100            | 16.094             | 0.0000      |
| Log (CO <sub>2</sub> e) | 0.2920             | 0.0959            | 3.0438             | 0.0024      |
| Log (Size)              | -0.3829            | 0.1190            | -3.2181            | 0.0013      |
| Age                     | -0.2194            | 0.0907            | -2.4177            | 0.0158      |

**Table 7:** Wald Test (ROA)

| Test Statistic | Value    | df       | Probability |
|----------------|----------|----------|-------------|
| F-statistic    | 3.698833 | (3,1220) | 0.0115      |
| Chi-square     | 11.09650 | 3        | 0.0112      |

**Table 8:** Wald Test (ROE)

| Test Statistic | Value    | df        | Probability |
|----------------|----------|-----------|-------------|
| F-statistic    | 217.3299 | (3, 1220) | 0.0000      |
| Chi-square     | 651.9898 | 3         | 0.0000      |

**Table 9:** Wald Test (ROI)

| Test Statistic | Value    | df        | Probability |
|----------------|----------|-----------|-------------|
| F-statistic    | 7.580676 | (3, 1220) | 0.0001      |
| Chi-square     | 22.74203 | 3         | 0.0000      |
| Age            |          | -0.030730 | 0.122133    |

**Table 10:** Summary of Hypotheses and Result

| Hypotheses                                                                                                                                      | Types of Data Analysis | Results     |
|-------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-------------|
| <b>H1:</b> There is a relationship between corporate carbon footprint and Return on Equity (ROA) in the manufacturing industry in Malaysia.     | Wald Test              | Significant |
| <b>H2:</b> There is a relationship between corporate carbon footprint and Return on Equity (ROE) in the manufacturing industry in Malaysia.     | Wald Test              | Significant |
| <b>H3:</b> There is a relationship between corporate carbon footprint and Return on Investment (ROI) in the manufacturing industry in Malaysia. | Wald Test              | Significant |