THE NEXUS AMONG TOP MANAGEMENT, ENVIRONMENTAL AND FINANCIAL PERFORMANCE: A COMPARATIVE STUDY OF CHINA, GERMANY AND JAPAN

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ABSTRACT

The traditional business model is not adequately equipped to address sustainable development issues as the former focused purely on profits where performance is evaluated using financial indicators, such as sales, costs, and profits. Society is increasingly discouraged from sacrificing the environment for economic progress as excessive pollution is steadily making the world uninhabitable. Ever since the landmark Paris Accord in 2015, governments, corporations, and other interested bodies have been working together to seek sustainable development paths. The extant literature presents mixed findings (positive and negative between environmental and financial performance), thereby requiring fresh studies to produce reliable and consistent results. Several governments have already introduced regulations to reduce carbon emissions and even establish emissions trading mechanisms. Consequently, environmental and social strategies have become the new tools of business warfare in this context. Corporate board members and management are likely to play an increased policy-making role in the new business competition model. Hence, this study aims at examining the relationship between top management team (TMT), and corporate environmental performance (CEP) and corporate financial performance (CFP). To investigate the nexus among top management, environmental and financial performance, this study followed stakeholder theory and upper echelons theory and applies a positivist approach to understand the environmental and financial factors that critically impact on corporate performance and involve 621 public firms from 2010 to 2018 from Germany, Japan and China. Financial performance was estimated using return on asset (ROA), return on equity (ROE) and Tobin's Q, while the environmental indicators were emissions per sale, environmental, social, and governance (ESG) disclosure, and CSR strategy. The TMT characteristics are measured by Gender diversity, i.e., ratio of a female director and the female executive director, and independent director, and Environmental Committee. Major findings by the study are firms in Germany more likely to hire female directors and independent directors compared with firms in Japan and China. Most companies from Japan (81%) and Germany (68%) have set environmental committees, but only 29.2% of China's firms have an environmental committee. CEP is performed well in firms in Germany and Japan compared with firms in China. The TMT characteristics are beneficial for the CEP (ESG and strategy). The female and independent board director is beneficial for carbon reduction in China but weak and harmful in Germany and Japan. It is not helpful of the Environmental committee on the emissions reduction of firms. The long-term analysis results showed that emissions per sale positively impacts CFP in China's corporate performance, but it is the opposite and exhibits a negative relationship in Germany and Japan. ESG information disclosure positively impacted CFP in all three country samples, while CSR strategy negatively impacted CFP in all three country samples. The emissions per sale positively impacted ROA in the high emissions industries but negatively impacted ROA in low emissions industries. The TMT characteristics negatively impacted CFP in China, but positively impacted CFP in Japan and Germany. The econometric results showed the possible occurrence of different causality in different countries and in different industries pointing to a need for the use of more detailed differentiation of causality variables between countries and industries in future studies. The source of the sample will affect the results suggesting the possible variations between a middle-income country such as China, and high-income countries like Germany and Japan. This study discloses the financial benefits of the company's environmental protection, which will gradually appear in subsequent years, but do not become reflected in the current year's financial statements.

Keywords: Corporate Environmental Performance; Corporate Financial Performance; Carbon Emissions; ESG disclosure, CSR strategy, Top management characteristics.

ABSTRAK

Model perniagan secara tradisional yang menumpukan penilaian prestasi berdasarkan indikator kewangan seperti jualan, kos and keuntungan adalah tidak mencukupi untuk menangani isu pembangunan kelestarian yang mampan. Kesan pencemaran secara berlebihan terhadap keabadian dunia telah mengubah sikap masyarakat untuk mengutamakan kelestarian alam sekitar berbanding pembangunan ekonomi secara tidak terancang. Pemeteraian Paris Accord di tahun 2015 telah menjadi titik perubahan bagi pihak kerajaan sedunia, peniagaan korporat dan badan-badan yang berminat untuk bekerjasama dalam mencari pendekatan untuk pembangunan yang mampan. Sebahagian kerajaan dunia telah memperkenalkan garis panduan dan mekanisme fasilitasi perdagangan untuk mengurangkan pengeluaran karbon. Namun, kajian literatur telah mengenalpasti pandangan yang berbeza mengenai strategi kelestarian korporat yang diperkasakan. Kini, strategi kelestarian korporat digunakan sebagai kaedah terbaharu untuk pegembangan perniagaan. Dengan itu, kajian baru diperlukan untuk mengesahkan dan menghasilkan keputusan yang lebih sahih dan konsisten. Secara dasar, ahli lembaga perniagaan dan pengurusan korporat akan memainkan peranan yang lebih besar dalam penggubalan polisi modal perniagaan yang baharu. Justeru, kajian ini bertujuan untuk menyelidik hubungan di antara pihak pengurusan atasan (TMT), prestasi alam sekitar korporat (CEP) dan prestasi kewangan korporat (CFP). Kajian ini menggunakan pendekatan positivis untuk memahami kesan faktor-faktor alam sekitar serta kewangan terhadap prestasi korporat dengan menganalisa 621 firma-firma awam dari Jerman, Jepun dan China di antara tahun 2010 dan 2018. Prestasi kewangan dianggarkan menggunakan pulangan atas aset (ROA), pulangan atas ekuiti (ROE) dan Tobin's Q manakala penunjuk alam sekitar menggunakan kadar pelepasan karbon bagi setiap jualan, laporan alam sekitar, sosial dan tadbir urus korporat (ESG) dan strategi CSR. Ciri-ciri TMT diukur dengan menggunakan kepelbagaian jantina di dalam ahli lembaga perniagaan, seperti

nisbah pengarah wanita dan pengarah eksekutif wanita, serta perlantikan pengarah bebas dan penubuhan Jawatankuasa Alam Sekitar di dalam firma. Kajian ini telah mendapati bahawa firma-firma di Jerman lebih berkemungkinan melantik pengarah wanita dan pengarah bebas berbanding firma-firma di Jepun dan China. Kebanyakan firma-firma dari Jepun (81%) dan Jerman (68%) telah menubuhkan Jawatankuasa Alam Sekitar tetapi hanya 29.2% firma-firma China yang mempunyai Jawatankuasa Alam Sekitar. Firma-firma Jerman dan Jepun menunjukan prestasi CEP yang lebih baik berbanding dengan firma-firma di China. Ciri-ciri TMT didapati berfaedah untuk CEP (dari segi laporan ESG dan strategi). Walaupun nisbah pengarah wanita serta pegarah bebas memanfaatkan firma-firma dalam usaha pengurangan karbon di China, kesimpulan yang berbeza dan bertentangan telah diperhatikan bagi firma-firma Jerman dan Jepun. Kewujudan Jawatankuasa Alam Sekitar tidak membantu dalam pengurangan kadar pelepasan karbon bagi firma-firma. Keputusan analisis jangka panjang menunjukkan bahawa kadar pelepasan karbon bagi setiap jualan memberi kesan yang positif pada CFP dalam prestasi korporat China, tetapi ia adalah sebaliknya dan mempamerkan hubungan negatif di Jerman dan Jepun. Laporan maklumat ESG diperhatikan memberi kesan positif ke atas CFP dalam ketiga-tiga sampel negara, manakala strategi CSR memberi kesan negatif ke atas CFP dalam ketiga-tiga sampel negara. Kadar pelepasan karbon bagi setiap jualan memberi kesan yang positif pada ROA bagi firma-firma di dalam industri pelepasan karbon tinggi manakala analisis yang sama melaporkan kesan negatif pada ROA bagi firma-firma di dalam industri pelepasan karbon rendah. Ciri-ciri TMT pula memberi kesan negatif ke atas CFP di China, tetapi memberi kesan yang positif bagi firma-firma Jepun dan Jerman. Keputusan ekonometrik menunjukkan kemungkinan berlakunya punca yang berbeza bagi negara dan industri yang berbeza. Sewajarnya, kajian yang lebih terperinci ke atas pembolehubah tidak bersandar (malar), dari segi perbezaan antara negara dan industri, disarankan untuk kajian akan datang.

Berdasarkan sumber sampel kajian, variasi keputusan di antara negara berpendapatan sederhana seperti China dan negara berpendapatan tinggi seperti Jerman dan Jepun adalah dijangkakan. Artikel ini juga mendedahkan bahawa faedah yang diperoleh daripada usaha firma-firma dalam activiti perlindungan alam sekitar tidak akan ditunjukkan dalam penyata kewangan tahun semasa secara serta-merta. Sebaliknya, kelebihan impak kewangan hanya akan diperhatikan secara beransur pada tahun-tahun seterusnya.

Keywords: Prestasi alam sekitar Korporat; Prestasi Kewangan Korporat; Pengeluaran karbon; laporan ESG, strategi kelestarian korporat, ciri-ciri pihak pengurusan atasan.

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AA1000 AS	:	The AA1000 Assurance Standard
ADF	:	Augmented Dickey-Fuller
AIC	:	Akaike information criterion
ARDL	:	Autoregressive Distributed Lag
ASX	:	Australian Stock Exchange
Bsize	:	Board Size
CalPERS	:	California Public Servants Retirement System
CalSTRS	:	California Teachers Retirement System
CDIA	:	CSR Directive Implementation Act
CEO	:	The chief executive officer
CEP	:	Corporate Environmental Performance
CFP	:	Corporate Financial Performance
COM	:	Environment Committee
CSR	:	Corporate Social Responsibility
ECT	:	Error Correction Term
EGE	:	Executive Gender Diversity
EIDSRP	:	Environmental Information Disclosure System Reform Plan
EMI	:	Emission Per Sale
EMP	:	Environmental Management Performance
EOP	:	Environmental Operational Performance
EPA	:	Environment Protection Agency
ESG	:	Environment, Social and Governance
ETS	:	Emissions Trading System
EU ETS	:	European Union Emissions Trading System

FE	:	Fixed Effect
FMOLS	:	Panel Fully Modified Least Squares
Fsize	:	Firm Size
FYP	:	Five-Year Work Plan
GDP	:	Gross domestic product
GEN	:	Gender Diversity
GHG	:	Greenhouse Gas
GRI	:	Global Reporting Initiative
I(0)	:	The unit root test stationary at level
I(1)	:	The unit root test stationary at first difference
IMF	:	International Monetary Fund
IND	:	Independent Director
IPCC	:	Intergovernmental Panel on Climate Change
IPS	:	Im Pesaran and Shin
ISAE	:	International Standard on Assurance Engagements
JVETS	:	Japan's Voluntary Emissions Trading Scheme
KLD	:	Kinder, Lydenberg and Domini
KPIs	:	Key Performance Indicators
LLC	:	Levin, Lin and Chu
MEE	:	Ministry of Ecology and Environment
MSCI	:	Morgan Stanley Capital International
NASA	:	National Aeronautics and Space Administration
NDC	:	Nationally Determined Contributions
NDC	:	Nationally Determined Contribution
NGO	:	Non-governmental Organization
OLS	:	Ordinary least squares

PP	:	Phillips–Perron
PwC	:	PricewaterhouseCoopers
RE	:	Random Effect
ROA	:	Return on Asset
ROE	:	Return on Equity
ROS	:	Return on Sales
ROSI	:	Return on Sustainability Investment
SASAC	:	State-owned Assets Supervision and Administration Commission
SASB	:	The Sustainability Accounting Standards Board
SBF	:	Société des Bourses Françaises 120 Index
SE	:	Standard Errors
SEEE	:	Shanghai Environment and Energy Exchange
TMT	:	Top Management Team
UK	:	United Kingdom
UNFCCC	:	The United Nations Framework Convention on Climate Change
US	:	United State
VIF	:	Variance inflation factor
WRI	:	World Resource Institute

CHAPTER 1: INTRODUCTION

1.1 Background of study

Global warming and air pollution can result in severe environmental changes (see Figures 1.1 and 1.2). Climate change is leading to more frequent natural disasters (van Aalst, 2006), increased diseases (Datar et al., 2013; Schraufnagel et al., 2018), reduced labour productivity (Chavaillaz et al., 2019), and has enhanced the cumulative expenses of countries (Rasiah et al., 2017). In recent years, the concept of sustainable development has been an issue of growing interest to national governments, universities and other NGOs (non-government organizations) (Suzuki & Tanimoto, 2005).

Firms make more contributions to environmental issues as firms face increased environmental issues regarding social responsibility (Molina-Azorı´n et al., 2009). Especially after The United Nations Framework Convention on Climate Change (UNFCCC)[1] (1992), the Kyoto Protocol[2] (1997) and the Paris Agreement[3] (2015) were formed, many countries have shown more concern about climate change. These two agreements have been established as incentives for countries to reduce carbon emissions. Environmental factors are becoming increasingly critical when governments and

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[1] The United Nations Framework Convention on Climate Change (UNFCCC) is an international system that for global environment. Lots of countries signature in the Earth Summit in June 1992. The object of this organization is reduced greenhouse gas emissions and protect the atmosphere from human activities, "stabilize greenhouse gas concentration in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system".

[2] The Kyoto Protocol is an international pact that expand from the UNFCCC, this treaty requires countries to reduce greenhouse gas emissions based on two reasons, first is the global warming in last decades, second is this phenomenon is caused by human activities. Since signing and ratifying the protocol, German target is reduce carbon emissions to 21% in 2012, 40% in 2020, 55% in 2030 and 95% in 2050, based on 1990 levels. (https://en.wikipedia.org/wiki/German_response_to_Kyoto_Protocol#cite_note-2, https://www.cleanenergywire.org/factsheets/germanys-greenhouse-gas-emissions-and-climate-targets).

[3] The Paris Agreement is also lunched to decrease the carbon emissions by UNFCCC in 2016. From this agreement, China will reduce carbon emissions of 60% to 65% in 2030 based on 2005 level. (https://chinapower.csis.org/china-greenhouse-gas-emissions/)

Japan has promised to mitigate carbon emissions by 26% until 2030 in Paris Agreement.

policymakers make economic policies (Furuoka, 2016; Furuoka, 2015). Regulations and laws are established in different countries to reduce firms' carbon emissions. Carbon markets were formed in recent years for carbon emissions trading between countries and firms, including Japan's Voluntary Emissions Trading Scheme (JVETS) and the European Union Emissions Trading System (EU ETS) was founded in 2005. Furthermore, China has also established the Chinese national emissions trading scheme (ETS), which started trading in July 2021.

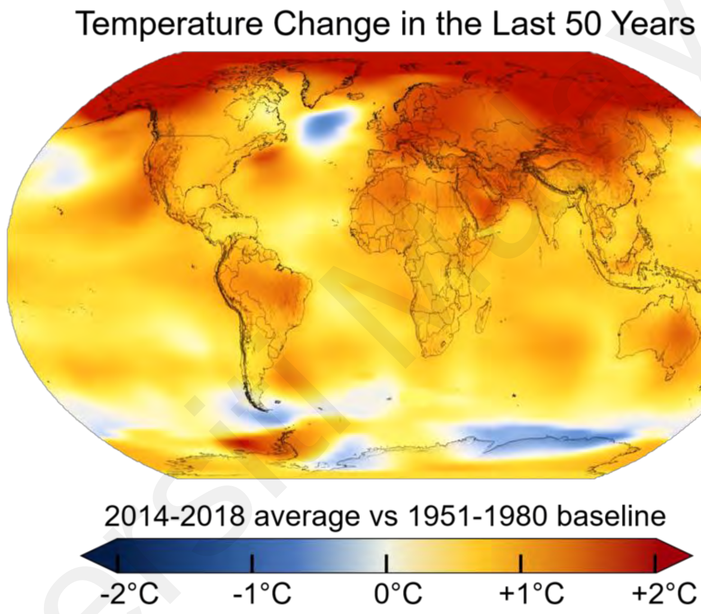

Figure 1. 1 Temperature change of last 50 years

Source: NASA (National Aeronautics and Space Administration)

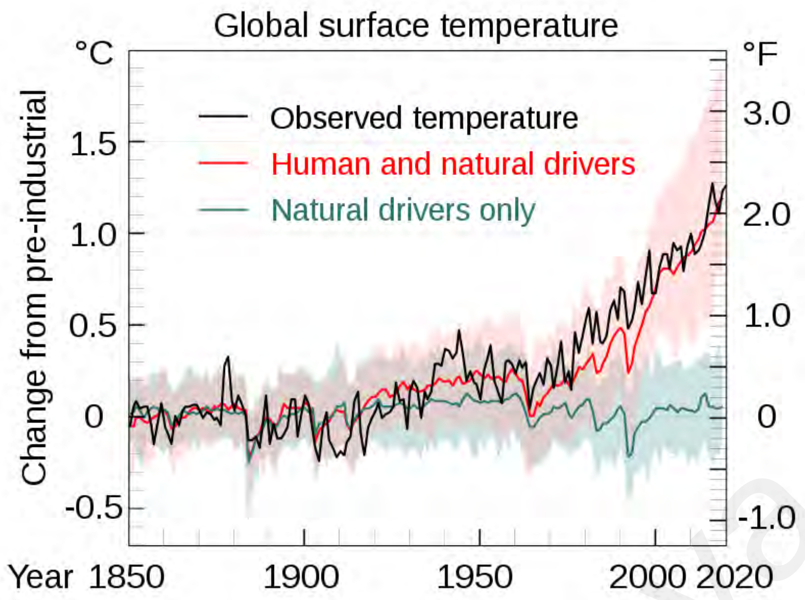

Figure 1. 2 The average annual temperature of the earth's surface

Source: NASA (National Aeronautics and Space Administration)

Figure 1.3 showed that from the Climate Action Tracker Prediction, which is based on national policy and begins the pledge starting from May 2021. It is an indication that without implemented climate policies, a resultant estimation of a 4.1 to 4.8°C warming would be expected by 2100 (relative to pre-industrial temperatures); a warming of 2.8 to 3.2°C by 2100 based on current implemented climate policies; if all countries achieve their current targets/pledges set within the Paris climate agreement, the estimated average warming by 2100 will be 2.5 to 2.8°C. It will go well beyond the overall target of the Paris Agreement to keep warming "well below two °C".

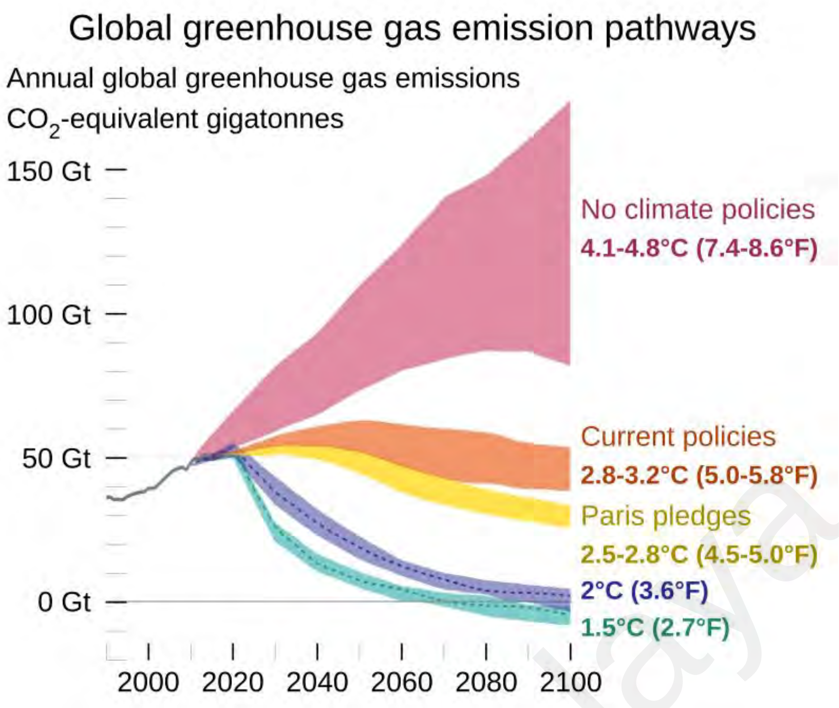

Figure 1. 3 Global GHG emission pathways

Source: Climate Action Tracker

As Figure 1.3 showed, the policy is more important concerning carbon emissions and decreases the Earth's Surface Temperature. Responsible countries have issued carbon emissions reduction policies and declarations. In May 2019, the UK was the first national government to declare a national climate emergency, followed by declarations by other countries and jurisdictions. Furthermore, the EU Parliament declared a "climate and environmental emergency" in November 2019, and the EU presented its European Green Deal intending to make the EU carbon-neutral by 2050. Major countries in Asia have made a similar pledge, South Korea and Japan have committed to carbon neutrality by 2050, and China by 2060 as part of the global effort to slow global warming and meet the goals of the Paris Agreement on climate change (X. Wei et al., 2022). The Nationally Determined Contributions (NDC) synthesis report includes information from all 191 parties to the Paris Agreement as of 30 July 2021, including information from 86 updated NDCs by 113 parties. For 113 parties with updated NDCs, greenhouse gas emissions are estimated to decrease by 0.5% compared to 2010. Furthermore, the Intergovernmental

Panel on Climate Change (IPCC) estimated that limiting global average temperature increases to 1.5 Celsius requires a reduction of CO_2 emissions of 45% in 2030 or a 25% reduction by 2030 to limit the global warming to 2 Celsius (UN Climate Press Release, 2021)[4].

The social responsibility of listed companies has always been a focus of attention in academic and practical circles (Y. He et al., 2017; Xu et al., 2007). With the continuous improvement of China's laws and regulations on environmental report requirements, the awareness to fulfil any social responsibility is also constantly changing, as are the enterprises that are more likely to disclose social responsibility reports (Elsayed & Paton, 2005; Rao & Tilt, 2016). Financial performance reflects four aspects such as an enterprise's profitability, asset quality, debt risk and operating growth within a certain period. According to the stakeholder theory, some scholars believe that corporate social responsibility will affect stakeholders' interests, and stakeholders will also affect the financial performance of companies. Therefore, there is an inseparable relationship between corporate social responsibility and financial performance (Galant & Cadez, 2017; McWilliams & Siegel, 2000; Simionescu & Dumitrescu, 2014). Firms with reasonable social responsibilities establish a good social image, conducive to obtaining more resources, such as the procurement resources of customers and investment resources of investors, thereby improving the financial performance of enterprises (Rika & Jacobs, 2019; Singh & Misra, 2021).

The traditional business model is not adequately equipped to address sustainable development issues as the former focused purely on profits where performance is

[4] UN Climate Press Release. (2021, September 17). Full NDC Synthesis Report: Some Progress, but Still a Big Concern. Retrieved from https://www.unfccc.int/news/full-ndc-synthesis-report-some-progress-but-still-a-big-concern

evaluated using financial indicators, such as sales, costs, and profits. Traditional business models emphasize profits and leave accountability to the business owners. This model has since been challenged as global governance has shifted to recognize the environment as a globally common issue so as to emphasize the regulation of climate change and global warming. Consequently, the growing importance of the green economy has increasingly imposed penalties on companies ignoring environmental performance to focus solely on financial performance (Grace & Odoemelam, 2018). Based on the original intention and purpose to create profits and develop, companies are also evaluated as successful by financial indicators, such as sales, costs, and profits. This business model generates profits and is only accountable to the business owners (Carter et al., 2007; Chams & García-Blandón, 2019; Gilley et al., 2000). Although now, this model faces challenges in a new competitive environment. The increasing shift to environmental greening has attracted major roles for external stakeholders in the management of corporations, such as governments, universities, and civil society organizations. Corporations have since strengthened their focus on sustainable environmental images for their operations. External stakeholders are more likely to care about corporate social and environmental responsibility than in-house managers. The role of external stakeholders can raise environmental performance as its absence can attract government fines, lost customers, legal issues and loss of reputation, which in the long run will increase corporate financial risk. These pressures imposed governments, NGOs, and the local community can force firms to establish a sustainable path that takes both corporate finance and social responsibility into account. The rise of the green economy threatens companies that ignore outside stakeholders and instead strictly pursuing profits, which will prove to be detrimental (Li et al., 1997).

Society is increasingly discouraged from sacrificing the environment for economic progress as excessive pollution is steadily making the world uninhabitable. Ever since the landmark Paris Accord in 2015, governments, corporations, and other interested bodies have been working together to seek sustainable development paths. Furthermore, climate change is a challenge for the world, especially for high greenhouse gas (GHG) emissions countries, most of whom have pledged to achieve carbon neutrality between 2050 and 2060. Companies' mix of energy consumption, (especially the shift from fossil fuels to renewable energy), and environmental governance are essential for sustainable development. National policies are increasingly imposing mandatory controls on the social responsibility of companies, which include carbon reduction and pollution-free goals. These developments are forcing corporations to disclose critical environmental practices in their annual reports (e.g., corporate social responsibility report). As Figure 1.4 indicates, in the traditional corporate business model, firm managers care more about the related financial element (Finkelstein & Hambrick, 1990; Ma et al., 2021). Top managers only respond to the shareholders and focus on the stakeholders related to corporate finances (Jan et al., 2019; Q. Tang & Luo, 2016). To increase profit, managers focus on investments from shareholders and creditors, revenue from customers, the high productivity of employees for products, and reducing costs through negotiations with suppliers (He et al., 2019; Rosa et al., 2019). Few managers care about outside stakeholders, such as the local community and governments, who emphasise environmental and social performance; the reason is due to traditional mindsets, as environmental and social performance is not beneficial for firm financial performance (Braschel et al., 2014; Francoeur et al., 2017).

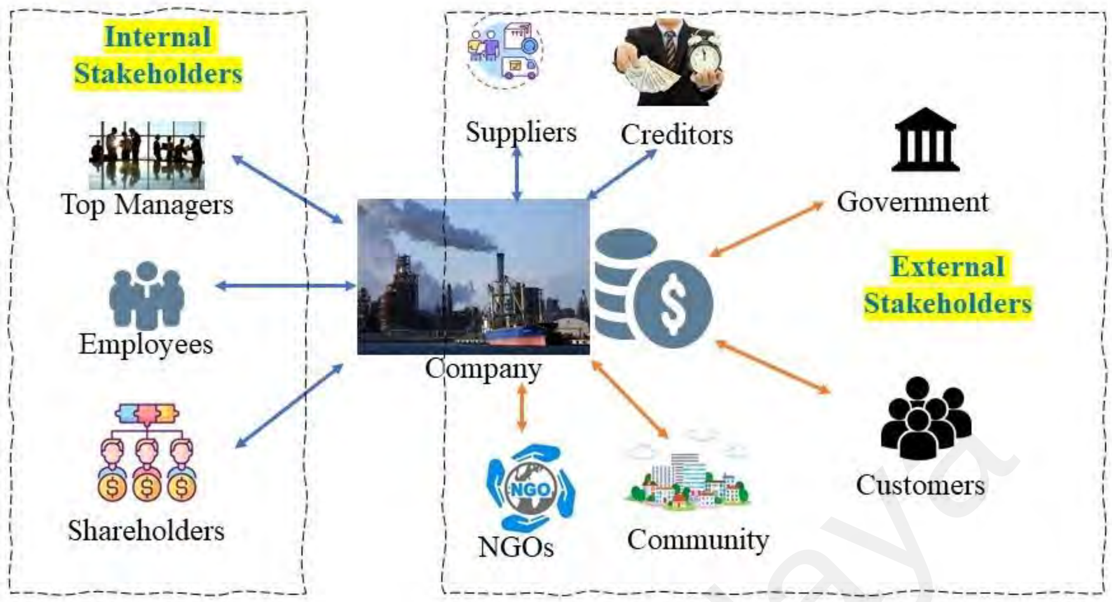

Figure 1. 4 Internal Stakeholders and External Stakeholders

Now, the business market context has changed in the last few decades; customers are more likely to purchase low-carbon products. The low carbon products design is a significant competitive advantage for the future (Liu et al., 2018; Tian et al., 2019). Customer reactions to carbon reductions in products is significant for firm financial performance (Rokhmawati et al., 2017); the green progress is an advantage to building loyalty relationships between firms and customers (Naidoo & Gasparatos, 2018). Governments also play a strict role in corporate business progress as governments form the laws and regulations that can impose fines on companies that violate these laws and regulations (Romero et al., 2018). The environmental problems and carbon emissions are critical indicators for sustainable development. External stakeholders such as the government, the public, and NGOs increase identity with green environmental protection (Li et al., 1997; Macaulay et al., 2017). Recently, outside stakeholders care more about the corporates' social and environmental responsibility performance.

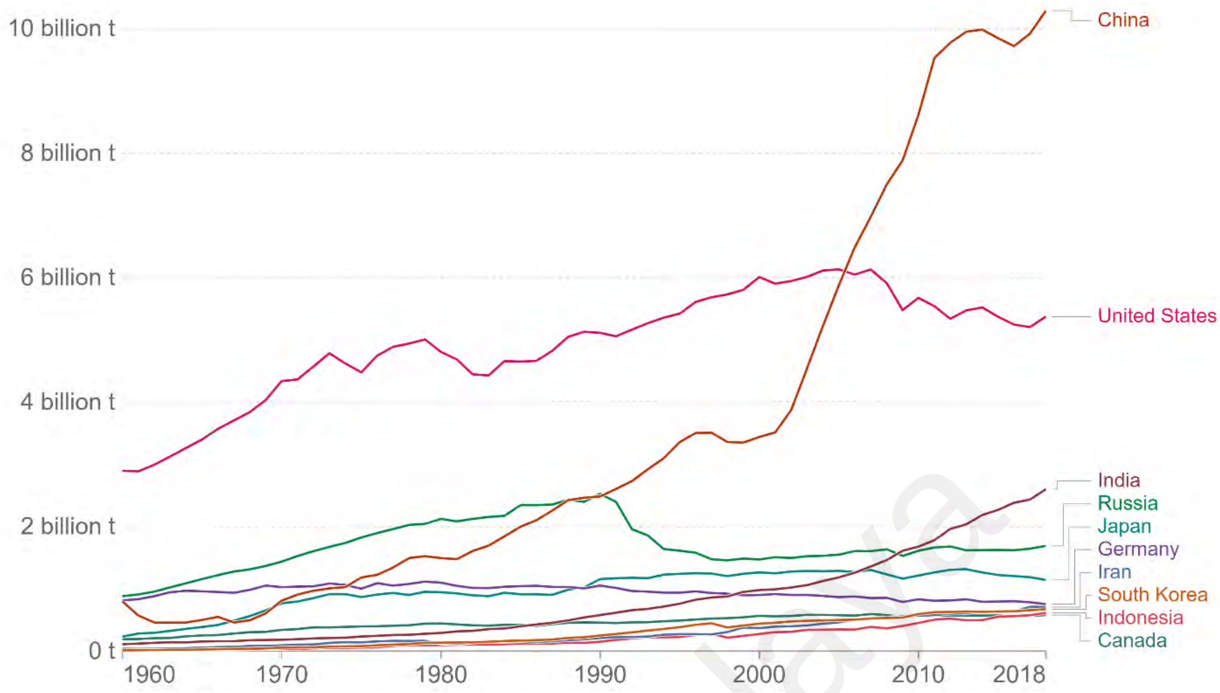

Figure 1. 5 Top ten CO2 emissions countries

Source: World Bank

The corporate business operation involves a significant aspect of carbon emissions that lead to climate change. In the short term, many people do not intuitively feel the consequences of the corporate impact on climate change. According to the World Resource Institute (WRI), Climate Watch and Data from the World Bank, As Figure 1.5 demonstrates that China has been indicated to be the largest emissions producing country at approximately 10313 MtCO2e[5] in 2018, Japan was ranked fifth with an estimated 1106 MtCO2e in 2018, and Germany was Ranked sixth with a calculated 710 MtCO2e 2018. Contrastingly, the emissions rate is not prominently related to Germany and Japan; although after entering the 21st century, China has significantly increased carbon dioxide emissions. This study selected the top 5 GDP countries worldwide (US, China, Japan, Germany and UK). The UK's carbon emissions rank around seventeenth, and were

[5] MTCO2e = Million Tons of Carbon Dioxide Equivalent

excluded from our sample; During Trump's 2016 election campaign, Trump promised to revitalize environmental regulations that have hampered the coal industry, according to his claim. So, because of the unstable Environment Coping Mechanisms that will affect the reliability of our data; this study excludes the USA. As such, China, Japan and Germany remain.

US President Biden initiated the Leaders' Climate Summit that was held online on Earth Day (April 22, 2021). Collectively, these countries emit more than 80% of the world's greenhouse gases and create more than 80% of the world's GDP. This summit aimed to mobilize all countries (massive economies and emitters) to propose more ambitious goals for reducing greenhouse gas emissions. China proposed to reach a carbon peak in 2030 and achieve carbon neutrality in 2060. Japan proposed to reduce greenhouse gas emissions by 45%–50% from 2013 levels in 2030. Germany and Japan promise that they will achieve carbon neutrality in 2050. In this case, the ETS is an essential market-based energy saving and emissions reduction policy tool that aims to reduce carbon emissions through market functions, reduce energy consumption and atmospheric carbon concentration, and promote industry and energy structure optimization. Carbon emissions units are afforded to industries, such as power companies and factories, and can be obtained as one-year carbon emissions permits from the government. If carbon emissions are reduced through technological upgrades or other measures during the year and the allowances are redundant, they can be sold on the trading market. If carbon emissions exceed the allowable limit during the year, firms can also buy the required allowance in the trading market. So, carbon emissions reduction will benefit firms, especially for high carbon emissions industries.

On the other hand, to meet the evolving information needs of investors, better manage non-financial performance, and respond to environmental and social risks, many stock exchanges or regulatory agencies have introduced ESG information disclosure requirements for listed companies (Petitjean, 2019). Some exchanges have also introduced ESG information disclosure guidelines. For example, Germany guides listed companies to disclose ESG information, and the German Stock Exchange provided the "ESG Practice Guidelines 2013". The existing international ESG report assurance standards are ISAE3000, "Assurance services other than the audit or review of historical financial information", and the AA1000 standard[6] established by AccountAbility. In 2013, the State-owned Assets Supervision and Administration Commission (SASAC) in China began to require all listed enterprises to issue CSR reports. The Shanghai Stock Exchange also requires companies in the corporate governance sector, companies with foreign shares listed overseas, and financial companies to issue CSR reports.

According to the research report of Standard Chartered Bank on June 10, 2021[7], "Countdown to Zero Carbon", multinational companies believe that 79% of their Chinese supplier partners have made good or very good progress in carbon transformation, ranking first in the surveyed market (Jiahua, 2020). "Zero Carbon Countdown" surveyed 400 multinational companies worldwide to explore the risks and opportunities faced by suppliers in emerging markets and rapidly developing markets as large companies transition to net zero. The report showed that in the process of decarbonization, multinational companies were expected to replace 35% of existing suppliers globally.

The priority of firms is profit, and many top managers are unwilling to increase costs for environmental governance. In this case, the outside stakeholders, such as governments, customers, investors, and NGOs, play a critical role in forcing firms to

[6] The AA1000 Assurance Standard (AA1000 AS) is a standard for assessing and strengthening the credibility and quality of an organisation’s social, economic and environmental reporting.

[7] Standard Chartered, Zero Carbon Countdown" survey report, June 10, 2021.

consider social and environmental performance under regulations. Firms have more pressure to enhance the environmental and social performance under the strict environmental policy from the government. Corporate managers thought that increasing environmental strategies would increase costs and reduce profits (H. Khan et al., 2020; Krüger, 2015). However, others argue that firms with good ESG information disclosure and CSR strategies will attract more investors and build customer loyalty, which benefits long-term corporate development (Abba et al., 2018; Q. Li et al., 2019).

In 2014, the European Union launched the "CSR Directive Implementation Act (CDIA)". This act was enacted into German national law in October 2014, requiring firms to disclose information about social, economic and environmental topics[8]. Japan had established environmental information-related disclosure rules many years prior and has corresponding laws on internal governance. However, the formulation of ESG integration rules is relatively late, and ESG disclosure by listed companies still adheres to a voluntary principle. Companies are encouraged to disclose ESG information mainly through market incentives. Japan uses pension fund investment as a financial guide to invest in listed companies with better ESG performance, encourage them to disclose ESG information actively, and strengthen ESG governance. China also established the ETS for carbon trading, and the new laws "Environmental Information Disclosure System Reform Plan" was issued by the Ministry of Ecology and Environment in May 2021. The Environmental Information Disclosure System Reform Plan (EIDSRP) that enforces enterprises' fulfilment of their statutory obligations of compulsory disclosure of environmental

[8] German Council for Sustainable Development. News: German Bundestag Passes Law Introducing CSR Reporting Obligations. Available online: https://www.nachhaltigkeitsrat.de/en/news/german-bundestagpasses-law-introducing-csr-reporting-obligations/ (accessed on 25 October 2018).

information shall be boosted, the public's right to know shall be guaranteed, and enterprises' lawful rights and interests shall be protected.

Investigations among the Fortune 500 companies showed that companies with the highest percentage of women in management provide shareholders with a 34% higher return on investment than those with the lowest percentage. For economies, the Goldman Sachs Group's report points out that eliminating gender inequality in employment has a massive impact on the global economy: If gender equality is achieved, the US GDP will increase by 9%, the Eurozone will increase by 13%, and Japan will increase by 16%. The World Economic Forum's 2014 Global Gender Gap Report pointed out that when the number of women participating in political decision-making reaches a certain threshold, their decisions based on broader social needs will be more inclusive. It also points out that females are more considerate of social and environmental problems. Firms will have more voice for social and environmental problems if more female directors are on the board (Wu, Furuoka, & Lau, 2021).

Independent directors are a significant motivation to perform their supervision and advice functions. Independent directors' deep-rooted ethics can prompt them to pay more attention to the ethics of corporate behaviour when performing their duties, thereby enhancing the performance of corporate environmental responsibilities and improving the company's environmental performance.

PwC's "2020 Annual Corporate Directors Survey" found that only 38% of board members believe that ESG issues will impact the company financially. Nonetheless, institutional investors such as Black Rock and State Street Global Advisors and significant asset owners such as the California Public Servants Retirement System (CalPERS) and California Teachers Retirement System (CalSTRS) are paying more attention to ESG performance. Corporate CEOs have also joined this camp. In August

2019, the business roundtable declared that the corporate mission was a broad and influential embrace of positive ESG behaviour. It required the board of directors to implement corporate ESG performance. Board members should ensure that the company has formulated a sustainable development strategy integrated into the company's business strategy and key performance indicators (KPIs) that are consistent with the critical reporting standards. The critical reporting standards have been integrated into the work plan and compensation and are guaranteed by a third party. The Sustainability Accounting Standards Board (SASB) provides unified reporting standards. Still, it will be customized according to the industry to designate major ESG issues, allowing directors and investors to monitor and track company concerns on major ESG issues. Board members should also require the senior management team to report on the financial impact of their ESG investments, including risk aversion and risk aversion based on models such as the Return on Sustainability Investment (ROSI) method of the New York University Stern Center for Sustainable Business. Intangible and tangible benefits such as employee retention and operational efficiency. Ensuring good performance on major ESG issues is the fiduciary responsibility of the board of directors and is essential to investors and the public. It helps achieve strong, long-term financial performance; in a world increasingly suffering from ESG-related crises, value meaning is also crucial.

China is the top carbon emitter globally. The Chinese government stated that China will reach a carbon peak in 2030 and achieve carbon neutrality in 2060, so Chinese corporations should face the pressure that balances environmental and economic goals to pursue sustainable development. One of the successes of environmentally friendly countries in Asia is Japan, in the top ten of the carbon emitting countries, but corporate environmental performance is worth learning. In the context of Japan's Voluntary Emissions Trading Scheme (JVETS), the carbon emissions reduction of listed firms in Japan has been well implemented. The EU ETS provides solid support for German firms to disclose carbon emissions and control emissions during the production process. This study will investigate why many German and Japanese brands and firms are famously successful worldwide and whether environmental performance plays a role in this success.

On the other hand, different countries exhibit different cultures. In Germany, as long as the board of directors of a listed company has more than three members, it must have a female director. For companies in which the Federation holds a majority stake, the rules are stricter: as long as the leadership consists of two or more members, one must be a woman. In recent years, promoting gender equality in the economic field has focused on the German government's work. In 2015, Germany passed a bill requiring that 30% of supervisory boards of large listed companies with more than 2,000 employees be female members.

Japanese companies face increasing international pressure, demanding that more women be promoted to positions of power. The Tokyo Stock Exchange will implement new regulations in 2022, prompting top listed companies to ensure diversification, including promoting women, which will align the Tokyo Stock Exchange with other major stock markets. These efforts in Japan aim to overcome a problem: political and business leaders have failed to deliver on their promise to increase opportunities for women in Japan for decades. They face some of the worst inequalities in developed countries. Due to the limited number of candidates, Japanese companies often complain that they cannot find enough qualified female candidates to fill the vacancies on the board of directors. In Japanese listed companies, government statistics showed that only 6% of directors are women, while the proportion of US Fortune 500 companies is about one-quarter.

Nevertheless, Japan still needs to make significant progress to make up for its unfulfilled promises. In 2003, the Japanese government announced that by 2020, women would occupy 30% of all senior management positions (that is, corporate vice presidents and above). Although no progress has been made in fulfilling the pledge, Shinzo Abe solemnly renewed his pledge after becoming prime minister in 2012 as part of his so-called economic plan for women to "glow." 2020 has been reached and although Japan has made some progress, it is still more than one and a half short of achieving its goals.

Compared with developed countries in Europe and America, the proportion of Chinese women leaders in business and politics is much lower than that of men. A study jointly conducted by the International Monetary Fund (IMF) and LinkedIn showed that Chinese women in most emerging industries have been generally low. The proportion of decision-making women in economic and commercial fields is minimal. The proportion of female directors in listed companies in China has increased over the past ten years; however, the number of female directors is still relatively small, making company Governance biased towards male thinking. There is still room for improvement in the efficiency and effectiveness of corporate decision-making[9].

With the increase of female directors and Independent directors, firms are more likely to disclose ESG information with regard to outside stakeholders' interests (Pucheta-Martínez et al., 2019; Rao & Tilt, 2016). Female directors help bring forth multiple viewpoints and prepare long and careful discussions in decision-making from the standpoint of different values and interests. Female directors may help improve a firm's ability to make decisions that improve environmental performance, including emissions reduction, resource reduction and product innovation (Birindelli et al., 2019;

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[9] Nankai University's "Report on Female Directors in China's Listed Companies in 2020"

Wasiuzzaman & Wan Mohammad, 2019; Wu, Furuoka, & Lau, 2021). The unique knowledge, experience and others aspects of a female director and independent director are beneficial for approach to the CSR and information disclosure (García-Meca et al., 2018).

The pressure to enhance the presence of female directors seems to be an ongoing global issue. Several countries have started adopting legislative or voluntary initiatives to promote female representation on corporate boards. For example, Norway (40 % gender quota for female directors or face dissolution), Sweden (25 % voluntary reserve for female directors or threat to make it a legal requirement), Spain (comply-or-explain type law requiring companies to reach up to 40 % female directors by 2015), France (the law which requires 50 % gender parity on the board of every public firm by 2015) (Rao & Tilt, 2016).

Exploiting the employment potential of women has become a necessary measure to enhance the stamina of China's economic growth. According to Goldman Sachs research, if the female labour force participation rate in Japan rises to the same level as that of men, GDP will be boosted by 10%. For companies, the significance of promoting gender diversity has long gone beyond pure gender equality and is closely related to business efficiency and value enhancement. According to a report released by Credit Suisse Research Institute in 2020, companies with women on the board of directors have better stock market performance. This positive correlation has become more apparent in the past decade. This study investigates the characteristics of board directors' impact on corporate financial performance that incorporate sustainability development.

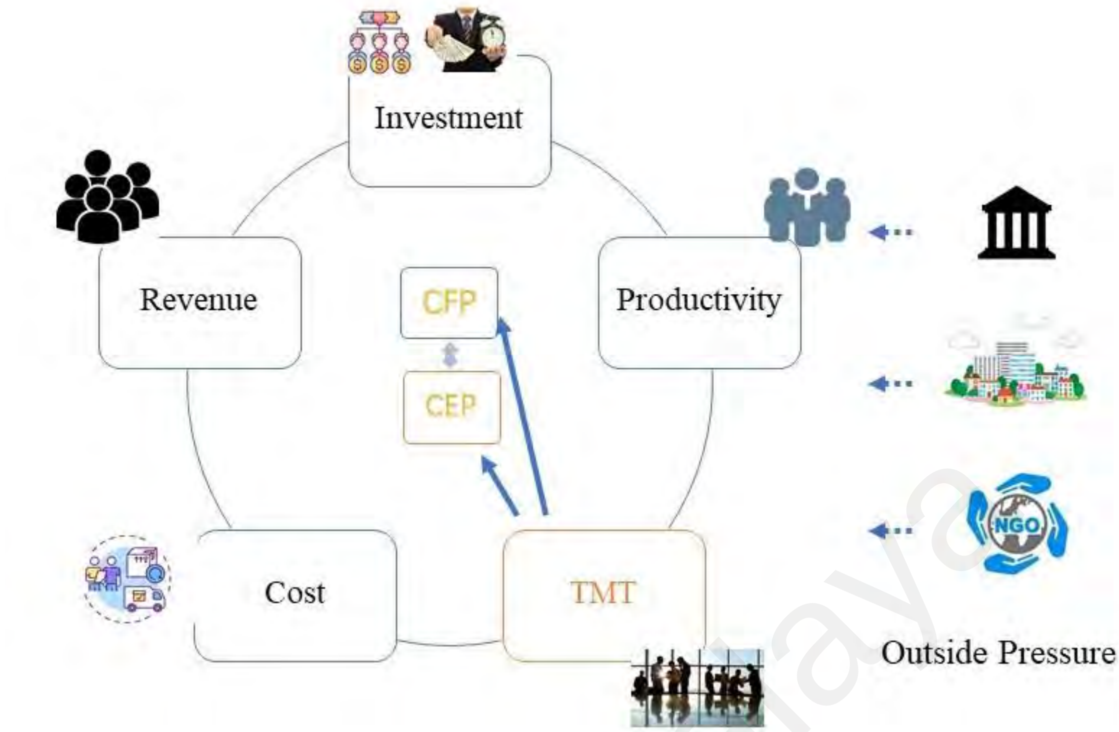

Figure 1. 6 The new Business Model

There are cognitive differences in ethical codes between female and male directors. According to gender socialization theory, women are considered as more prone to make a society-oriented decision and foster joint development; men care more about personal achievement (Carlson, 1972; Dawson, 1997). Females on the board are more likely to exhibit characteristics such as cautiousness, submissiveness, and compassion. Males consistently exhibit agentic goals that promote hierarchy and competition; however, female personal traits look for society's welfare (Radtke, 2000). Due to these characteristics of the female working perspective, women are more proactive in deciding on social and environmental strategies (Atif et al., 2020). Independent directors promote both "shareholders" and other "stakeholders", so independent directors on the board will increase the transparency and information disclosure (Cucari et al., 2017). Usually, independent directors do not have any interest in the firm and provide an integrity judgement concerning firm decisions, especially with regard to the social and environmental strategies (Cuadrado-Ballesteros et al., 2015). Independent directors on the board from outside and part-time directors do not have close ties to the firm; they can be more considerate of stakeholders' interests when making decisions (Z. Liao et al., 2019). Female directors and independent directors on the board are more likely to focus on social and environmental performance due to the high responsibility on the outside stakeholders.

The primary purpose of the firm is profit in the old business model, but now the customers care more about the firm's environmental and social responsibility. Due to climate change, the government issued many carbon limit policies (Bebbington & Larrinaga-Gonzaléz, 2008; Hoffman, 2005). Firms must adapt to these policies to avoid risks and fines for not following the new rules (I. M. García-Sánchez et al., 2019; Post & Byron, 2013). Enterprises need to maintain a sustainable and environmentally friendly image in production and operation (Clarkson et al., 2015). External stakeholders are more likely to care about corporate social and environmental responsibility (Delmas, 2001; Stefan & Paul, 2008). Companies may face environmental issues that lead to other issues, such as government fines, lost customers, legal issues and loss of reputation; these issues will further increase corporate financial risk. Under government pressure, the NGOs, and the local community, firms should look for a sustainable path that considers corporate finance and social responsibility.

Financial performance, which incorporates elements such as revenue and profit, no longer functions as the only pursuit or condition for the survival and development of an enterprise. Firms are responsible for fulfilling the environmental and social requirements of external stakeholders (Braam et al., 2016). Regulations and laws require firms to improve environmental performance and provide the disclosure of more environmentally related information. A greater diversity of board members will be a vital force in driving businesses to adapt to the new model. Female and independent directors from the outside can incorporate new knowledge to improve firm social and environmental performance as well as add value (Post et al., 2011).

The composition of the relationship between corporate environmental performance (CEP) and corporate financial performance (CFP) is one of the most confusing phenomena concerning firm research and the natural environment (Adegbite et al., 2019). The traditionalist view involved the position that the high standard of environmental and social requirements would increase corporate costs and that the firm would need to sacrifice the economics for environmental protection (Ben Lahouel et al., 2020; C.-J. Chen et al., 2018). In addition, the increase of environmental expenditure would increase the cost of products and decrease the company's competitiveness (Palmer et al., 1995; Walley & Whitehead, 1994). The conventional view thought that the strict policies of corporate environmental requirements would change the work focus and primary responsibility of corporate managers, which is to pursue profit for shareholders (Friedman, 1970).

Another contrasting view is that the old business model is no longer suitable for today's development. The strict CSR requirement and environmental practice will reduce waste of materials and energy consumption which may be beneficial for reducing cost (Pereira-Moliner et al., 2015). Well-designed environmental strategies may help a firm achieve a "win-win" situation by stimulating innovation (Ben Lahouel et al., 2020). Increased CSR performance also avoids government penalties for companies due to environmental pollution, increases reputations, attracts customers and creditors, and increases sustainable financial benefits.

Good corporate management is more helpful in increasing environmental and financial performance. The impact of TMT (top management team) characteristics (such as female directors, independent directors, and ecological committees) has proven beneficial for the environmental performance of firms (Aldamen et al., 2016; DiMaggio & Powell, 1983; HAYNES & HILLMAN, 2010; Hillman & Dalziel, 2003). Some female firm directors care more about social performance, such as Global Reporting Initiative (GRI) disclosure, carbon emissions, strong ethics, and ESG performance (Wu, Furuoka, & Lau, 2021). Independent directors from outside can bring new knowledge to improve board performance and add firm value (R. B. Adams & Ferreira, 2009; Dulewicz & Herbert, 2004).

1.2 Problem statement

Human activities cause environmental pollution (Casazza et al., 2017; B. Lin & Jia, 2019; S. Tang & Demeritt, 2018), especially when business operations play an essential role in environmental pollution and global warming. The change for the modern business is that firms need to balance the CSR performance and the main target (financial performance). Two different opinions are formed in this case. Shareholders and most executive directors thought that the burden is greater for firms during the emissions cutting process, the disclosure of environmental information, and improved corporate CSR strategies (Johansson et al., 2015; Tabata et al., 2017). On the other hand, some directors and researchers agree with the green business model. The environmentally friendly business model will attract investors and customers; furthermore, it will benefit corporate finance in the long term. This view is consistent with the stakeholder theory. Stakeholder management theory refers to business manager management activities to comprehensively balance various stakeholder interests (Chams & García-Blandón, 2019; Pita et al., 2020; Sanda et al., 2011). Compared with traditional shareholder supremacy, this theory establishes that the development of any company is inseparable from the input or participation of various stakeholders, and a company pursues the overall interests of stakeholders, not just the interests of certain subjects. It is a big challenge for firms to balance the economic target and social responsibility target. According to the upper echelon theory, the cooperation of managers and relevant professional perspectives are required in this process, the idea that top executives view their situations through their own highly personalized lenses. The individualized construal of strategic situations arise because of differences among executives with respect to their experiences, values, personalities and other human factors. There is a lot of evidence that has shown that female directors and independent directors are more careful about the interests of outside stakeholders; most of them argue that social responsibility is also an indicator that cannot be ignored (Cavaco et al., 2017; Terjesen et al., 2016; Yang et al., 2019).

According to the "2007 National Public Environmental Awareness Survey Report" issued by the Chinese Academy of Social Sciences, as environmental pollution has become a severe social problem in China, the Chinese public's environmental protection value orientation has generally been increasingly strict. The importance and necessity of environmental protection has increased public awareness. At the same time, this awareness of environmental protection is still low and is mainly reflected in the fact that the public's active safeguarding of environmental protection is low, especially in the instance when there may be no major environmental pollution problem in the region, the public's awareness of environmental protection awareness is lower. On the issue of environmental pollution, people are more aware of environmental protection issues from the perspective of those affected by environmental pollution incidents rather than from the perspective of active agents of environmental protection (Fang & Guo, 2018).

In the case of Germany, firms will get a certificate with good CSR performance, which will reduce their tax base by the amount spent (Galetska et al., 2019). Companies consider CSR performance an advantage in Germany. The first successful firm was the large pharmaceutical establishment Betapharm. Citizens, consumers and investors demanded high standards from the business enterprises and their products and required corporate social responsibility (Jonker et al., 2010). The customers in Germany care more about positive CSR performance when they choose products (J. J. Singh et al., 2012). A greater CSR performance will increase customers' purchase intentions (Katharina, 2014).

Japanese companies followed the US and Europe so these firms are more aware of CSR. Since 2005, the most prominent companies have joined the GRI; the Japan Association of Corporate Executives (Keizai Doyukai) published a report on CSR in March 2003 to increase awareness of CSR in Japanese firms (Keizai Doyukai, 2003). In October, the Japan Business Federation (Nippon Keidanren) discussed CSR among Japanese firms in the same year. The corporate CSR performance in Japan is affected by firm size, environment-relatedness and oversea sales. The different styles of CSR performance are illustrated between Japanese companies and western companies; fewer Japan's companies care about employee opinions as compared with western firms (Suzuki & Tanimoto, 2005). Finally, as the nexus of companies, communities and governments are reconsidered, firms are expected to contribute more to society (Suzuki & Tanimoto, 2005).

Many of the stakeholders (shareholder, workers, authorities, investors, consumers and the public) that are focused on firm social responsibility. Compared with China and Japan, German firms incorporate greater concern into the voiceless stakeholders (consumers, workers and the public) (Galetska et al., 2019). The firms from Japan, although lacking in autonomy, exhibit a high standard of CSR performance within Asia, but they neglect the disclosure of the environmental and social information of China's firms due to government pressure.

Previous studies have attempted to find a nexus between corporate environmental performance and financial performance (Aragon-correa, 2003; Clarkson et al., 2011; Darnall et al., 2008; Iraldo et al., 2009). There is not a simple linear relationship between

CEP and CFP. Córdova et al. (2018), Feng et al. (2018) and Uribe-Bohorquez et al. (2018) documented the positive relationship between CEP and CFP. Other researchers found that environmental performance is beneficial for economic performance and it is worth noting that the relationship exists under a specific condition (Burritt & Schaltegger, 2010; Henri & Journeault, 2010; Palmer et al., 1995; Rugman & Verbeke, 1998). However, other studies demonstrated no relationship between environmental performance and financial performance (Böhringer et al., 2012; Walley & Whitehead, 1994). The CEP–CFP relationship is not easy to confirm, as indicated by the inconsistent results from previous studies (e.g. Abban & Hasan, 2021; Boakye et al., 2021; Nirino et al., 2021; Simionescu & Dumitrescu, 2014; Wegener et al., 2019; Wu & Furuoka, 2020). We can see that the results from the different areas will impact the CEP–CFP empirical results. The cultural difference (such as attitude towards employees) as well as the differentiated environmental performance in eastern and western regions, western countries are more likely to considerate employees' voice (Suzuki & Tanimoto, 2005). The policies and pressure from governments and other outside stakeholders have also not been the same as in previous samples. The many kinds of manifestations of research methods also lead to different results as Wu, Furuoka, & Pui (2021) mentioned, the measurement of the environment and financial performance are not consistent in past research, such as with the representation of environmental performance (e.g. Environmental pollution, environmental disclosure, environmental management) in different dimensions. Also, companies have different plans and strategies for environmental performance. No single metric can perfectly capture the complete picture of a company's environmental performance. Similarly, there are many different financial variable measurements (e.g. cost, accounting-based performance, marketing-based performance, and financial risk). Consequently, due to the differences in research methods and samples this lent to the production of inconsistent results in past research.

This study will continue to explore the nexus between CEP and CFP. We use three indicators to measure corporate environmental performance: CO2 emissions, environmental disclosure, and environmental concern.

Firstly, carbon emissions performance is a critical element of the environment of the firm; the companies harm our environment through routine operation, production, and other activities (Ambec & Lanoie, 2008; Busch & Hoffmann, 2011; Hart, 1995; Klassen & McLaughlin, 1996; K. Lee, 2009; K. Lee & Kim, 2011; Porter & Van der Linde, 1995). Corporations need more green management to produce sustainable products and improve green practices (Bhattacharya et al., 2019; Romero et al., 2018). In recent years, environmental degradation and environmental externalities of business have been of greater concern for more of our society, and firms are more motivated to find a way to mitigate the impact on the environment with regard to business (Porter & Reinhardt, 2007). The link between corporate carbon emissions and financial performance needs further discussion.

Secondly, establishing an excellent environmentally-related information disclosure system is important for attracting environmentally friendly stakeholders and investors. However, consumers prefer to use products depending on the quality of products not related to the environment (Hibiki & Managi, 2010). Thus, an environmentally friendly firm is not more competitive because of the burden of environmental expenditure. So, environmental performance improvement can't bring profit (Fujii et al., 2013). But other research documents that the customer's response can strengthen the influence of CEP on CFP (Rokhmawati et al., 2017). In most areas, the customers become more aware of a firm's environmental impact. The need more ecological products is greater now than before (E. E. Smith & Perks, 2010). In March of 2017, the German Bundestag issued the law to improve its ESG information disclosure in their management reports, announcing that German corporate social responsibility had entered a new stage[10]. The firm did well to disclose some environmental transparency information (Clarkson et al., 2013) that helped enhance the firm return of assets, but this act did not significantly relate to the firm's cost. Thus, it is still unclear concerning the influence of ESG information disclosure on CFP.

Thirdly, increased environmental concern and CSR strategies will proactively reduce environmental pollution (K. H. Lee & Min, 2015; Porter & Reinhardt, 2007). From the resource-based review, firms with good CSR strategies and environmental management will tend to have an excellent economic outcome (Córdova et al., 2018; Fujii et al., 2013; Gallego-Álvarez et al., 2015; Ganda & Milondzo, 2018; Y. He et al., 2017; Iwata & Okada, 2011). By improving the corporate environmental management system and using environmentally friendly activities and strategies that lead to more material efficiency, economic performance ultimately benefits (L. W. Lee & Low, 2014; Menguc & Ozanne, 2005; Orlitzky et al., 2003a; Vlasov et al., 2014). Whether or not environmental R&D spending is a viable tool, this environmental attitude can increase incentives for environmental stewardship to aid in protecting the environment. Therefore, it is believed that there is a relationship between environmental attitude and its financial performance.

The CEP depends on the environment-related management of the firm. In this case, the top management team plays an unignored role in this process. In stakeholder theory, the stakeholders place requirements on the firms concerning their environmental and social performance based on legitimate interests (Donaldson & Preston, 1995). This is done to achieve corporate environmental performance and show accountability to stakeholders through appropriate strategies and reports (Qin et al., 2019). To create good

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[10] www.csr-in-deutschland.de

sustainable environmental strategies, top managers work as a team based on upper echelons theory. It is indicated that top management team (TMT) characteristics could also influence corporate environmental performance and financial performance (Reinhardt et al., 2008; Siagian et al., 2013). This study uses three dimensions of TMT characteristics in this study: named gender diversity, independent directors, and environmental committee.

Firstly, if women run and manage a corporation, is it better for firm performance (M. R. Johnson & Coderre, 2012)? Many studies have investigated the effect of female directors on corporate financial performance (Wu, Furuoka, & Lau, 2021). Existing research has documented that a female director is more cautious than a male director concerning some critical decisions (Huang & Kisgen, 2013; Levi et al., 2014). Most female directors are good at audit skills and dealing with external stakeholders relations (R. B. Adams & Ferreira, 2009; Gul et al., 2008). The novel perspective and experience of female directors prove to be beneficial for corporate governance (Hillman et al., 2007). In addition, in the same position on the board committee, female directors are more likely to have an advanced education and greater technical skills than male directors (Carter et al., 2010; Post & Byron, 2013). In 2015, German law required the quota of gender to be more than 30% in large listed companies (R. B. Adams, 2016). On the other side, women directors on the board in public companies of Norway with a stable quota (40%) will decrease firm value when the firm has more governance than before (Ahern & Dittmar, 2012). Because of the different cultures between western countries and eastern countries, other countries also exhibit different social statuses (Terjesen et al., 2009; Terjesen & Singh, 2008). According to Goldman Sachs research, if the female labour force participation rate in Japan rises to the same level as that of men, GDP will be boosted by

10%[11]. So, is any quota for women to be included on the board necessary for the financial performance of a firm?

Secondly, although the independence of directors has long been recognized as being necessary for the successful monitoring of the top management, previous studies have shown mixed results on the effectiveness of independent directors on firm financial performance (R. Adams et al., 2008). The concept of the independence of directors has grown from one of ambiguity to that of transparency in the West and various other parts of the world. R. Adams et al. (2008) advocated that too much independence on the board may result in poorer monitoring. However, with particular emphasis on remuneration for committee independence in many corporate governance codes, director independence is less noticeable. On the other hand, independent directors may now be recruited from a CEO warm pool of candidates and function as 'puppets', eroding their independence. In fact (R. B. Adams & Ferreira, 2007) suggested that management friendly boards may perform better. Cavaco et al. (2017), Duchin et al. (2010), Harris & Raviv (2006) indicated that independent directors have more potent influences on effective board operation when the cost of obtaining information is high. To curb this problem, it was suggested to separate the functions of the board of directors to supervise and monitor decision-making. Germany was the first jurisdiction to have this implemented in 1861. In a world where more than half of the directors are independent, if the board is not clear, true "independence" improves the monitoring of the board's influence and affects financial performance (D. R. Dalton et al., 1998; Kolev et al., 2019). The influence of independent directors on environmental governance and financial performance is worthy of being discussed.

[11] Goldman Sachs research: An American multinational investment bank and financial services company headquartered in New York City

Thirdly, some research studies about the relationship between the board committee and CEP. Most of the research is focused on the remuneration committee (Fich et al., 2011), nominating committee (Faleye et al., 2011) and the audit committee (Beck & Mauldin, 2014). A rare study involved the environmental board committee influencing financial performance, even though some articles document the environmental board committee's influence on environmental performance (L. Liao et al., 2015; Peters & Romi, 2012), this is an unexplored field of firm economics. Under stakeholder theory, high sustainability firms are more likely to form an environmental committee (Eccles et al., 2014) and increase the transparency of GHG emissions disclosure (Peters & Romi, 2012). Even still, many studies examine the financial performance and untraditional committee (environmental committee) and the environmental committee that has been documented can enhance environmental transparency (Peters & Romi, 2012), improve the firm environmental performance (Walls et al., 2012) and decrease penalties (Gilley et al., 2000), thus, benefiting financial performance. The environmental committee reveals a good environmental attitude and is an excellent element to attract outside stakeholders. The environment committee is a subcommittee that companies have gradually set up in recent years; it is not like the audit committee, compensation committee and other traditional committees. The environment committee is set up to improve corporate environmental performance. This study examines the corporate financial performance associated with the corporate environment committee.

This study suggests firms of Environmental accounting systems. After the government's statement of achieving Carbon-Neutrality by 2050 (Germany and Japan) and 2060 (China), organizations need a new environmental accounting system to face Carbon finance in the following decades. After China joins the emissions trade system as a massive economy globally, the ETS will bring more changes into the carbon market. Even though many studies investigate the relationship between CEP and CFP, it will be a challenge to maximize the win-win situation of the environment and economy in different contexts. This article will also explore how companies can achieve sustainable development under different carbon emissions trading systems and management cultures (female directors). On the other hand, different industries have different carbon emissions levels. This study will investigate how the high and low emissions industries find sustainable development methods suitable for themselves. The gap of this study is worth addressing and inspiring companies to adapt to a green business model.

In corporate governance now, the environment is an indispensable measure, and in recent years, the company's environmental indicators have been a report that has attracted much public attention after the financial indicators. The environmental accounting system is functional to combine corporate environmental governance and financial performance. The board plays a very important role in this environmental governance progress. Under the context of climate change mitigation and carbon reduction all over the world, the policy is formed in different countries to force companies to achieve environmental governance and carbon reduction.

1.3 Research questions

Scholars and environmental stakeholders hoped for a positive association between CEP and CFP. Thus, managers might reduce the environmental impact of their companies under an economic rationale. The extensive research conducted on this topic aside, (Ambec & Lanoie, 2008; Ben Lahouel et al., 2020, 2022; Etzion, 2007; Z. Liu, 2020; Molina-Azorı´n et al., 2009), there remains an unanswered question as to whether 'it pays to be green' (Ambec & Lanoie, 2008; Dixon-Fowler et al., 2012; Etzion, 2007). The existing antilogy in the relation between CEP and CFP revealed in research may stem from reasons such as small sampling or a lack of an adequate method to solve this problem (Ambec & Lanoie, 2008; Busch & Hoffmann, 2011; Martínez Ferrero & Frias Aceituno, 2015). By examining the cause and effects of CEP and CFP, the relationship between CEP and CFP may be revealed as more complicated than simply a relationship that is positive, negative or void of any relationship qualities at all (Orlitzky, 2013; Salzmann et al., 2005). This study is aimed at exploring another possible illustration of the contradictory relationship between CEP and CFP.

Considering the theoretical relevance of the TMT influence on the environmental and financial performance in the firm, we employ the upper echelons theory (D. C. Hambrick & Mason, 1984). From the perspective of the upper echelons, TMT characteristics affect environmental and financial performance. They documented that top management teams with different characteristics have different skills and features. These various skills and features can affect strategic choices and enhance the firm's environmental performance (reducing pollution and saving resources) and financial performance (profit, growth, reputation). To examine the relationship of top management, environmental and financial performance, the following research questions are to be proposed:

To what extent do Top Management Team (TMT) characteristics impact Corporate Environmental Performance (CEP)? Is the relationship moderated by board size?

To what extent does the Corporate Environmental Performance (CEP) influence Corporate Financial Performance (CFP)? Is the relationship moderated by firm size?

To what extent do the Top Management Team (TMT) characteristics influence Corporate Financial Performance (CFP)? Is the relationship moderated by board size?

1.4 Research objectives

We followed the research questions. Three research objectives can be stated as follows:

To examine the influence of Top Management Team (TMT) characteristics on Corporate Environmental Performance (CEP) and examine the moderating effect of board size on the nexus between TMT and CEP.

To examine the influence of Corporate Environmental Performance (CEP) on Corporate Financial Performance (CFP) and examine the moderating effect of firm size on the nexus between CEP and CFP.

To examine the influence of Top Management Team (TMT) characteristics on Corporate Financial Performance (CFP) and examine the moderating effect of board size on the nexus between TMT and CFP.

1.5 Scope of research

This study locates the empirical context in three countries: Germany, Japan, and China; they joined the UNFCCC as a party in 1993. This study selects these countries for three reasons. First, to compare different countries from Asia and Europe; to examine the fundamental relationship among TMT characteristics, CEP and CFP; to determine if there are any different results between these countries. Germany, Japan, and China are important countries within their respective regions, and they rank in the category of top ten carbon emitters worldwide. China ranks as the highest carbon emitting country, with emissions around 30% of GHG in the world in recent years[12]. Germany is a highly industrialized economy, and it has the largest economy in Europe[13]. Hence, there is a significant obstacle to successfully adopting environmental practices in Germany. Germany is a leading country with a population of 83 million and based on this aspect, a

[12] "Fossil CO2 emissions of all world countries-2018 Report". Publications Office of the European Union. Retrieved 10 March 2019

[13] Economic Overview Germany (2019)

genuine role model for the future development of the environment with the European region (Weidner & Mez, 2008). Likewise, Japan is significantly the largest and the most rapidly growing developed country with 126 million globally; these examples are compared with China, which is an emerging country in East Asia with the world's largest population near 1.4 billion[14]. These three countries have experienced a high GDP ranking in recent years (China is second, Japan is third, and Germany is fourth of all countries)[15].

Second, Germany, Japan, and China have adopted different board structures. For example, Germany is adopting two-tier boards. Board roles are separated into two-tier boards[16], where independent directors advise and monitor the board. In contrast, non-independent directors are responsible for running the firm's operations within the management board. Chinese public listed companies adopt two-tier board structures by referring to their respective Corporate Governance Codes (Y. Wei, 1998). And Japan is adopting hybrid board structures (known as Kabushiki Kaisha) to strengthen the supervisory powers of the board in ensuring that the directors act in the interests of the relevant corporation (Passador, 2016). Thus, this study will answer the research questions that focus on independent directors on firm boards.

In addition, feminism is differs across Europe and Asia (De Vido, 2018); the female director’s proportion reached 25% in 2018 in German companies due to the strict rules that firms need to hire more women to achieve gender equality. However, few female directors are on board committees in Japan and China. Japan is 10.6%, and China is 11.5%. This study incorporates Germany, Japan, and China; this study also responds to

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[14] Source: World Population Prospects (2019 Revision), http://worldpopulationreview.com/countries/

[15] World Economic Outlook Database, October 2019". IMF.org. International Monetary Fund. 15 October 2019. Retrieved 3 September 2019.

[16] Government Commission. "German corporate governance code". Retrieved 26 November 2014.

the call for theory integration by using western and eastern countries (Barkema et al., 2015). In particular, this research applies two theories: the upper echelons theory and stakeholder theory to develop a conceptual framework and hypotheses. Using these two theories in a mature market (Germany and Japan) and emerging market (China) will provide better opportunities for academic enhancement and testing, thereby enabling a better understanding of how these two theories apply in different institutional contexts.

Thirdly, these three countries issued the corporate carbon emissions trade system. Germany followed the EU ETS. The Tokyo Cap-and-Trade Program launched on April 1, 2010, is Japan's first mandatory ETS and linked to the Saitama ETS. China's national ETS started operating in 2021, bringing the world's largest ETS online after three years of preparation since the political launch.

The companies of our samples are from three countries under different ETS policies. Over the period of our data from 2010 to 2018, firms in Japan and Germany were under the strict rule of the ETS, but firms in China did not face these regulations.

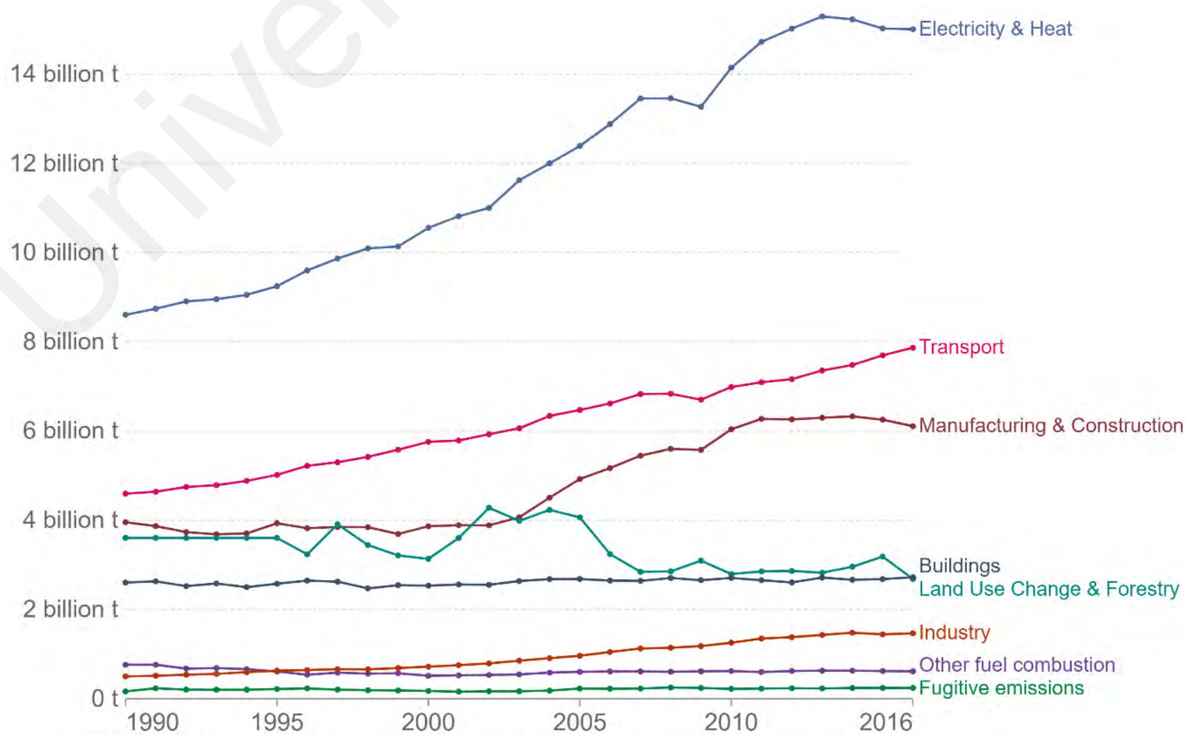

Figure 1. 7 The CO2 emissions by sector (world)

Source: Global Carbon Project (GCP) and CDIAC

This study selected the sample from the different industries; most of them belong to the Secondary Sector (Manufacturing and Industry)[17] (Iwata & Okada, 2011; Rassier & Earnhart, 2011). The sample of this study consisted of 18 industries. We separated the industries into two groups; one consisted of environmentally sensitive sectors: chemical, construction, electricity, energy, food, manufacturing, oil & gas, steel and other metals, and transportation. The other group involved the non-environmentally sensitive sector: electronics and communication, equipment, financial services, health, high technology, pharmaceutical, retail, service and others (C. Deegan et al., 2002; Dong & Xu, 2016; Jenkins & Yakovleva, 2006; Seguí-Mas et al., 2018). Many of the sensitive industries convert raw materials into goods and products; in this process, these sensitive industries usually produce more waste materials and heat, leading to higher carbon emissions or environmental pollution.

1.6 Significance of Study

This study examined the TMT characteristics, corporate environmental and financial performance nexus through an empirical method. The research will provide new insights into how top managers and corporate social performance play a role in the financial performance of a firm. This study also included the unexplored area of board characteristics–including a CSR committee and contributes to the existing literature in the field. By comparing the results of the countries of Germany, Japan, and China, this

[17] https://www.hq.nasa.gov/iwgsdi/Manufacturing.html

https://en.wikipedia.org/wiki/Secondary_sector_of_the_economy research will expand the current understanding of government policies and firms' environmental performance.

This study will provide evidence supporting the stakeholder theory in the relationship between environmental performance and financial performance. This study also supports the upper echelons theory in the board of directors' composition.

Methodologically, this study contributes to current research by adapting ARDL models to environmental and financial performance of firm-level data. Many empirical studies are using Autoregressive Distributed Lag (ARDL) to investigate the relationship between Environmental and Economic performance of country-level data. This study introduces this method for firm-level data for both short-term and long-term relationships. This study also includes firm size and board size as a moderator variable to test the moderator effect. For interaction in a fixed-effect model, this study employed demeaned interaction terms. To avoid multicollinearity in interaction terms in this study, we conducted a Centralized Processing Solution method.

The practical contribution of this study suggests that policymakers pursue a sustainable economy and give more consideration to environmental protection and mitigate carbon emissions at the firm level. This study will also provide some suggestions for governments to develop a path to encourage the alignment of company goals with the goals of a country in order to achieve sustainable development.

For firm-level contributions, this study's results will help firms understand the effectiveness of the environment concerning financial performance to improve social responsibility awareness. This study will also help firm stakeholders to understand the effectiveness of gender diversity on board and financial performance. The carbon financial component will become increasingly important to accounting and financial systems. Perhaps in the future, carbon emissions rights will be an asset of a company and will be reflected on a company balance sheet. Carbon emissions reduction will also be essential for enterprises to improve their advantages in future competition.

This study will be more contribute to the academic that explore more of the environmental governance process. It is a link for corporate managers, corporate environmental and financial performance. Other side, this study also give suggestions to policy makers in country level and corporate governance in firm level environmental strategies.

1.7 Definition of key concepts

1.7.1 Top management teams

Most past researchers identified the TMT as executives who served on the board of directors (Finkelstein & Hambrick, 1990; Haleblian & Finkelstein, 1993). Furthermore, some researchers included board measures with executives holding the senior-most offices (Carpenter & Fredrickson, 2001). This study employed gender diversity, independent directors and environmental committees as top managment characteristics.

Gender diversity

Corporate gender diversity is the representation of females and males in firms. It most commonly refers to a quota of men and women in a firm. In recent years, gender diversity in corporate boards has been extensively studied, and many ongoing initiatives have researched and promoted gender diversity in traditionally male-dominated fields (Blickenstaff, 2005; Campbell & Mínguez-Vera, 2008). Some studies measured the gender diversity of a number of female directors (Ben-Amar et al., 2017; Cabeza-García et al., 2017; Cook & Glass, 2017; Kyaw et al., 2017); this included the measurement of the percentage of female directors on the board because traditionally, the percentage of female board members has been quite small (Elmagrhi et al., 2018; Haque, 2017; Jizi, 2017; Pucheta-Martínez et al., 2019; Yasser et al., 2017). The number of female directors cannot reflect the female power if there are more numbers of directors on the board. In this study, we use the percentage of female directors and the percentage of executive female directors to measure gender diversity.

Independent director

An independent director is a member of a board who does not have an interest in a relationship with a company or related persons, except sitting fees. They are employed by the company services to a board but not as an executive manager. They have their legal duties and responsibilities to address firm strategies and management (Baldini et al., 2016). Independent directors are a percentage of a board of directors of a company or organization that is not a member of the executive management team (Bear et al., 2010; Beji et al., 2020; Byron & Post, 2016; Cucari et al., 2017; Luan & Tang, 2007). This study follows previous research that measures variable independence as a percentage of independent directors on the board.

Environmental committee

The Environmental board committee is related to stakeholder demands; stakeholder demands serve as an essential part of the social performance of firms (Brower & Mahajan, 2013). Currently, firms are organized as specific board committees that can address environmental problems and communicate with stakeholders; this committee improves firm functionality based on risk perspectives and strategic opportunities (L. Liao et al., 2015). Board oversight is essential to improve firm reputation and business operation.

Larger boards of directors communicate and connect with key stakeholders. Hence, companies with large boards are likely to facilitate access to critical financial resources, giving them more economic leeway to follow environmental plans (Villiers & Van Staden, 2011). Any rules that do not mandate an environmental or CSR committee are voluntary depending on the firm (Dixon-Fowler et al., 2012). An environmental or CSR committee play an essential role in decision-making efficiency (Spira & Bender, 2004), and are helpful for building environmental and social legitimacy, accountability and constructed strategic systems (Harrison et al., 1987). There are more and more CSR committees that have formed in recent years. An environmental committee on the board may pursue proactive or reactive environmental strategies to manage firm environmental issues.

1.7.2 Corporate environmental performance

Corporate Environmental Performance has received much attention in the last few decades, but there is no clear definition. Corporate environmental performance is defined as "the measured result of an organization's environmental, operational performance" (Trumpp & Guenther, 2015). Corporate environmental performance typically consists of environmental management performance (EMP) and environmental operational performance (EOP). These dimensions capture a different aspect of environmental performance (Clemens & Bakstran, 2010; Xie & Hayase, 2007).

Environmental management performance (EMP) measures environmental problems and resource consumption, and what the company does to make an effort to decrease environmental pollution and carry out precautions. Environmental management performance (EMP) also includes green management, which demands green innovation, strict legitimacy, employee skills training, supply chain management, and stakeholder communication (Dragomir, 2018). Firm activities can also influence the natural environment (Walls et al., 2012) and includes two categories. This involves input-based measurement (resources consumption and energy input) and output-based size (GHG emissions and waste) (Shahgholian, 2019).

CO_2 emissions

The critical aspect of environmental performance involves carbon emissions, or the release of carbon into the atmosphere. The main component of GHG emissions is CO_2 (Brander, 2012). The carbon emissions reduction of a firm is under social and government scrutiny. A firm with bad carbon performance will face greater pressure from governments and markets, and these firms will then have more incentive to improve carbon performance to change public perception (Y. He et al., 2013). The carbon emissions level is associated with a firm's risk and opportunities due to customer loyalty (Rahman, Rasid, & Basiruddin, 2014; Najah, 2012).

Environmental disclosure

Environmental disclosure is the need a firm has to communicate with stakeholders to fulfil its responsibility of firm activities and provide useful environmentally-related information to interested parties for decision making. According to the general reporting principles of environmental reporting, environmental disclosure is a systematic, comprehensive statement of the environmental burden and environmental efforts (such as environmental policies, objectives, plans and outcomes, organizational structures and systems of environmental activities) in an organization's activities that become published and reported to the public (Environmental Reporting Guidelines, Ministry of Environment, Japan, 2003).

Environmental concerns

Environmental concerns range from a specific attitude toward environmentally appropriate behaviour to a more encompassing value orientation. Both straightforward attitudes towards behaviours and general value orientations are likely to play an important role in behaviour determinants (Fransson & Gärling, 1999). Environmental concern equates with environmental attitudes. It portrays a practical perspective adopted regarding serious and important environmental pollution; positive affective attitudes reduce environmental problems and improve governance. Negative affective refers to a group that caused environmental issues (Takács-sánta, 2007). By following environmental protection trends, firms increase environmental management systems as a benchmark of CEP (Environmental & Initiative, 1998). Environmental management often uses environmental strategy, and environmental issues are proactive in the strategic process, environmental practice, product initiative, and other management systems that can aid in reducing environmental pollution (Molina-Azorı´n et al., 2009). Many sensitive firms follow ISO 14001 certification rules under government policy (X. He & Jiang, 2019).

Companies need more green management to improve sustainable products and practices. In recent years, environmental degradation and environmental externalities of business have become a greater concern to more of our society, and firms are more motivated to find ways to mitigate the impact of the environment (Porter & Reinhardt, 2007). Environmental operation performance indicates the pursuit of good environmentally friendly production, and as such, companies need to design green technology or strategies in order to mitigate the impact on the environment. This might include implementing new efficient systems to improve green management of production processes. In many organisations, environmental and research expenditure improves the environmentally-related operations and reduces substantial risks, such as government pollution penalties.

1.7.3 Corporate financial performance

CFP measurements usually include accounting-based performance, such as profit, Return on Asset (ROA), Return on Equity (ROE), and market-based performance such as Tobin's Q, and market value (Earnhart, 2018). Financial performance is defined as "economic outcomes resulting from the interplay among an organization's attributes, actions, and environment" (Combs et al., 2005), while CFP is also a composition of different dimensions (Trumpp & Guenther, 2015). CFP consists of four dimensions: liquidity, profitability, growth, and stock market performance (Hamann et al., 2013). The researcher often used profitability and stock market performance to measure financial performance to examine the relation between CEP and CFP (Dixon-Fowler et al., 2012; Endrikat et al., 2014; Orlitzky et al., 2003b). And liquidity and growth are not the focus of existing empirical studies or theoretical concepts in the context of the research of this area (Trumpp & Guenther, 2015). This study uses ROA, ROE, and Tobin's Q to measure financial performance.

Accounting-based corporate financial performance

Accounting-based measurements focus on revenues and costs. Some researchers focused on the profit (Menguc & Ozanne, 2005; Rexhäuser & Rammer, 2014), such as profitability or return measures and included Return on Sales (ROS), Return on Equity (ROE), Return on Assets (ROA), and Return on Investment (ROI). Most studies of accounting-based measures exploit these return measures (Przychodzen & Przychodzen, 2015; Russo & Fouts, 1997). A few studies examine profit margins (Karagozoglu & Lindell, 2000; Link & Naveh, 2006; Watson et al., 2004). In contrast to these profits studies, some studies focus on costs savings (Delmas et al., 2011; Klassen & Whybark, 1999; Pereira-Moliner et al., 2015). This study uses ROA and ROE to measure accounting-based financial performance. ROA is the ratio of earnings before interest and taxes to total assets. ROE is the ratio of earnings before interest and taxes to total equity.

Marketing-based corporate financial performance

Market-based measures stem from a company's stock price. Some studies simply examine a company's stock price (Filbeck & Gorman, 2004), while others use panel data on stock prices to calculate a stock return (Hamilton, 1995). Some other studies transform the stock price into market value by multiplying the price by the number of stock shares

(Konar & Cohen, 2001). Previous studies using market value divided the firm's replacement costs to create Tobin's Q (Dowell et al., 2000). Cordeiro & Sarkis (1997) use security analyst earning forecasts, which represent market predictions of an accounting-based outcome. A few studies draw upon neither accounting-based nor stock market-based financial performance in exploring an individual firm's market share (Judge & Douglas, 1998; Karagozoglu & Lindell, 2000; Menguc & Ozanne, 2005).

Tobin's Q means that the shareholders believe the company is worth more than its book value; a value smaller than one means that the market expects the company to destroy shareholder value in the future. This study uses Tobin's Q to measure market-based financial performance.

1.8 Structure of Study

This study is composed of six chapters. Chapter one introduces the study by outlining the difference between new and traditional business models. Outside stakeholders are increasingly concerned about the corporate social and environmental progress background of global corporate carbon emissions reduction and environmental protection awareness, as well as the role of top management in this process. Then it follows with a problem statement, which helps form the research questions and objectives. This study aims at the significance and narrows the scope to Germany, Japan, and China. Chapter two reviews the most previous relevant empirical literature on the relationship among top managers, environmental progress and financial performance. This literature indicates the research gap, and we develop the hypothesis based on the literature. The research also introduces the theoretical background of this study and demonstrates the framework. Chapter three introduces the methodology; the fixed-effect, random effect model and the ARDL test is analysed in this study. The causality relationship is also tested via the Dumitrescu Hurlin Panel Causality Test. Chapter four presents the examination of the

TMT characteristics, Corporate Environmental Progress and corporate financial performance nexus. The techniques are described in chapter three. Chapter five discuss empirical findings of this study. Chapter six give conclusions of this study, highlights the critical research, practical and policy implications. This chapter also provides details concerning the research limitations and possibilities for future research.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

In this chapter, we formed a conceptual foundation from previous research. Section 2.2 introduces the theory of corporate environmental accounting, as well as the determinants of corporate environmental and financial performance. In section 2.3 is a review of previous studies of top management and corporate environmental performance and includes the development of a hypothesis. Section 2.4 includes a review of previous studies on the relationship between environmental performance and financial performance, and provides further hypothesis development. In section 2.5, the top management and financial performance is reviewed alongside the hypothesis development. Section 2.6 coalesces the hypothesis summaries from sections 2.3, 2.4 and 2.5. Section 2.7 provides the theoretical background. Section 2.8 forms the conceptual framework of this study.

2.2 Theory of Environmental accounting

The corporate environmental performance is more attractive to scholars as it proves to be more meaningful in finding an approach to lead companies in conducting a sustainable business style (Kantabutra & Ketprapakorn, 2020). Some articles reveal the environmental and economic phenomena by the data facts and conclusions based on the observations (Beddewela & Herzig, 2013; Williams, 2015), while others employed theories to explain sustainable corporate development. Meadows et al. (1972) were the first scholars to post the concept of environmental accounting in Norway to track resource use; in the 1980s, they developed the means to account for air emissions and pollution.

Environmental accounting is formed as a management theory to provide a guideline for corporate governance to achieve sustainable development. Under the environmental accounting guideline, environmental disclosure and other strategies will bring environmental conservation benefits. The environmental conservation benefit is obtained from prevention, materials reduction, environmental impact avoidance, carbon emissions reduction, and other related aspects (Prevention & Incorporated, 1995). The environmental conservation benefit is important to meet outside stakeholder requirements and enhance corporate reputation. Environmental management accounting is committed to making an internal decision by the data of use, flows and fates of fossil energy, water and other materials, and information on environmentally related costs, earnings and savings. Another function of corporate environmental accounting is to provide the information needed by outside stakeholders on financial and non-financial performance (C. M. Deegan & Deegan, 2003). Certified Emission Reductions (CERs) accounting comprises the recognition of the non-monetary and CO2 emissions at all levels of the value chain as well as the recognition, evaluation, and monitoring of these emissions credits with respect to the carbon cycle of ecosystems (Kumar & Firoz, 2019).

There are two outcomes from the environmental protection progress. First is the cost of environmental conservation. There is an investment for environmentally-related expenditure. The expenditure for environmental performance is recorded during several periods. The second is the financial benefit from environmental conversation activities, such as increased sales and revenue due to a company's environmental activities, reduced material cost and financial risk. The corporate environmental conversations will impact financial performance in two ways: generate more cost and create more benefits.

2.2.1 Corporate Environmental Performance

Corporate environmental accounting is focused on the environmental cost structure and corporate environmental performance. Corporate environmental performance is the duty against the natural environment in business progress (Mazurkiewicz, 2004). In the past few decades, controversy developed concerning corporate social responsibility as stakeholders required companies to enhance environmental awareness and social responsibility. In the traditional business model, only environmental interest from the public and government maintained the principal responsibility for environmental protection (Duker & Olugunna, 2014). The public sector focuses on policies made and implemented on environmental protection. In recent years, the rise of new eco-friendly business models argue that in conjunction with governments, companies should be made responsible for environmental protection (Mazurkiewicz, 2004). Now many governments and large companies are providing strategies for social and environmentally friendly performance and consequently, companies are changing the old model (where responsibility only involved inside stakeholders, such as shareholders, creditors, and suppliers) to new eco-friendly models (with responsibility placed upon shareholders, creditors, suppliers, customers, employees, communities and other outside stakeholders).

The benefit of the environmentally friendly model increases company survivability in the markets; customers have responded with overall satisfaction and loyalty when companies have better environmental performance (González-Rodríguez et al., 2019). Many governments will also support companies that prioritize environmental protection, through incentives such as tax relief, reduced loan interest rates, preferential loans and other preferential policies. Under the ETS policy, a reduction in corporate carbon emissions means more revenue and fewer fines.

The primary elements of corporate environmental performance predominantly mitigate material waste and CO_2 emissions. The efficient consumption of energy and resources is also maximized. The harmful impact on the environment and biodiversity is also addressed. In this study, we measure environmental performance in three different dimensions, from the environmental outcome perspective with the employment of CO_2 emissions reduction, from the perspective of communication with outside stakeholders we measure environmental performance through ESG disclosure, and from the perspective of firm environmental policies, this study measures environmental strategies.

2.2.2 Corporate financial performance

Financial performance is significant; it tells investors about general situations, it reflects the financial health of a company and financial results within a particular period (Bashir, 2003; Goldsmith Raymond, 1969; Kakani et al., 2011; Warfield et al., 2007). Firms are formed to do business and make a profit for owners; in the old business model, the main goal of companies was to earn profit, and maximum it for shareholders. In this case, maximising return to shareholders is the objective of all business activities. This situation changed when we included sustainable development; companies should run not only to maximize profit for shareholders but also to balance the interests of stakeholders.

Finance accounting usually evaluates a firm's financial performance by financial ratios formed from balance sheets, case flow statements, and income statements (Heidari & Branch, 2012). Shareholders use financial indicators, creditors, and suppliers to check corporate financial performance and reduce financial risk (Edmister, 1972; Sulaiman et al., 2001). The financial analyst constantly compares companies and industries by the financial ratio. In public firms, the market price is also used in financial indicators.

The different financial indicators show information, such as profitability, to disclose income and sustain firm growth. Based on data from income statements and balance sheets and solvency for a company's capability payment for creditors, the indicator is calculated from the balance sheet; so, liquidity indicates the cash flow performance that should satisfy business operations and data from the balance sheet allows the indicator to be calculated. This study uses the profitability indicators return on asset (ROA) and return on equity (ROE) to measure the accounting-based financial performance as well as the market indicator Tobin's Q to measure marketing-based financial performance.

2.3 TMT characteristics and Corporate Environmental performance

Many previous studies focus on the relationship between top corporate managers and firm environmental progress. With the development of the capital market, non-financial information plays a more important role in the information disclosure system. A report produced by a board of directors, which is emerging and gradually improving at home and abroad, is a good example. As an essential disclosure of non-financial information, this report is mainly based on language information, and the environmental decisions of the management prove to be of great significance to the sustainable development of a company. A good CSR rating will benefit corporate reputation, and corporate CSR performance mediates the relationship between gender diversity and corporate reputation (Bear et al., 2010).

2.3.1 Gender diversity and corporate environmental performance

With the separation of ownership and management rights, the status of enterprise managers and enterprise management decision-making has been continuously improved. Compared with shareholders, they have a more direct right to speak and make decisions. On the other hand, as many government laws expressly require the inclusion of female talents at the top of a company, the status of female executives in corporate governance has gradually increased. This has also attracted great attention from all walks of life, and academic circles have launched extensive discussions on the governance effect of female executive participation in corporate decision-making. Numerous studies from psychology and sociology have shown that women differ from men in moral standards, risk appetite, and altruistic tendencies; the female director exhibits a more communal trait and cares more about CSR information before considering investment (Kaspereit et al., 2016). Therefore, differences in beliefs, ethical standards, and risk preferences, brought about by differences in gender characteristics of executive teams may affect corporate behaviour, and mainly due to these three aspects.

Female directors are underrepresented on boards because of negative stereotypes (R. B. Adams, 2016). Liao et al. (2015) Post et al. (2011) have documented that female firm directors care more about outside stakeholder interests compared to males. Board diversity means increasing a female director's appearance rate, and this will help to improve the chance of diversified knowledge playing a critical role in corporate CSR management. Because of significant differences in the cultural and social approaches of women and men, such as personality, communication style, and the social experience and attitude toward social responsibility (Buss, 2005), there are governance reforms for introducing women as top managers onto corporate boards. Other evidence also showed that women are better at managing operating environments of boards and dealing with internal or external relationships.

Kaspereit et al. (2016) investigated listed firms from the US between 1996 and 2012. The Morgan Stanley Capital International Kinder, Lydenberg and Domini (MSCI KLD) data expressed more communal traits of female directors; they need more CSR information for decision-making and exhibit more concern over stakeholders than male directors. Kaspereit et al. (2016) thought that it benefits increasing board gender diversity. Bravo & Reguera-Alvarado (2019) collected data from the Madrid Stock Exchange from 2012 to 2015. The evidence from Spain showed that female directors on the Audit committee positively impacted ESG reports. Nekhili et al. (2017), using the SBF 120 index of French companies from 2001 to 2011, showed that in firms with high female directors, a CSR is more related to the market value as compared to a board with entirely male directors; furthermore, the gender diversity of a board exemplifies a CSR assurance. To investigate the relationship between female directors and corporate environmental performance, we measure female board members and executive female board members separately, named gender diversity and executive gender diversity. This study developed these hypotheses:

H1a. A firm's gender diversity would have a positive relationship with carbon emissions reduction.

H1b. A firm's gender diversity would have a positive relationship with corporate ESG disclosure.

H1c. A firm's gender diversity would have a positive relationship with corporate CSR strategy.

H1d. A firm's executive gender diversity would have a positive relationship with carbon emissions reduction.

H1e. A firm's executive gender diversity would have a positive relationship with corporate ESG disclosure.

H1f. A firm's executive gender diversity would have a positive relationship with corporate CSR strategy.

2.3.2 Independent director and corporate environmental performance

The relationship between independent directors and corporate transparency is not clear. Firms can alter their transparency to adapt to outside stakeholder informational demands of particular top managers (Armstrong et al., 2014). Because independent directors are relatively independent of internal directors, they can improve the supervisory ability of the board of directors. Because they have no direct relational interest with a company's management and consequently fewer conflicts of interest, they are able to maintain their independence. The higher the proportion of independent directors on a board of directors, the more likely it is to safeguard the rights and interests of investors and other stakeholders, improve the effectiveness of supervision, and prevent company management from taking actions that are not conducive to environmental protection for short-term economic interests and violating relevant environmental protection regulations. Administrative regulations enhance the awareness of corporate social responsibility; at the same time, most independent directors are held by highly educated scholars, experts in a specific field or managers with rich management experience. Conservation and other aspects of projects and strategic decision-making provide multi-faceted and multi-field professional advice and seize long-term development strategic opportunities.

There are different perspectives, provisions of knowledge, and time horizons between internal and external directors. Internal directors usually focus on short-term firm performance because firm performance will be linked to their salary or other interests. External directors are not the primarily focused on financial aspects and profits, but instead of sustainable development, they always pursue long-term performance and corporate CSR performance (L. Liao et al., 2015). Cuadrado-Ballesteros et al. (2015) also supported that with a high percentage of independent directors, a firm would have high information transparency, but with companies that are controlled by families or personally this will usually disappear.

Grace & Odoemelam (2018) investigated the sample from South Africa and Nigeria. The data of 303 firms from these two countries documented those independent directors on the board positively impacted on corporate environmental report. Puni (2015) investigated the companies listed on the Ghana Stock Exchange (GSE) from 2006 to 2010. The result showed that firms equipped with intelligent external directors from different areas will be helpful to the board committee, and independent directors are beneficial for long-term corporate goals. Their evidence from Saudi Arabia showed no link between board independence and board size with corporate financial performance. In addition, the independent director is more costly for firms and can reduce financial performance in some situations (Alshetwi, 2017). To investigate the relationship between independent directors and corporate environmental performance, this study employed these hypotheses:

H2a. The percentage of independent directors would have a positive relationship with carbon emissions reduction.

H2b. The percentage of independent directors would have a positive relationship with corporate ESG disclosure.

H2c. The percentage of independent directors would have a positive relationship with corporate CSR strategy.

2.3.3 Environmental Committee and corporate environmental performance

Liao et al. (2015) Michals (2009) point out that companies establish an environmental committee to deal with environmental matters and commitments to outside stakeholders. The environmental committee is a subcommittee for upper echelons to enhance the systematic plan concerning environmental issues. The environmental committee may encourage employees to reduce carbon initiatives, reduce fossil fuel consumption, and pursue carbon-neutral products (Dietz & Hope, 2007). The environmental committee helps devise environmental strategies to improve environmental progress through the awareness of employee working productivity and environmental rewards. The environmental committee minimises corporate environmental risk regarding global warming and maintains adequate communication with external stakeholders.

Peters & Romi (2014) Walls et al. (2012) thought that an environmental committee is beneficial for firm non-financial information disclosure and for improving corporate environmental performance. The environmental committee is an unexplored area for academic study (Kolev et al., 2019). Grace & Odoemelam (2018) separated CSR reporting into two dimensions: one with an integrated reporting framework and a traditional reporting framework; they revealed that the environmental committee has a positive impact on the integrated reporting framework, but not enough impact on the traditional reporting framework. To investigate the relationship between the environmental committee and corporate environmental performance, this study set forth these hypotheses:

H3a. A firm's environmental committee would have a positive impact on carbon emissions reduction.

H3b. A firm's environmental committee would have a positive impact on corporate ESG disclosure.

H3c. A firm's environmental committee would have a positive impact on corporate CSR strategy.

2.3.4 Board size and corporate environmental performance

As an important factor affecting the level of corporate governance, the size of the board of directors affects an enterprise's strategic decision-making and supervision to a certain extent. Environmental strategy is a relatively new topic, and environmental issues are more complex, involving multiple factors, and concerning its policy implementation, the results are highly uncertain. Therefore, the larger the board size, the more diverse the background of the board members, the more environmentalists and directors present with professional environmental skills and diverse abilities to deal with environmental issues, this wide array of environmental preferences will help to guide the company to consider environmental issues and provide relevant advice and resources to enable companies to make strategic decisions that are conducive to improving their environmental performance from long-term perspectives.

Secondly, a large-scale board of directors is conducive to obtaining external investments, and the political and social resources brought by directors are more conducive to obtain valuable information on environmental policies and other relevant information; in addition, the larger the board of directors, the more favourable it is to improve the level of mutual supervision and the supervision of the management of environmental decision-making implementation and enhance the scientific and comprehensiveness of supervision. Suppose it is not conducive to the environment, so in that case, the decision-making behaviour of management will be detected and dealt with promptly, which will promote enterprises to participate more actively in environmental improvement activities.

Environmental performance is an investment in consumed capital and resources, and this process does not benefit the firm quickly. As (Song et al., 2017) investigated the samples from Chinese listed firms, the result showed corporate environmental performance increased financial performance in the future. The evidence from Indian firms showed that the board size does not significantly impact corporate disclosure (Khandelwal et al., 2020). This study used board size as a moderator variable to investigate board size effect on the relationship between top manager teams and environmental performance.

H1aa. Board size has a moderating effect on the relationship between gender diversity and emissions reduction.

H1bb. Board size has a moderating effect on the relationship between gender diversity and ESG disclosure.

H1cc. Board size has a moderating effect on the relationship between gender diversity and CSR strategy.

H1dd. Board size has a moderating effect on the relationship between executive gender diversity and emissions reduction.

H1ee. Board size has a moderating effect on the relationship between executive gender diversity and ESG disclosure.

H1ff. Board size has a moderating effect on the relationship between executive gender diversity and CSR strategy.

H2aa. Board size has a moderating effect on the relationship between percentage of independent directors and emissions reduction.

H2bb. Board size has a moderating effect on the relationship between percentage of independent directors and ESG disclosure.

H2cc. Board size has a moderating effect on the relationship between percentage of independent directors and CSR strategy.

H3aa. Board size has a moderating effect on the relationship between environment committee and emissions reduction.

H3bb. Board size has a moderating effect on the relationship between environment committee and ESG disclosure.

H3cc. Board size has a moderating effect on the relationship between environment committees and CSR strategy.

2.4 Corporate environmental performance and financial performance

Research on the CEP–CFP relationship is from 1970 (Friedman, 1970; Trumpp & Guenther, 2015). In the last few decades, a greater amount of research about the CEP and CFP relationship has shown inclusive results (Albertini, 2013; Córdova et al., 2018;

Petitjean, 2019; Shen et al., 2019). There is an ongoing debate on the relationship between CEP and CFP (Bansal, 2005). Some scholars have stated a positive relationship exists between CEP and CFP (Córdova et al., 2018; Feng et al., 2018; Uribe-Bohorquez et al., 2018). They asserted that firms need to be sensitive to customers concerned about environmental friendliness in business practice. This sensitivity will push firms to pursue green products and improve their reputation regarding the environmental conservation; CEP is a critical component of this and functions as an advantage to incorporate business operations. Firms with good environmental performance that also have advanced energy efficiency have used that make to make costs more economically beneficial (Uribe-Bohorquez et al., 2018). Z. Liu (2020) found that a company's Environmental Performance and Financial Performance are significantly and positively correlated. Also, he suggested that, in general, a proactive Environmental Management strategy helps improve future Financial Performance (i.e., it does pay to be green). In contrast, other researchers claimed a negative CEP–CFP association. If firms want to improve CEP, they should spend more money on environmental conservation (Fujii et al., 2013) and reduce other budgets (Aragon-correa, 2003; Busch et al., 2011). They also claim different components of CEP (carbon emissions, environmental information disclosure, and other pollutions) would have no consistent linkage with CFP (Shen et al., 2019).

However, not all industry sectors can emulate this strategy and benefit from implementing an environmental management strategy. Post-acquisition financial performance exhibited improvement, particularly in profitability and activity. Furthermore, financial performance was found to mediate between financial decisions and future profits (Daryanto, Arminta, et al., 2020; Daryanto, Hasanah, et al., 2020; Ledhem & Mekidiche, 2020).

2.4.1 CO_2 emissions and corporate financial performance

A firm with poor carbon performance will incentivize to improve environmentally and attempt to change public perception (Y. He et al., 2013). For firms with good carbon emissions disclosure and performance, the financial performance is higher than counterpart industries (Y. S. Liu et al., 2017; Matsumura et al., 2014). The carbon emissions reduction strategy positively impacts the market value (Böhringer et al., 2012). A customer's response to a firm's CO2 emissions reduction is significantly and positively linked to a firm's financial performance measured by ROS (Rokhmawati et al., 2017).

A particular study documents the positive relationship between carbon performance with financial debt in Europe (Córdova et al., 2018). During the same year, there were different results from others, a U-shaped relationship between carbon performance and cost of debt financing in China (Z. Zhou et al., 2018), and a negative relationship between carbon emissions and financial performance (measured using ROE, ROI, ROS) in South Africa (Ganda & Milondzo, 2018). Clarkson, Li, Pinnuck, & Richardson (2015) found a negative association between carbon emissions shortfalls and firm value of European firms under the European Union Carbon Emissions Trading Scheme. This study developed these hypotheses:

H4a. A firm's CO2 emissions reduction would have a positive impact on return on assets (ROA).

H4b. A firm's CO2 emissions reduction would have a positive impact on return on equity (ROE).

H4c. A firm's CO2 emissions reduction would have a positive impact on Tobin's Q.

2.4.2 ESG disclosure and corporate financial performance

An early study examines the link between environmental disclosure and CFP using agency theory, stakeholder theory and legitimacy theory (Berthelot & Robert, 2011; Freedman & Jaggi, 2005; Y. He et al., 2013; Llena et al., 2007). Corporate, social and environmental information disclosure can help a firm build a good reputation and improve its corporate brand (Bebbington et al., 2008). In stakeholder theory, making a good reputation and developing a good relationship with stakeholders can enhance the competitive advantage of firms, increase revenue and profit growth, and attract new investors and customers (Murray et al., 2006).

If a firm discloses more information about environmental performance and management, the firm will be less influenced by adverse events (Blacconiere & Patten, 1994). Using Germany's evidence, improved environmental disclosure is associated with lost costs of firm operations (Aerts et al., 2008; Cormier & Magnan, 2007). A similar result was derived from evidence of US environmental disclosure quality and proved to be a positive influence of firm value based on five sensitive environmental industries (Pulp and Paper, Chemicals, Oil and Gas, Metals and Mining, and Utilities) (Clarkson et al., 2013). This study developed these hypotheses:

H5a. A firm's ESG disclosure would have a positive impact on return on assets (ROA).

H5b. A firm's ESG disclosure would have a positive impact on return on equity (ROE).

H5c. A firm's ESG disclosure would have a positive impact on Tobin's Q.

2.4.3 CSR strategy and corporate financial performance

Some research studies on the CER (corporate environmental responsibility) practices can help a company improve resources used and energy-saving, thus reducing cost and improving financial performance (Ambec & Lanoie, 2008; Lai & Wong, 2012). Green supply chains have been documented as beneficial for firm environmental and financial performance (G. Zhu et al., 2018). Firms with sound financial and environmental performance will have more incentive to disclose environmentally-related information to stakeholders to reduce information asymmetry and avoid negative attention from customers and other stakeholders (Villiers & Van Staden, 2011). A firm with good environmental performance and environmental legitimacy proves to be more helpful in obtaining stakeholders' trust. Some academics consider trust capital generates financial benefits (economic growth and cost-saving) and non-financial benefits (reputation, business potential) (Qin et al., 2019).

Documenting customer response, (Rokhmawati et al., 2017), can strengthen the influence of CEP on CFP. In most areas, when customers become more aware of a firm's environmental impact, firms are urged that more eco-friendly products should be produced than before (E. E. Smith & Perks, 2010). A firm is well to disclose some environmental transparency information that will help enhance return of assets for the firm, but this is not significantly related to the firm costs (Clarkson et al., 2013). Other research revealed that consumers prefer to use products dependent upon the quality of the products and not upon its relation to the environment (Hibiki & Managi, 2010). An environmentally friendly firm is not more competitive because of environmental expenditure and cost burden. So, environmental performance improvement does not generate company profit but decrease profit margins (Fujii et al., 2013). Thus, it is still unclear as to what extent that environmental disclosure influences CFP. Some research studies on Chinese corporate environmental responsibility practices can help a company improve resources used and energy-saving, thus reducing cost and improving CFP (Ambec & Lanoie, 2008; Lai & Wong, 2012). An example is the green supply chain that has been documented to function beneficially for CEP and CFP (G. Zhu et al., 2018). Firms with good CEP have greater incentive to disclose environmentally-related information to stakeholders to reduce information asymmetry and avoid negative attention from customers and other stakeholders (Villiers & Van Staden, 2011). A firm with a good CEP and environmental legitimacy is has greater potential in obtaining stockholder trust; some academics think that trust capital can generate financial benefits (economic growth and cost-saving) and non-financial benefits (reputation, business potential) (Qin et al., 2019). Environmental strategies reduce environmental pollution through proactive ways (K. H. Lee & Min, 2015; Porter & Reinhardt, 2007). From a resource-based review, firms need to improve CFP through improving environmental performance, such as reducing carbon emissions and other pollution (Córdova et al., 2018; Fujii et al., 2013; Gallego-Álvarez et al., 2015; Ganda & Milondzo, 2018; Y. He et al., 2017; Iwata & Okada, 2011).

The improved corporate environmental management system and friendly environmental activities and strategies lead to more material efficiency (Orlitzky et al., 2003; Vlasov et al., 2014). Whether environmental research and development expenditure is a legitimizing tool, this environmental attitude can improve environmental management motivation for protecting the environment. This study constructed these hypotheses:

H6a. A firm's CSR strategy would have a positive impact on return on assets (ROA).

H6b. A firm's CSR strategy would have a positive impact on return on equity (ROE).

H6c. A firm's CSR strategy would have a positive impact on Tobin's Q.

2.4.4 Firm size and corporate environmental performance

Despite numerous research conducted on the CEP–CFP relationship, there is little literature that examines the impact of firm size on the relationship between these variables. Notable exceptions are some pioneer studies (Dang & Li, 2015; Frank & Goyal, 2003; Moeller et al., 2004).

Larger companies are more visible and sensitive to social reactions (W. L. Lin et al., 2019). Romero et al. (2018) found that large firms are more at risk of penalties; the size of the company producing the pollution plays a significant role in the penalty received; this means that large firms are harmful to firm environmental performance and financial performance to some extent. Herbohn et al. (2014) suggested that the large firm is more accountable for ecological disclosure and more pressure from stakeholders. From the perspective of regulations, Lyon & Maxwell (1999) analysis, voluntary environmental protection plays an essential role in firm strategies. The cost of new rules will lead small firms to exit from specific industries, but large firms may benefit from the regulations that require industry-wide compliance. Konar and Cohen (2000) found that the largest firms are most likely to reduce emissions under pressure of information disclosure to the public. Arora and Timothy (1995) Khanna and Damon (1998) suggested that large firms are more likely to join the Environment Protection Agency (EPA) program than smaller firms. Patten (1992) indicated that firm size improves corporate environmental disclosure. Gray et al. (1995) examined the UK firms and concluded that large firms are more prone to exposure of more mandated and voluntary ecological information. Clarkson et al. (2008) concluded that large firms tend to disclose environmentally-related information and that larger firms are less affected by social responsibility with more social buffering (Meznar & Nigh, 1995). Large organizations are related to higher-level finances which can significantly affect their commitment to environmental initiatives (R. A. Johnson & Greening, 1999). Different company-level attributes affect CEP. Therefore, it is crucial to understand these effects because they can develop strategic value from green strategies (Hörisch et al., 2015; Madden et al., 2006). Large companies are better at using environmental plans to create profits (Hörisch et al., 2015). But other studies give different opinions. (W. L. Lin et al., 2019) revealed small firms that invest in green innovation can bring more profit than large firms. Madden et al. (2006) indicated that small and medium enterprises prefer to avoid cash donations, are more willing to support local causes, and benefit from developing best practice guidelines.

2.4.5 Firm size and corporate financial performance

Large companies with more market concentration are more efficient and better for firm profitability (Gichura, 2011; Kakani et al., 2011; Merikas et al., 2006). Tarawneh (2006) pointed out that barriers to entry and company strategies are the advantages of a big firm that makes them have more competition to overcome other competitors and therefore, beneficial for financial performance. Glen et al. (2003) found that big firms have more solid competitive capability than small competitors; these differences afford larger companies superior access to resources and financial support. Large firm size improves firm ability to produce highly technological products, leading to concentration within the supplies market. Therefore large firms have accessed more of the market segment and thereby significantly improved the CFP (Agiomirgianakis et al., 2006; Hall & Weiss, 1967).

Previous studies have shown mixed firm size influence on CEP and CFP. Firm size influence on CEP is inconsistent. Some scholars suggest that large firms tend to disclose more environmental information (Hörisch et al., 2015). However, others believe that small firms are incentivised to pursue green innovation and generate high profits (W. L. Lin et al., 2019; Romero et al., 2018). Even though many corporate environmental studies include firm size, most of them identify firm size as a control variable, and rarely produce an empirical result. This study will examine firm size role and its influence on CEP and CFP. Most previous studies have shown that large companies pay more attention to environmental protection and have more resources to achieve goals, form an environmental management system and set up an environmental committee to address the environmental issues and relationships with external stakeholders.

The reputation of a large company is more important than a small company. Furthermore, there is an inconsistent result in relation to firm size and CFP. Most of them suggested that the firm size positively impacts corporate profit (Gichura, 2011; Kakani et al., 2011; Merikas et al., 2006). However, others demonstrated a negative (Banz, 1981; Tarawneh, 2006) or absent relationship (Amato & Amato, 2004; Goddard et al., 2006) between firm size and CFP. Therefore, firm size is a critical element that prompts firm concern about environmental issues, and also an unexplored area regarding CEP influence on CFP under the moderating effect of firm size. Most previous research focuses on firm size with relation to firm profit and ROA, but little research exists regarding firm size influence on market-based CFP. To investigate the moderate effect of firm size on the relationship between environmental performance and financial performance, this study developed these hypotheses:

H4aa. Firm size has a moderate effect on the relationship between emissions reduction and return on assets (ROA).

H4bb. Firm size has a moderate effect on the relationship between emissions reduction and return on equity (ROE).

H4cc. Firm size has a moderate effect on the relationship between emissions reduction and Tobin's Q.

H5aa. Firm size has a moderate effect on the relationship between ESG disclosure and return on assets (ROA).

H5bb. Firm size has a moderate effect on the relationship between ESG disclosure and return on equity (ROE).

H5cc. Firm size has a moderate effect on the relationship between ESG disclosure and Tobin's Q.

H6aa. Firm size has a moderate effect on the relationship between CSR strategy and return on assets (ROA)

H6bb. Firm size has a moderate effect on the relationship between CSR strategy and return on equity (ROE).

H6cc. Firm size has a moderate effect on the relationship between CSR strategy and Tobin's Q.

2.5 TMT characteristics and corporate financial performance

The directors of a board provide significant amounts of critical, internally based methods for management monitoring. They can oversee a firm's management and offer incentive advances to managers that improve firm governance (Fama, 1980). The top management team is beneficial for corporate functions if the upper echelons work as a team (Carpenter, 2002). The board director is leader in a group, based on the upper echelons theory and the informal hierarchy of the board can increase the working efficiency and improve financial performance (HE & HUANG, 2011). But other results have shown that based on the upper echelons theory and social capital theory, the TMT characteristics such as age and female director negatively impact corporate technological innovation (W. Zhu & Yin, 2015).

2.5.1 Gender diversity and corporate financial performance

Board gender diversity is increasingly attractive for the scholar in recent years; there have been a significant number of research analyses on the functions of women on the board for organizational decision making, effects on outside stakeholders, and further impacts on corporate social and financial performance (Kirsch, 2018; Wu, Furuoka, & Lau, 2021). Another review paper from 400 publications reveals that women directors on the board improve corporate governance by using the entire talent pool capital available and dealing with the relationships of stakeholders (Terjesen et al., 2009).

Previous studies documented that female directors can enhance financial report quality, firm reputation, social and financial performance (Byron & Post, 2016; Chapple & Humphrey, 2014; Gul et al., 2013; Post & Byron, 2015; Srinidhi et al., 2011). Other researchers have suggested that the increased female board representation commonly relies on four criteria: improving financial performance, access to a vast talent pool, increasing responsiveness to the market and strengthening corporate governance. Female directors have displayed an increased sensitivity to social and environmental performance (Doldor et al., 2012). Policymakers seem to agree that women leaders can save firm economics (R. B. Adams, 2016). Perryman et al. (2016), Vieito & Khan (2012) found gender diversity in top managment will reduce firm risk and increase financial performance through panel data analysis. Evidence has also been provided that even though top female managers have increased this year, there is still an unbalanced salary between female and male managers. By analyzing female board representation, more can be determined concerning the constraints women face and their career advancement.

The appointment of women directors should boost a firm's performance in these areas, leading to a favorable reputation amongst its stakeholders (Bear et al., 2010). Consequently, stakeholders may easily get information from the company and resources that they can control, with a subsequent beneficial effect on financial performance and value of a firm (Low et al., 2015). Francoeur et al. (2008) investigated the 230 public firms from Canada. The result showed that the high ratio of female directors on the board proved to be more beneficial to improving corporate management and governance. From the agency theory perspective, the result supported the advantages of women directors on a board for firm business. Evidence from European firms showed that female directors directly increase firm value and some other ethical aspects that are not captured by accounting-based financial performance (Isidro & Sobral, 2015). Another study highlighted similar evidence from Fortune 500 companies and showed gender diversity improves firm financial performance through ethic enhancement (Carter et al., 2007).

By analysing 2,500 of the largest Danish firms from 1993 to 2001, N. Smith et al. (2006) found that top female managers are strongly dependent on qualifications and increase firm financial performance. The evidence from multiple areas of Asia (Hong Kong, South Korea, Malaysia and Singapore), resulted in identifying that female director positively impacted upon the accounting-based financial performance of ROE, but this effect of female directors will be diminished in countries with high female economic participation and empowerment (Low et al., 2015).

Galbreath (2011) revealed that companies motivated by innovation recognize that women on boards can enhance a company's competitive advantage through their experience, skills and broader perspectives. In symbolic appointments, an appearance of board gender diversity is maintained without female directors playing an influential role. There are various research reports on increasing female members corporate boards participation (Hafsi & Turgut, 2013). Given that the number of women on corporate boards has increased, several researchers have made the attempt to elucidate the contribution of women to a company's performance. Some studies reported that the presence of women on corporate boards resulted in improved company performance. There is a positive link between the ratio of broad female-to-male members on Tobin's Q in Spanish firms (Campbell & Mínguez-Vera, 2008). There is similar evidence from the sample of Fortune 1000 companies (Carter et al., 2003) and Malaysian companies (Julizaerma & Sori, 2012).

Contrastingly, other researchers employ empirical studies and produce different results. They have determined that there is a negative relationship between gender diversity and financial performance. This is due to information that females on the board will over-monitor the companies and lead to bad influence (R. B. Adams & Ferreira, 2007, 2009). Other information may indicate that if women on the board are driven by family relationships rather than professional skills and experiences, it might reduce ROA's and Tobin's Q (Darmadi, 2011). Other evidence from 47 countries from 3,876 public firms supported a female director's function on the board; the result showed that the high percentage of female directors will increase firm accounting-based financial performance ROA and marketing-based financial performance Tobin's Q (Terjesen et al., 2015). A similar result from Erhardt & Werbel (2003) has investigated 127 large US companies and found a positive link between the demographic diversity of board directors and financial performance. The panel data analysis from Spanish firms by gender indicators of Blau and Shannon indices showed that increasing gender diversity will generate economic gains (Campbell & Mínguez-Vera, 2008).

Lam et al. (2013) have investigated Chinese listed firms from 2000 to 2008. The 10,000 firm-year data showed that Chinese firm female managers increase quickly. Still, there is no substantial evidence to support that the female component benefits firm financial performance. The evidence from Norway reveals that female directors negatively influence financial performance and mitigate financial risk (Yang et al., 2019).

There are other indicators that should be considered in analysing the relationship between gender diversity and financial performance. Y. Liu et al. (2014) investigated samples from China. They found that a female director increases the financial performance of the private firm, but this effect does not appear within state-owner firms. To investigate the relationship between gender diversity and corporate financial performance, executive gender diversity and financial performance, this study developed the below hypotheses:

H7a. A firm's gender diversity would have a positive impact on return on assets (ROA).

H7b. A firm's gender diversity would have a positive impact on return on equity (ROE).

H7c. A firm's gender diversity would have a positive impact on Tobin's Q.

H7d. A firm's executive gender diversity would have a positive impact on return on assets (ROA).

H7e. A firm's executive gender diversity would have a positive impact on return on equity (ROE).

H7f. A firm's executive gender diversity would have a positive impact on Tobin's Q.

2.5.2 Independent director and corporate financial performance

Independent directors on the board positively influence firm financial performance (J. J. Choi et al., 2007; Schmid & Zimmermann, 2008), independent directors are more effective in impacting firm management capability (Mura, 2007) and protecting shareholder interests against managerial opportunism (R. Adams et al., 2008; Klein, 2002). Independent directors focus on long-term benefits rather than short-term performance, and along with this focus, the board committee generally includes outside members (Klein, 2002). An independent director significantly enhances firm financial information quality and integrity (Fernandez, 2014). Wang (2014) used meta-analysis to investigate the effect of independent directors on corporate financial performance in Chinese firms by 30 empirical articles. The result showed that an independent director does not significantly impact financial performance; an independent director on a committee assumes an advisory role but does not monitor. Research concerning US companies showed that independent directors increase profits in low profitability firms, but this function does not work in high profitability firms (Black & Bhagat, 2000). The documented national context has a moderate impact on the relationship between an independent director and financial performance, and the legal system does not (Zattoni et al., 2017).

Independent directors provide board services, bring them additional skills and experiences, and play a crucial role in firm strategies (Min & Smyth, 2014). It allows them to improve management skills in the firm, reduce costs and increase financial transparency (X. Chen et al., 2015; Cuadrado-Ballesteros et al., 2015; Isabel María García-Sánchez, 2010). This also includes the avoidance of benefit conflict between managers and shareholders (Villarón-Peramato et al., 2018). It has been documented that an independent director on the board will enhance technical efficiency and improve firm financial performance using international samples (Uribe-Bohorquez et al., 2018). It has been found that independent directors have an overall positive effect on athletic operating performance in China. Meanwhile, empowering independent directors may lead to more effective monitoring and higher firm value (Y. Liu et al., 2015). Evidence from Malaysian firms showed that a high percentage of independent directors will enhance the corporate governance mechanism effectively (Ashikin et al., 2011). Sanda et al. (2011) investigated the panel data of 205 firms from Nigeria. The results indicated that firms should increase director independence to enhance corporate governance; in conjunction, the effective governing mechanisms of independent directors on the board have also been documented in Malaysia (Ashikin et al., 2011).

On the other hand, because independent directors do not stay with a company for a long time, their decisions are not always timely and suitable (Cavaco et al., 2017; Uribe-Bohorquez et al., 2018). It showed that an independent director does not significantly influence financial performance because some firm independent directors lack absolute independence (Alshetwi, 2017). Ammari, Amdouni, Zemzem, & Ellouze (2016) documented the existence of a board dominated by independent directors that exhibited a negative impact on accounting performance.

Singhchawla & Evans (2011) investigated the subcommittees of 250 listed firms from Australia and the results showed that if the independent director was not independent and influenced by shareholders, independent directors would negatively impact firm financial performance. The other study from Terjesen et al. (2015) showed that an independent director does not contribute to firm financial performance unless there is gender diversity on the board. Another study showed that an independent director can negatively impacted financial performance. The main reason is that the outside director cannot play an independent role by restricting shareholders (Singhchawla & Evans, 2011). In Greece, H. Zhou et al. (2018) investigated the Athens Stock Exchange during 2008–2012; the result revealed no association between independent directors and financial performance. To investigate the relationship between independent director and corporate financial performance, this study developed hypotheses below:

H8a. The percentage of independent director would have a positive relationship with return on assets (ROA).

H8b. The percentage of independent director would have a positive relationship with return on equity (ROE).

H8c. The percentage of independent director would have a positive relationship with Tobin's Q.

2.5.3 Environment committee and corporate financial performance

The environmental committee is interchangeably called the sustainability committee or CSR committee (Biswas et al., 2018). The environmental committee in the panel provides services to design strategies to manage social and environmental issues and improve environmental management implementation. From a stakeholder theory perspective, establishing an environmental committee indicates to stakeholders the firm's concern for high sustainability. Firms need to set a sub-committee to enhance social and environmental confidence for the market and investors (Eccles et al., 2014).

Most studies focus on the relationship among the risk committee (Elamer & Benyazid, 2018), nomination committee and remuneration committee (Zraiq & Faudziah Hanim Bt Fadzil, 2018) on corporate financial performance. There are relatively few studies on the environmental committee and financial performance. The results for the environmental committee and financial performance have generally been inconclusive as the limited research on the impact of environmental concerns in relation to and the sustainability of corporate financial performance suggests a need to study this relationship further (Kolev et al., 2019), although more recent studies incorporating more specific controls have challenged this (Peter and Romi, 2014).

GHG emissions disclosure used data gathered on United Kingdom firms and this effect was enhanced with a board that consisted of more independent directors or environmental committees. Peter and Romi (2014) similarly argued that from the point of view of the stakeholder theory, support for the presence of an environmental committee is positively associated with the likelihood of greenhouse gas disclosure. Significant evidence was found that links the expertise of its members with greenhouse gas disclosure. Previous research on the environmental committee has mainly been studied as an effect based on the environmental performance, but little is known about the cause of the environmental committee on financial performance. Whereas board committees such as audit and remuneration committees have always been a tradition in a board's governance structure, environmental committees are a reasonably new establishment. To investigate the relationship between the environmental committee and corporate financial performance, this study employed these hypotheses:

H9c. A firm environmental committee on the board would have a positive relationship with return on assets (ROA).

H9c. A firm environmental committee on the board would have a positive relationship with return on equity (ROE).

H9c. A firm environmental committee on the board would have a positive relationship with Tobin's Q.

2.5.4 Board size and corporate financial performance

Due to the complexities of a firm in operation, especially if a firm is large, it may often display dysfunctional characteristics (M. C. Jensen, 1993; Khanchel, 2007). Corporations may prefer a limited number of boards directors (M. C. Jensen, 1993; Lipton & Lorsch, 1992). Many studies have been conducted on board size and their risks and performance (M. C. Jensen, 1993; Lipton & Lorsch, 1992; Rashid et al., 2010). Lipton & Lorsch (1992) recommended that the number of directors should be between seven or eight persons, because when its size increases the board might become less effective in monitoring management. Jensen (1993) argued for keeping boards small as when the board size goes beyond that board members are less likely to function, and it would undermine the monitoring role of the board of directors and slow decision making with regard to firm performance through efficient use of resources.

Abundant research has also been conducted on firm financial performance in relation to board size. There has been mixed response though to the existing relationship between board size and firm performance. Some have found that large boards will lead to less effectiveness and negatively influential firm performance (Hermalin & Weisbach, 2001; M. C. Jensen, 1993; Kalsie & Shrivastav, 2016; O'connell & Cramer, 2010; Razali et al., 2019). It has also been considered that when a board becomes too big, it often moves into a more symbolic role rather than performing its monitoring role. Jensen (1993) stated that a small board can improve firm financial performance and make it easier for a CEO to monitor.

Ammari et al. (2016) investigated 80 publicly listed French firms from 2001 to 2013. The results showed that the large board size negatively affected market performance but positively impacted the firm accounting performance. Another investigation showed that board size was positively related to corporate financial performance, but this is because firms with large board sizes usually have large firm sizes (Badu & Appiah, 2017). H. Zhou et al. (2018) investigated the Athens Stock Exchange during 2008–2012 in Greece, and the results supported the positive relationship between large board size and financial performance.

In contrast to smaller boards, a large number of directors on the board increases problems of communication (Cheng, 2008). Larger boards may be skeptical about making strategic decisions and more of a minor part in the natural management process (Hermalin & Weisbach, 2001). In contrast, some studies have found that company performance improves when the board is larger rather than smaller (Adhikary et al., 2014; Alkdai & Hanefah, 2012; Shukeri et al., 2012). Fauzi & Locke (2012) also found that large boards are more effective in monitoring management and achieving long-term objectives. Another study in India found that firms with larger boards indicated that financial accounting structures are monitored better (Sahu & Manna, 2013). Setia-Atmaja (2008) analyzed firms listed on the Australian Stock Exchange (ASX) and found a positive relationship between board size and Tobin's Q. Most arguments suggest that beyond a certain board size or crucial period, the widening of a management team can improve firm performance. To investigate the moderate effect of board size on the relationship between top management teams and corporate financial performance, this study provided the following hypotheses:

H7aa. Board size has a moderate effect on the relationship between gender diversity and return on assets (ROA).

H7bb. Board size has a moderate effect on the relationship between gender diversity and return on equity (ROE).

H7cc. Board size has a moderate effect on the relationship between gender diversity and Tobin's Q.

H7dd. Board size has a moderate effect on the relationship between gender diversity and return on assets (ROA).

H7ee. Board size has a moderate effect on the relationship between gender diversity and return on equity (ROE).

H7ff. Board size has a moderate effect on the relationship between gender diversity and Tobin's Q.

H8aa. Board size has a moderate effect on the relationship between percentage of independent directors and return on assets (ROA).

H8bb. Board size has a moderate effect on the relationship between percentage of independent directors and return on equity (ROE).

H8cc. Board size has a moderate effect on the relationship between percentage of independent directors and Tobin's Q.

H9aa. Board size has a moderate effect on the relationship between environment committee and return on assets (ROA).

H9bb. Board size has a moderate effect on the relationship between environment committee and return on equity (ROE).

H9cc. Board size has a moderate effect on the relationship between environment committee and Tobin's Q.

2.6 Research Gaps

This study found research gaps follow the literature review. We develop research gaps in four dimensions. Firstly, for knowledge gap, this research we explore more of the environmental committee, which is untraditional committee and is a new research area without more explored (Kolev et al., 2019). Secondly, for population gap, this study Compare Germany, Japan and China and investigate how different attitude to female director will impact on corporate governance. Thirdly, for methodological gap, This study using board characteristic as moderating indicator to test the top managers on corporate environmental and financial performance, this study using ARDL model to test the CEP-CFP relationship. Lastly, for practical purposes, As inevitable to pay attention to firm environmental performance, this study try to find the way that how firms to balance the environmentally friendly strategies and financial performance. This study also give suggestion for firms of Environmental accounting systems, after the statement of government of Carbon-Neutral in 2050 (Germany and Japan) and 2060 (China), organizations need a new environmental accounting system to facing Carbon finance in following decades.

2.7 Hypothesis Framework

Following the sections 2.3, 2.4 and 2.5, we developed 33 hypotheses that involved top management, environmental progress and corporate financial performance; we also devised another 33 hypotheses to investigate board size and firm size as moderate variables for the top management, environmental and financial performance nexus. We measured top management using four dimensions: gender diversity, executive gender diversity, percentage of independent director and dummy variable environment committee. Furthermore, we provided three dimensions of corporate environmental performance, named emissions reduction, ESG disclosure and CSR strategy; alongside these three variables to measure financial performance were included: ROA, ROE and Tobin's Q.

As Figure 2.1 illustrates, the hypothesis of relationship between top manager team and environmental performance (H1, H2 and H3), the hypothesis of relationship between environmental and financial performance (H4, H5 and H6), and the hypothesis of relationship between top manager team and financial performance (H7, H8 and H9) have been indicated. The moderate effecting of firm size and board size from figure 2.1 are also included and are detailed as the moderate effect of board size on the relationship between top managers and environmental performance (H1aa-H3cc); board size on the relationship between top managers and financial performance (H7aa-H9cc); firm size on the relationship between environmental performance and financial performance (H4aa-H6cc).

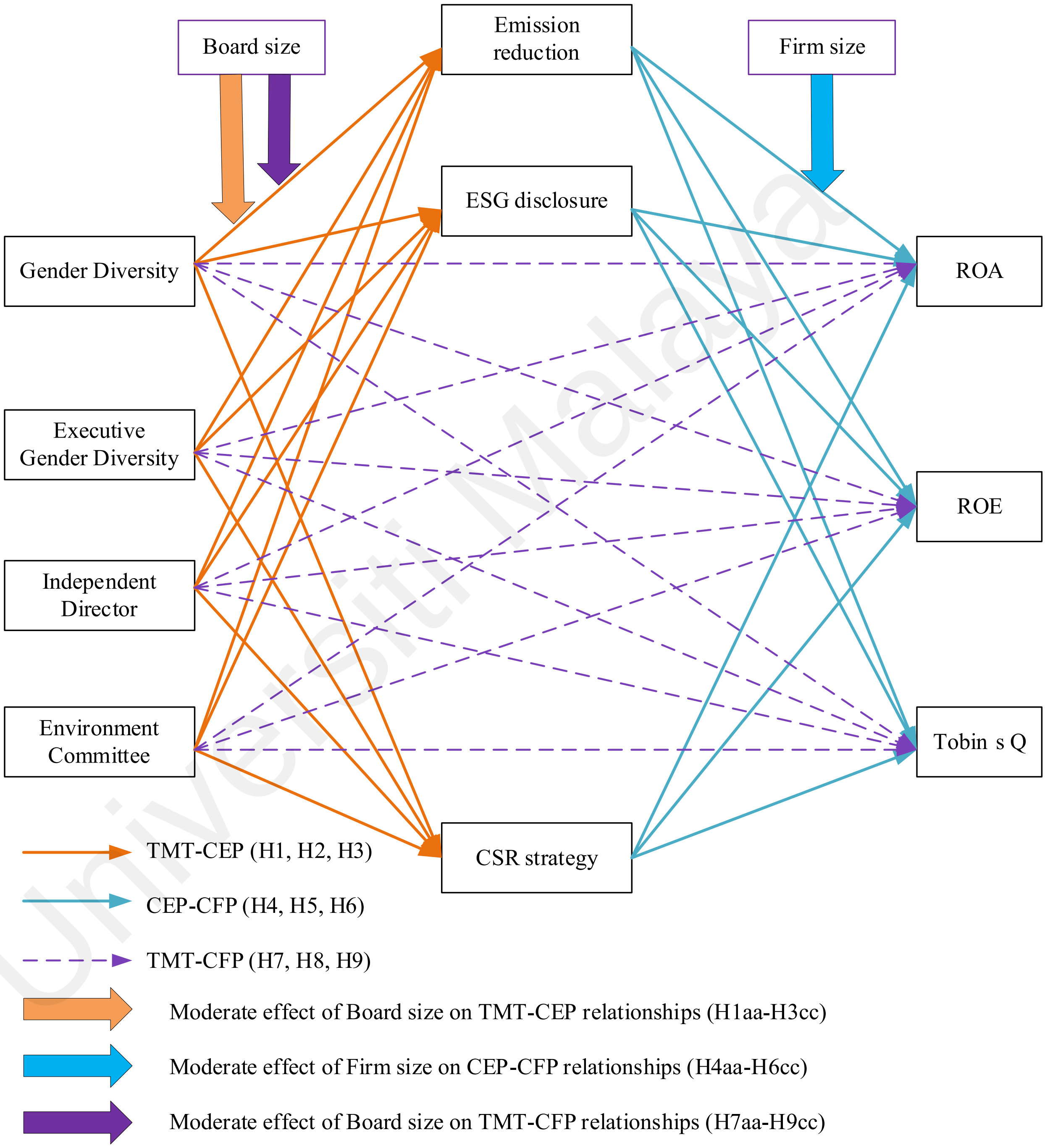

Figure 2. 1 Hypothesis Framework

2.8 Theoretical background

Corporate environment performance, the role of governance mechanisms such as board gender diversity and environmental committees in corporate finance performance can be regarded from different theoretical viewpoints, overlapping with each other (J. C. Chen & Roberts, 2010; L. Liao et al., 2015). Many theories explain top corporate management, environmental performance and financial performance (e.g. gender socialization theory, critical mass theory, resource dependency theory, upper echelons theory, agency theory, stakeholder theory, signal theory, institutional theory and legitimacy theory).

The gender socialization theory (Connell, 1987; Gilligan, 1993) compares the development of females and male morals. Males usually exhibit a perspective of justice and can discriminate right from wrong. Females usually portray a perspective of responsibility and consider the social and environmental aspects more when making decisions. Women on the board or women CEOs are more concerned with the welfare of outside stakeholders and female directors are more likely to attempt to reduce environmental-related risks (Carlson, 1972; C. Liu, 2018).

Critical mass theory (Kanter, 1977; Marwell & Oliver, 1993) originated within physics and has now been applied to social science to interpret the number of female directors and independent directors on the board that influence board decisions. When the size of a subgroup has been increased to a certain level, significant influencers become apparent with the minority group. Previous literature argued that with a greater number or percentage of female directors and independent directors on the board, it can become easier for opinions to be expressed and it is easier to influence company environmental strategies (Ben-Amar et al., 2015; Birindelli et al., 2019; Biswas et al., 2018; Charumathi & Rahman, 2019; Cook & Glass, 2017; T. L. Lin et al., 2018).

Resource dependency theory was formed by (Salancik & Pfeffer, 1978), and it indicates how external resource impact company behaviour and strategies (Hillman et al., 2009). There are complex business contexts and strict environmental requirements and so leaders in a firm may begin to rely more on outside stakeholder support (Terjesen et al., 2009). In this case, a good leader on the board will bring information and expertise to the company and generate useful communication and prudent decisions with outside stakeholders (Badu & Appiah, 2017; DiMaggio & Powell, 1983; H. Zhou et al., 2018).

Using the upper echelons theory (D. C. Hambrick & Mason, 1984) indicated that a top manager's background and characteristics predict firm performance. The upper echelons require observation data of the background of top managers (Carpenter et al., 2004), and other investigations focus on the executive result of corporate governance (Donald C. Hambrick, 2007). Top managers as a team, will give a sustainable perspective and strategies for firm environmental and financial performance (Shahab et al., 2019).

Agency theory (M. C. Jensen & Meckling, 1976) revealed the principal–agent problem of companies. The problem in business is that top managers as agent operating companies will exhibit a greater likelihood to sacrifice owner interests for their own sake. Managers will develop projects with short-term benefits and indicates less willingness to develop sustainable projects as these actions help their bonuses and careers (Carter et al., 2010; Francoeur et al., 2008; M. Jensen & Meckling, 2012; Kyaw et al., 2017; Ross, 1973). Independent directors on a board that represent shareholders and other stakeholder interests and female directors will care more about sustainable perspectives and so this may work to solve the proxy problem to a certain extent (Cabeza-García et al., 2017; Cha & Abebe, 2016; Hossain et al., 2017; Lone et al., 2016; Mustafa et al., 2016).

Stakeholder theory (Friedman, 1970) is a corporate governance theory and business ethic. Company operations are not influenced by shareholders (owners) but external stakeholders, such as creditors, employees, communities, customers, and other participants. The top managers of companies are not only responsible for shareholders but also for external stakeholders (Fernandez-Feijoo et al., 2014; Frias-Aceituno et al., 2013; Hermalin & Weisbach, 2001; Valls Martínez et al., 2019; Yasser et al., 2017). Companies in modern business models need to change methods of management where profit is the primary pursuit because that is not the only concern of external stakeholders.

Institutional theory (DiMaggio & Powell, 1983) indicates that organisations follow rules, norms, and guidelines of business behaviour. Under strict government regulations and policies, firms are obligated to disclose CSR performance and increase the strategies addressing environmental performance (Marquis & Qian, 2014; Pearce & Chertow, 2017). In this case, as environmental policies become increasingly restrictive worldwide, firms must adapt and develop environmental strategies in response to national policies.

Legitimacy theory (C. Deegan, 2006; C. Deegan et al., 2002) argues that companies need to satisfy external stakeholders by disclosing social and environmental responsibility information. The legitimacy theory assumes a contract exists between firms and external stakeholders; in essence, firms should be responsible for external stakeholders (Drees & Heugens, 2013; Hummel & Schlick, 2016; Jung et al., 2016; Qin et al., 2019).

Table 2. 1 Summary of Theories

Theory	Key reference	Application in Corporate Management
Gender socialization theory	Connell (1987), Gilligan (1993)	Female cares more about social responsibility
Critical mass theory	Kanter (1977), Marwell & Oliver (1993)	Female and Independent director easily express opinions in greater numbers
Resource dependency theory	Salancik & Pfeffe (1978)	External resources impact company behaviours and strategies

Upper echelons theory	D. C. Hambrick & Maso (1984)	Top managers influence firm performance outcomes
Agency theory	M. C. Jensen & Meckling (1976)	Owner and management information asymmetry may lead to changes in management decisions
Stakeholder theory	Friedman (1970)	External stakeholders prioritized over profit

Table 2.1 continued

Institutional theory	DiMaggio & Powel (1983)	Company business behaviour influenced by rules, norm and guidelines
Legitimacy theory	C. Deegan (2006) C. Deegan et al (2002)	Implicit contract between firms and external stakeholders

2.8.1 Stakeholder theory

The stakeholder theory is based on the legal right of different groups (such as employees, customers, suppliers, governments, and environmentally-related groups) that participate as company stakeholders (Donaldson & Preston, 1995; Friedman, 1970). On the one hand, firms need to manage expenditure costs to improve ecological performance to satisfy stakeholders when facing environmental issues. On the other hand, firms may enhance reputation via improving environmental performance and stakeholder responsiveness. For example, customers may prefer products manufactured by a company with a reputation for good environmental performance and thereby improve company sales (Galant & Cadez, 2017; Rokhmawati et al., 2017).

In order to achieve corporate environmental targets, an organization needs to improve environmental performance and take responsibility for involved stakeholders. The firm can legitimize its environmental performance to stakeholders by enhancing customer loyalty and bolstering reputations, ultimately increasing firm financial performance to ensure sustainable development (Qin et al., 2019). According to stakeholder theory, firms should satisfy stakeholders with appropriate environmental performance, particularly the government sustainability development requirement is primarily the highest level of power (Y. He et al., 2017; Marquis & Qian, 2014).

Considering the stakeholder's fulfilment of corporate environmental performance, the firms need to comply with government environmental standards and regulations (Buysse & Verbeke, 2003). In solid social democracies, such as in Germany and some other developed countries, stakeholders have considerably more stable legal positions than in developing countries. Finally, stakeholder theory predicts that demonstrating greater accountability and transparency via an increased commitment to good environmental practice can help to improve firm reputation by balancing conflicting demands of various stakeholders. Brower & Mahajan (2013) investigated 447 firms from the US from 2000–2007 and the results indicated that firms need excellent environmentally friendly strategies in order to be able to develop greater sensitivity to stakeholders; these kinds of firms are at greater risk of increased scrutiny or stakeholder actions and have a broader range of (corporate social performance) CSPs responsive to the stakeholder environment they face.

2.8.2 Upper echelons theory

Board diversity and the creation of environment committees can also be viewed through the lens of the upper echelons theory, which has its origin in the seminal study of Hambrick & Mason (1984) and demonstrates how firm financial performance is dependent on its top management team characteristics as they hold power to make decisions that affect the firm (Carpenter et al., 2004; Hambrick & Mason, 1984; Hambrick, 2007). Thus, the background, experiences and behaviours of a top management team play an essential role in the planning, strategies, and operations of a firm (Carpenter et al., 2004; Hambrick & Mason, 1984; Hambrick, 2007). Also, the upper echelons theory indicates that better governance of a firm is achieved when board members are working together as a unified team. With their specific characteristics (including psychological and observable traits), these top management teams can affect company strategic choices and thereby improve corporate financial performance such as profits, growth, and survival (Shahab et al., 2018). Furthermore, female directors and independent director representation on the board not only impact environmental performance (McGuinness et al., 2017) but also decrease a firm's risk and improves financial performance (Luo et al., 2018). A director is different from their cognitive frames. This mental frame influences financial performance (Hambrick, 2007). Some studies use race, gender or education to measure TMT characteristics (Dezsö & Ross, 2012; Krishnan & Park, 2005). Therefore, the stakeholder and upper echelons theories suggest that organizations with good environmental performance and board characteristics effectively protect the interests of multiple stakeholders, which can positively impact corporate financial performance.

2.8.3 Theoretical contribution

By reviewing previous theories in this field, this study conducted research based on the upper echelons and stakeholder theories. As figure 2.2 indicates, based on the stakeholder theory, firms should enhance corporate environmental progress (eg. environmental policy, reduce environmental risk, make environmentally friendly products, carbon emissions reduction and CSR strategies) to improve reputation and attract customers, further reducing financial risk and increasing financial performance. Top managers in a firm play a critical role in communication with outside stakeholders, yet female and independent directors are care more about corporate social and environmental performance. The upper echelons theory argues that top managers will impact corporate performance, so this indicates that top managers of the board will devise suitable strategies to balance interests of different corporate stakeholders.

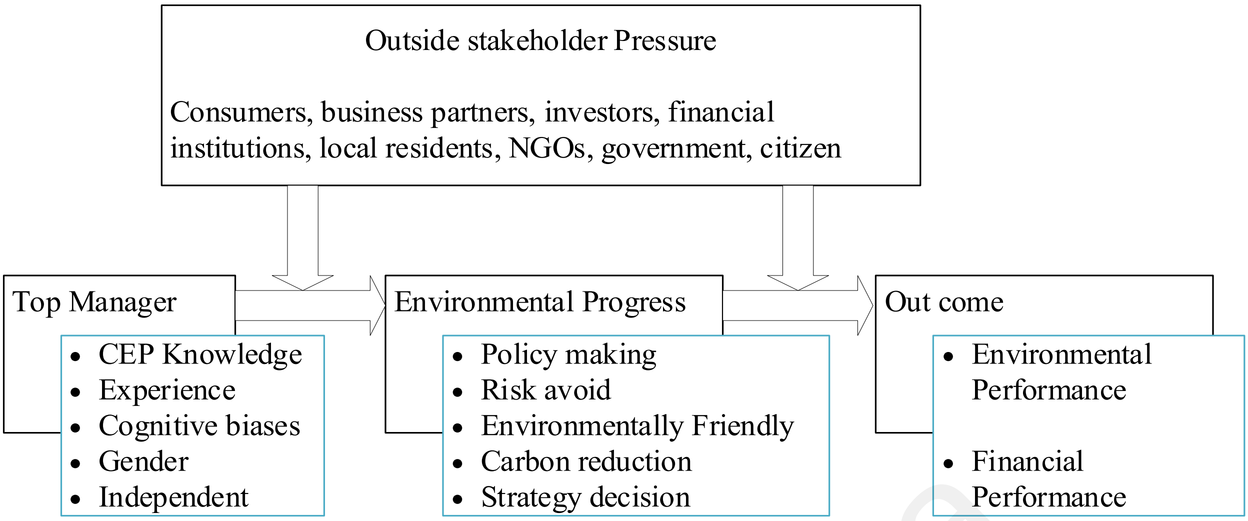

Figure 2. 2 Theoretical Framework

According to stakeholder theory, firms need to fulfill their environmental protection responsibilities. To achieve sustainable development, firms are required to enhance corporate environmental performance and significantly mitigate carbon emissions. In the context of the Carbon-neutral goal, the unprecedented challenge for corporations in the sustainability business is to properly steward the environment and deal with outside stakeholder relationships. From the perspective of interest stakeholder theory, this study analyses whether a company's environmental responsibility will affect development and financial benefits. In other words, firms with bad environmental performance will destroy relationships with stakeholders. This is dangerous for the long-term development of the company. Different TMT characteristics impact the environmentally-related strategic decisions and corporate environmental performance. Female directors and independent directors on the board pay more attention to a firm's non-financial performance, and the environmental committee is a special subcommittee for handling company environmental affairs. The traditional target of corporate business is economic profit—this is not suitable for green, sustainable development. In the past, temporary management would only pay attention to the benefits during the tenure without considering an enterprise's long-term development. Evidence has substantiated female directors care more about corporate social responsibility performance than males. This can consequently enhance the relationship between a company and interested stakeholders. Independent directors are usually outside and avoid violating the law and morality in business operations. The CSR Committee is a subcommittee that focuses on corporate social and environmental issues. In this study, we incorporate board characteristics to investigate the ability of upper echelons to achieve the target of firms successful interaction with stakeholders to further sustain corporate development.

This study will contribute to the upper echelon theory and stakeholder theory through the following three dimensions: Firstly, previous studies have been applied separately; the stakeholder theory has been used to analyze corporate environmental performance, and the upper echelons theory has been used to analyze the influence of TMT characteristics on financial performance. However, one study in particular combines these two theories to explore the relationship between TMT characteristics, corporate environmental performance, and financial performance (Ben Lahouel et al., 2020, 2022; Z. Liu, 2020). Therefore, this study will examine TMT characteristics that influence firm environmental and financial performance combining the stakeholder theory and upper echelons theory. Secondly, although studies on stakeholders have been explored in recent years, researchers aim to examine substantial stakeholders (shareholders, investors, suppliers). A smaller amount of study has been focused on minor power stakeholders (employees, customers, and NGOs) or unvoiced ones (environment, residents, and animals). But now, under strict regulations (Triebswetter & Hitchens, 2005) and laws related to the social responsibility of firms that are being employed in numerous countries, business functions face more challenges. Corporations should give greater consideration to the less powerful and voiceless stakeholders. The stakeholder theory provides a wider review of environmentally-related parties. The community and investors will exhibit more interest over time concerning a firm's environmental performance and firm reputation, which will thereby alter investor attitude and affect the competitiveness of enterprises. Thirdly, previous research has used the upper echelons theory to analyze the influence of firm TMT characteristics on corporate financial performance. Most of these studies on executive directors or CEO characteristics have rarely been focused on external directors—this study uses the upper echelons theory to examine different board characteristics (female director, independent director and CSR committee) that influence CEP and CFP.

2.9 Conceptual Framework

Friedman (1970) points out that an enterprise should improve social conscience and encourage responsibility for avoiding pollution and protecting the environment. The upper echelons theory was formed in 1984 and improved in 2007 (Hambrick & Mason, 1984; Hambrick, 2007). It was founded in the "upper echelons perspective", and was designed to analyze top management functions concerning a firm's strategic choices and firm performance. In this study, we followed these two theories and formed a concept that top managers are very important in a firm's environmental progress, especially top managers who communicate with external stakeholders. As figure 2.3 shows that, this study assumes that with a greater diversity of top managers, firms will more likely operate with environmentally friendly strategies and will be more likely to increase ESG information disclosure in order to achieve external stakeholder social and environmental requirements, and foster reputation and increase competitive capability as it is helpful to increase corporate sustainable development and have good financial performance over a long term. This study included board size as a moderate variable to check the moderating effect of board size on the relationship between top managers and environmental performance, as well as the moderate effect on the relationship between top managers and financial performance. This study also included firm size as a moderate variable to examine the moderate effect of firm size on the relationship between environmental performance and financial performance.

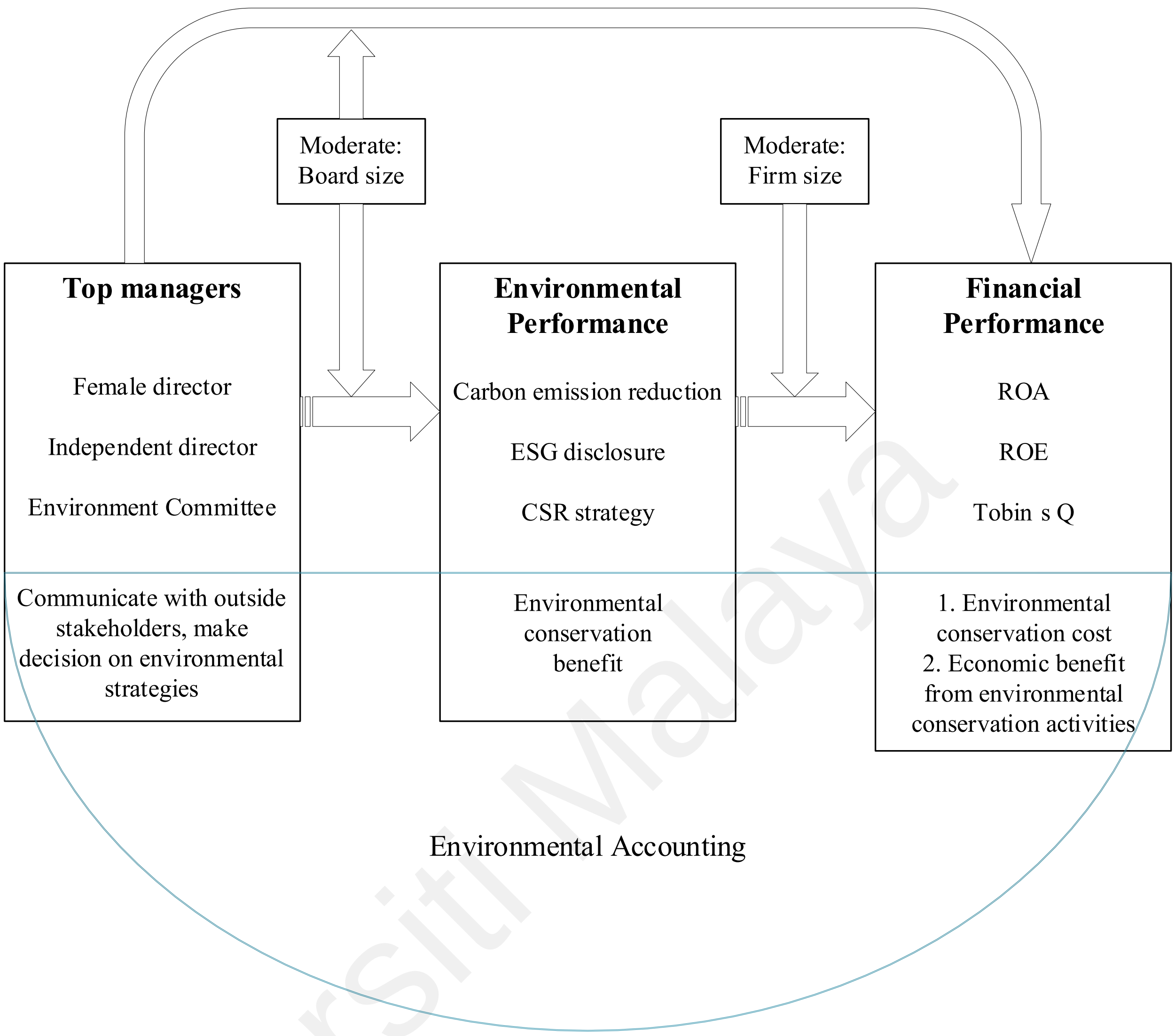

Figure 2. 3 Conceptual Framework

The increasing shift to environmental greening has attracted major roles for external stakeholders in the management of corporations. Corporations have since strengthened their focus on sustainable environmental images for their operations. External stakeholders are more likely to care about corporate social and environmental responsibility than in-house managers. The role of external stakeholders can raise environmental performance as its absence can attract government fines, lost customers, legal issues and loss of reputation, which in the long run will increase corporate financial risk. Based on the review of the corporate environmental accounting mechanism and corporate sustainable development issue raised, the follow research gaps are identified.

Corporate environmental and social performance is very important to companies, especially under local laws and regulations. Governments and other external stakeholders care more about corporate environmental and social performance than financial performance. This runs counter to the profit-oriented survival and development goals of enterprises. Enterprises urgently need to find a way to balance environmental protection and company development.

After the governments declare carbon neutrality in 2050 (Germany and Japan) and 2060 (China), organisations need a new environmental accounting system to deal with carbon finance in the coming decades. Carbon reduction is currently under discussion and may become an asset and be disclosed on the balance sheet. This will lead to future enterprises' financial planning to incorporate environmental issues into a link of their development.

This research fills and inspires companies to adapt to green business models. From the analysis of the characteristics of the management of the board of directors of the company, the role of the management of the board of directors in the environmental and social responsibility of the company, as well as the impact on the company's finance.

2.10 Summary of this chapter

This chapter we introduce the theory of environmental accounting, summarize the empirical literature review between variables, after review the previous research in this area, we found resarch gaps and developed the hypothesis. This chapter also summarize the theoretical background of this area and developed the conceptual framework of corporate environmental accounting system.

CHAPTER 3: METHODOLOGY

3.1 Introduction

This chapter aims to describe the methodology used in our study. The chapter is divided into five major parts. In part 3.2, the research philosophy is introduced. In part 3.3, variables used in this study are explained. In part 3.4, the sample in this study is discussed. In part 3.5, data collection of this study is discussed. In part 3.6, explains the data cleaning of this study. In parts 3.7 and 3.8, the statistical methods used in this research are presented and explained.

3.2 Research Paradigm

There are three philosophical foundations, namely ontology, epistemology and axiology, that are accessed to guide this research paradigm. Firstly, as a branch of philosophy, ontology is about the kinds and construction of existing things that are used to understand those things better; ontology is employed to engage with objects of inquiry and examine the nature of reality; it is used to establish different categories to classify existing things to better understand those things (Borchert, 2006; Floyd & Rumpza, 2020; Zalta, 2015). Secondly, epistemology is the study of the nature, origin and limits of human knowledge; epistemology deals with questions such as what is knowledge, what counts as knowledge, how knowledge claims are justified and the nature of explanations, subject-object relations and fact-value relations (Britannica, 1993; Steup, 2005). Thirdly, axiological ethics concerns itself with the values by which ethical standards and theories are upheld; it explores the justification for these values and examines if there is any beyond arbitrary preference. While axiological ethics can be considered a subfield within the branch of ethics, it also draws on thought from other fields of philosophy, such as epistemology and value theory (Findlay, 1970; Honderich, 2005).

Before initiating research, it is imperative to outline the research philosophy. This term is known as the research paradigm. According to Guba & Lincoln (1994), a research paradigm is the central belief system or principles that guide the researcher. It also represents how a researcher perceives the world. Paradigms play a fundamental role in science. Additionally, many past studies (e.g. Collis & Hussey, 2013; Creswell & Poth, 2016; Mouton & Marais, 1990; Neuman & Robson, 2012; Strydom, 2011) already employed the term and in supporting the theory of paradigms has consequently generated a significant impact on the philosophy and methodology of the social sciences.

In general, a paradigm is best described as a fundamental system of thinking (Neuman & Robson, 2012). A paradigm refers to the established research traditions within a particular discipline (Mouton & Marais, 1990), or a philosophical framework, as Collis & Hussey (2013) opine. More specifically, a paradigm would include the accepted theories, traditions, approaches, models, frames of reference, acknowledged bodies of research and methodologies and could be seen as a model or framework for observation and understanding (Babbie & Rubin, 2010; Creswell & Poth, 2016). A paradigm is thus essential because they become a storehouse of beliefs and dictates, which, for scholars in a particular discipline, can be influential in what should be investigated, how it should be examined, and how the rigorous inquiry should then be interpreted. According to Guba & Lincoln (1994), four paradigms are known as a choice of acceptance for researchers to follow: positivist, post-positivist, critical theory, and constructivism. Among the four, the positivist paradigm was applied in this study.

In simple terms, epistemology is the theory of knowledge and is used to consider knowledge gathering approaches and source selection. In research terms, the particular worldview and knowledge perspective primarily guides data interpretation, hence, the philosophical research approach should be immediately established (D. E. Gray, 2021;

Lehmann et al., 2016). Positivists assume that reality is objectively given and quantifiable at the ontological level. The positivist paradigm is generally referenced as the scientific paradigm. The measurable positivism outcomes explained by Cohen et al. (2000) include the assumptions of determinism, empiricism, parsimony and generality. Determinism implies cause and effect meaning, which factors cause the events observed by the researchers. Determinism helps empirical researchers better understand the meaning and expectations of research conducted through prediction and control. This further explains that researchers need to make predictions and formulate hypotheses based on the factors determined in the research. Thus, this study applies positivism to understand the various factors that impact environmental performance and financial performance, empirically predicting the top management, environmental and financial performance nexus.

3.3 Measurement of variables

This study examines our empirical methodology and separates it into four parts. First, the relationship between top managers and corporate environmental performance is assessed. In this part, emissions per sale, ESG disclosure and CSR strategy function as dependent variables, while gender diversity, executive gender diversity, percentage of independent director and environmental committee were designated to be independent variables; the board size serves as a moderating variable to test the moderating effect of board size on the relationship between top managers and environmental performance. The second part, is used to examine the relationship between environmental performance and financial performance both in the short run and the long run; ROA, ROE and Tobin's Q have been assigned as the dependent variables with emissions per sale, ESG disclosure and CSR strategy categorized as independent variables; the percentage of foreign sales, leverage and logincome have been classified as control variables in the short run, while logemployee has been selected to measure firm size as a moderating variable to check the moderating effect of firm size on the relationship between environmental performance and financial performance. In the third part, the relationship between environmental and financial performance is examined and compared amongst different industries. ROA, ROE and Tobin's Q have been assigned as dependent variables, with emissions per sale, ESG disclosure and CSR strategy set as independent variables. In the final part, the short-term relationship between top managers and corporate financial performance is explored and board size is included as a moderating variable to check the moderating effect of board size on the relationship between top managers and corporate financial performance. ROA, ROE and Tobin's Q have been classified as dependent variables, while gender diversity, executive gender diversity, independent director, environmental committee have been categorized as independent variables; here, leverage, logincome, logcapitalization, logemployee and foreign sale all have been designated as control variables.

There are four main types of variables in this study. The first is the dependent variable, also called a response variable; it is used to identify response to change in another variable. The second is referred to as an independent variable and it is used as an explanatory for the dependent variable. The third one is designated as the moderating variable and it essentially serves to moderate the relationship between independent and dependent variables. This study included firm size and board size as moderating variables to check the moderating effect of firm size and board size in this study. The moderating variables in this paper delineate the constraints and scope of application for the existing theories. The original theory is enriched in this research through an examination of how a set of relationships changes under different conditions and the reasons behind it are considered. The "different conditions" here are the scope and assumptions of the theory. Therefore, moderator variables can help us advance existing theories and aid theories in explaining the relationships between variables in more refined manners. The final, the control variable, functions to control the omitted variables in the model to ensure unbiasedness of the regression coefficient of the variable of interest; although the coefficient after regression of the control variable has no causal explanation for the explained variable.

As table 3.1 indicated, the financial performance in this study includes ROA, ROE and Tobin's Q. Corporate environmental performance involves emissions per sale, ESG disclosure, and CSR strategy. Top manage characteristics include gender diversity, executive gender diversity, independent directors and environmental committee.

The measurement of variables are as follows:

Emissions per sale

This research uses CO2 emissions per sale to measure corporate carbon performance (Fujii et al., 2013).

$$\text{Emissions per sale } = \frac{CO2\ Emissions}{total\ sales}\left(\frac{Ton}{1000USD}\right) \tag{1.}$$

ESG disclosure

This study will use corporate environmental, social and governance information to measure ESG disclosure (Pereira-Moliner et al., 2015; Petitjean, 2019).

CSR strategy

This study uses a CSR strategy to measure environmental performance.

Gender Diversity

The variable Gender Diversity is measured using the percentage of female directors on a board.

Executive Gender Diversity

The variable Executive Gender Diversity is measured using the percentage of executive female directors on a board.

Independent director

Independent director is measured as the percentage of independent directors on a board.

Environmental committee

For this research, environment committee functions as a dummy variable; if a firm has an environmental committee or sustainability committee this registers as a 1, otherwise a zero is indicated (Aldamen et al., 2016).

This study uses ROA and ROE as proxies for a firm's accounting-based financial performance.

This study also uses Tobin's Q market value of stock plus the book value of debt divided by the book value of total assets. This study employed Tobin's Q to measure financial performance because this indicator reflects a firm's market expectation. It is unlike accounting data and looking forward to future performance (Y. He et al., 2017; K. H. Lee & Min, 2015; Shen et al., 2019). If a firm's Tobin's Q is below 1.00, the available resources are poor (Campbell & Mínguez-Vera, 2008).

ROA is the ratio of earnings before interest and taxes to total assets and is calculated as follows:

$$ROA = \frac{EBIT}{total\ assets} \tag{2.}$$

ROE is the ratio of earnings before interest and taxes to total equity and is calculated as follows:

$$ROE = \frac{EBIT}{total\ equity} \tag{3.}$$

Tobin's Q has been used to measure market-based financial performance since 1994 and is calculated (Nekhili et al., 2017) as follows:

$$Tobin's\ Q = \frac{\text{Firm's market capitalization} + \text{Book value of debt}}{Book\ value\ of\ total\ assets} \tag{4.}$$

If Tobin's Q value is more than 1, the market is overvaluing the firm. If Tobin's Q value is less than 1, the market is undervaluing the firm.

Moderating variables:

Concerning firm characteristics, firm size, commonly used in most prior environmentally-related studies (Low et al., 2015; Qiu et al., 2016), as proxied by the logarithm of a firm's total assets (Jung et al., 2016), the logarithm of a firm's market value and the logarithm of a firm's sales. This study will use the number of employees as firm size.

This study also moderates several board characteristics typically used in prior literature as proxies for strong corporate governance. These include board size, as proxied by the number of board of directors for a firm in the current years (Bernile et al., 2018; L. Liao et al., 2015).

Control variables:

This study uses foreign sales, leverage, logincome, logcapitalization and logemployee as control variables that help ensure that empirical results are fair, unbiased, and not caused by other functions.

Table 3. 1 Measurement of variables

Variable	Definition
A. Financial variables	
ROA (return on asset)	The ratio of earnings before interest and taxes to total assets
ROE (return on equity)	The ratio of earnings before interest and taxes to total equity
Tobin's Q	The market value of a company divided by its assets' replacement cost
B. Environmental variables	
Emission per sale (EMI)	CO_2 emissions per sales
Environmental disclosure (DIS)	Environmental information quality is measured as ESG disclosure
CSR strategy (STR)	Firm CSR strategy score
C. Top managers variables	
Gender diversity (GEN)	The proportion of female directors on the board.
Executive gender diversity (EGE)	The ratio of female executive directors
Independent director (IND)	The proportion of independent directors on the board.
Environmental committee (COM)	A dummy variable with the value of 1 if the firm has an environmental committee or sustainability committee and 0 otherwise
D. Moderating variables	
Firm size (Fsize)	The logarithm of employees for the current fiscal year.
Board size (Bsize)	The total number of executive and non-executive directors.
D. Control variables	

Table 3.1 continued

Leverage (LEVER)	Total debt / Total capital
Logincome (LGINC)	Log income
Logmcapitalization (LGCAP)	Log of market capitalization
Fsale (FSALE)	The ratio of foreign sales of total sales
Logemployee (LGEM)	Log of total employee

3.4 Sample selection

To avoid bias and endogeneity of sample selection, this study selected publicly listed firms from three countries; these firms were noted to be from the leading stock exchange in these countries. Using international data allows the observation and analysis of different firms between different countries' legal systems (Isabel María García-Sánchez et al., 2017). The observation period of this sample is nine years, from 2010–2018, because numerous firms in China did not disclose information about CO2 emissions until 2010 (Fujii et al., 2013; T. Liu et al., 2019); furthermore the global financial crisis in 2008 caused dramatic change to a significant amount of corporate financial data, hence unstable data may affect our results, so we collected data from 2010. For the data collection of this study from 2019 and 2020, firms did not disclose an annual report and financial statement from 2019 in DataStream, so this study collected data from 2010 to 2018.

3.5 Data collection

As table 3.2 indicated, data was obtained from DataStream and corporate financial statements.

Table 3. 2 The data collection

Variable	Data
ROA (return on asset)	Calculated from financial data
ROE (return on equity)	Calculated from financial data

Table 3.2 continued

Tobin's Q	Calculated from financial data
Emission per sale (EMI)	Calculated from financial data and CO_2 emission
Environmental disclosure (DIS)	ESG disclosure calculate from environmtnal, social and governance score of firm from DataStream
CSR strategy (STR)	CSR strategy score from DataStream
Gender diversity (GEN)	The proportion of female directors from DataStream
Executive gender diversity (EGE)	The ratio of female executive directors from DataStream
Independent director (IND)	The ratio of independent directors from DataStream
Environmental committee (COM)	A dummy variable with the value of 1 if the firm has an environmental committee or sustainability committee and 0 otherwise, from DataStream
Firm size (Fsize)	Calculated from employee data, from DataStream
Board size (Bsize)	Calculated total board number, from DataStream
Leverage (LEVER)	Calculated from financial data
Logincome (LGINC)	Calculated from financial data
Logmcapitalization (LGCAP)	Calculated from financial data
Fsale (FSALE)	Calculated from financial data
Logemployee (LGEM)	Same as firm size, employee data, from DataStream

3.6 Data cleaning

This study collected panel data of firms from Germany, Japan and China. All firms are from stock exchange markets. We cleaned data using the following steps: first, this study excluded firms from the sample that did not yield full years from 2010 to 2018; second, firms with missing data were excluded; third, firms were exclude that exhibited duplicate data and that were listed on more than one stock market; lastly, after calculating ROA, ROE, Tobin's Q and emissions per sale, firms with abnormal data were excluded.

There are three advantages to using panel data; the first one is that panel data is useful for solving the omitted variables problem: omitted variables bias is a pervasive problem.

Although it can be solved by the instrumental variable batch method, influential instrumental variables are often difficult to find. Omitted variables are often caused by unobservable individual differences or "heterogeneity", and if such individual differences "do not change over time", panel data can solve the problem of omitted variables. Second, panel data provides more information on the dynamic behaviour of individuals. Since panel data has both cross-sectional and time dimensions, it can sometimes solve problems that cannot be solved by separate cross-sectional data or time-series data. Third, panel data has a larger sample size, which can improve the accuracy of the estimation (Qiang, 2014). The disadvantage of panel data though is that panel data is often costly to collect and not readily available.

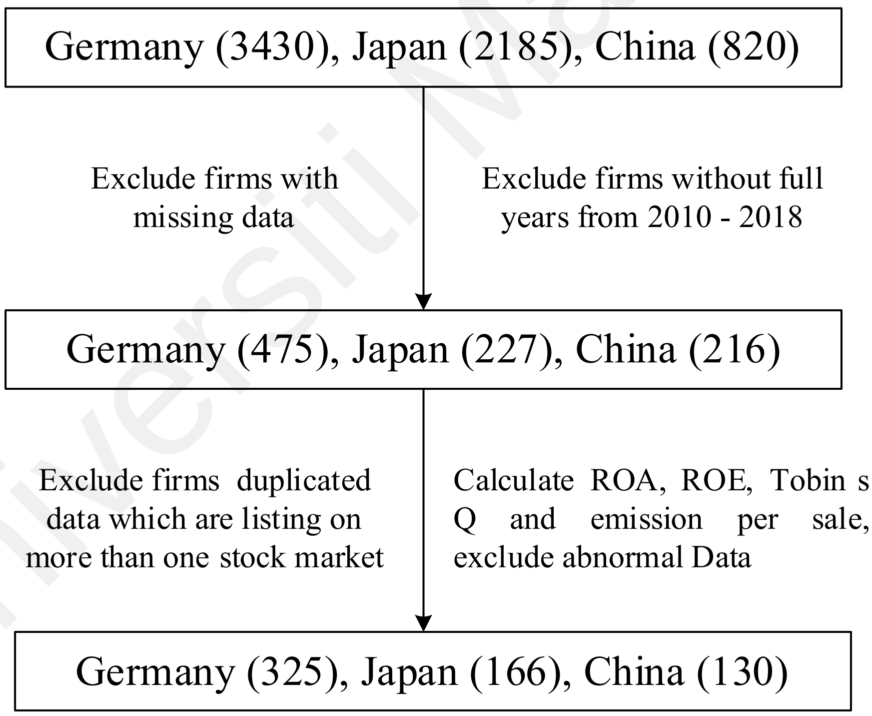

Figure 3. 1 Data cleaning

3.7 Long-term data analysis

Panel data can model both common and individual behaviors of groups. Panel data contains more information, variability, and efficiency than pure time series or cross-sectional data. This study involved 621 firms from Germany, Japan, and China from 2010 to 2018. This study examined the relationship of environmental performance and financial performance in the long term using FMOLS and ARDL models. As figure 3.2 showed, we conducted our analysis by using the indicated steps as follows: unit root test, cointegration, FMOLS and ARDL, and checked by causality test.

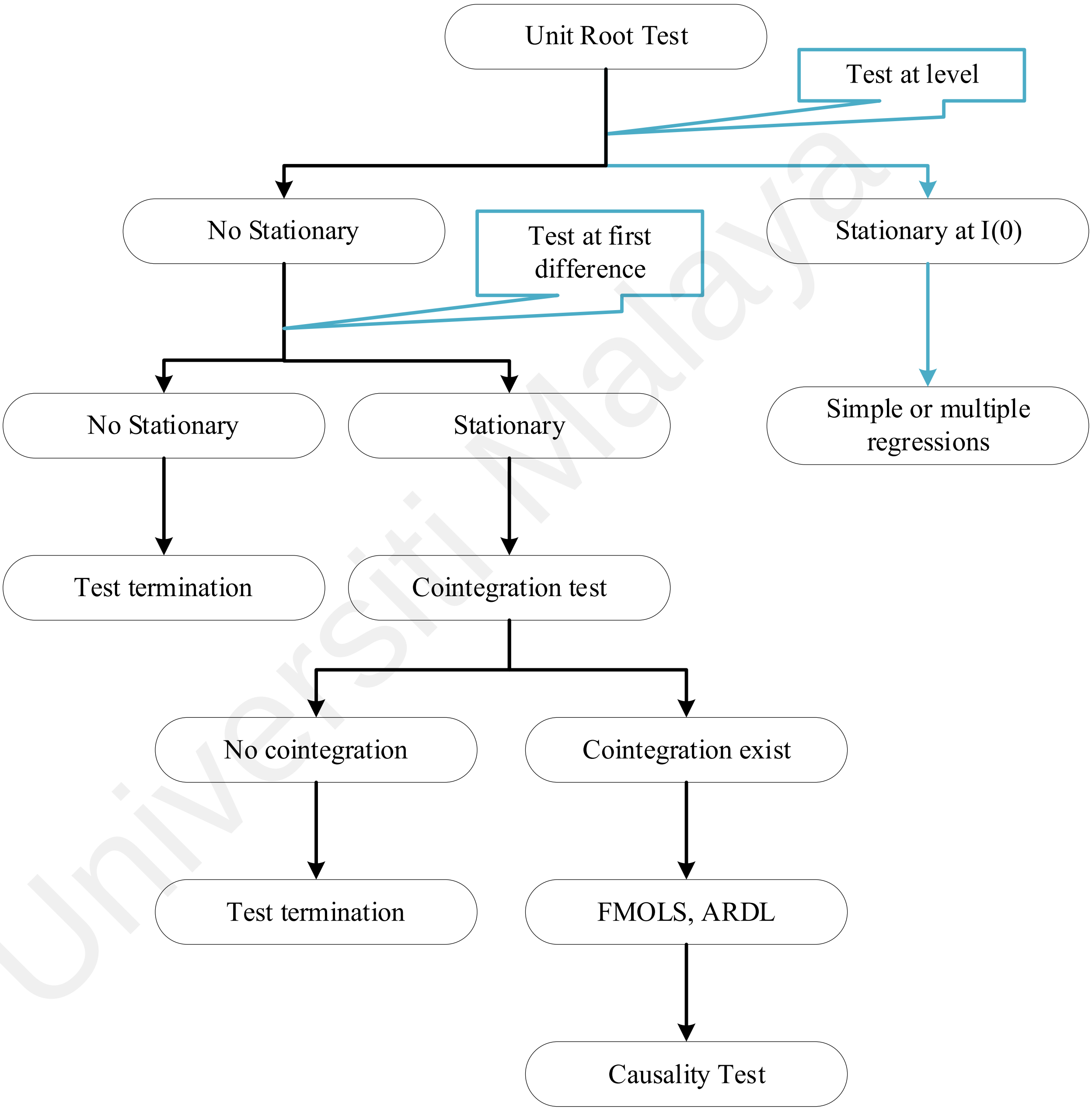

Figure 3. 2 Long term analysis process

3.7.1 Descriptive statistics

This step explains each variable's characteristics in the model and, if possible, relates them to each group to engage in an empirical analysis (Aldamen et al., 2016; Braam et al., 2016). The maximum and minimum values can be used to check whether there is any abnormality in the data. The mean are central tendency indicators used to describe the data. Standard deviation is a discrete trend indicator used to describe data (Leys et al., 2013). When comparing two sets of data with different units (or values that are too different), the coefficient of variation is used to compare the degree of dispersion.

3.7.2 Correlation Analysis

This study's correlation analysis (Benesty et al., 2009; Neuman & Robson, 2012) showed that the regressors do not have perfect or exact linear representations of one another. This study tests our models by correlation relationship to avoid multicollinearity.

3.7.3 Panel unit root test

Following Engle & Granger (1987), Granger (1980), Granger & Newbold (1974), Granger IV et al. (2001), Im et al. (2003), Levin et al. (2002), this study deployed panel cointegration tests to avoid spurious correlations. The exercise started with a check for stationarity of the variables before the panel estimations were made. This study will use homogeneous panel unit root test Levin, Lin and Chu (LLC), and heterogeneous panel unit root test Im Pesaran and Shin (IPS), ADF-Fisher and PP-Fisher.

The first one is the LLC test. LLC homogeneously represents autoregression coefficients that indicate the absence or presence of the unit root problem through (Augmented Dickey-Fuller) ADF regression. There are four steps used in the LLC test. First, each cross-section of different ADF regression is applied, and the equation is as follows:

$$\Delta Y_{it} = \beta Y_{it-1} + \sum_{j=1}^{ni} \beta_{ij} Y_{i,t-j} + z'_{it}\rho + \mu_{it} \tag{5.}$$

This formula estimates the standard deviation ratio from the short run to the long run. The null hypothesis and alternative hypothesis are expressed as follows:

H0: $\rho_i = 0$

Ha: $\rho_i < 0$

The next step runs the separate regression and saves the residual ρ_{it} and $\mu_{i,t-1}$.

$$\Delta y_{it} = \lambda_i + \sum_{j=1}^{ni} \alpha_{i,t-1} \Delta y_{i,t-j} + \rho_{it} \tag{6.}$$

$$y_{i,t-1} = \alpha_i - \sum_{j=1}^{ni} \psi_{i,t-j} \Delta y_{i,t-j} + \mu_{i,t-1} \tag{7.}$$

Finally, the test is computed according to the last equation:

$$\Delta y_{i,t} = \lambda y_{i,t-1} + \varepsilon_{i,t} \tag{8.}$$

The second one is IPS for the unit root test; the IPS unit root test allows heterogeneity, it differs from the LLC test, which is restricted because it must be homogeneous. The ADF test is applied to individual series and t-test statistics and depends upon anathematized means of each individual's ADF statistics. The equation is as follows:

$$\Delta y_{it} = \alpha_j + \alpha_i Y_{it-1} + \sum_{j=1}^{\rho i} \phi_{i,j} Y_{it-j} + \nu_{i,t} \tag{9.}$$

Where α_i is under the alternative hypothesis, and IPS allows heterogeneity. The t-statistics of the ADF mean value is calculated for each individual as follows:

$$t_{yz} = \frac{1}{y}\sum_{i=1}^{y} t_{i,t}(p_i) \tag{10.}$$

As $t_{i,t}$ expresses the ADF t-statistics of each firm and p_i is the lag order in ADF regression; t-statistics are estimated as follows:

$$A_t = \frac{\sqrt{y(z)}[\bar{t}_z - E(t_z)]}{\sqrt{var(t_z)}} \tag{11.}$$

The third one is the Fisher type test; it is similar to the IPS test, which is tested on individuals first and then combined together. More specifically, this type of test will test on every unit of panel data (ADF-Fisher or PP-Fisher test), we obtained n test statistics and corresponding P-values $\{p_1, p_2, \cdots, p_n\}$. Choi (2001) proposes the following ways to combine these p-values into Fisher-type statistics. For the "inverse chi-squared transformation":

$$P \equiv -2\sum_{i=1}^{n} \ln p_i \xrightarrow{d} \chi^2(2n) \quad T_i \to \infty \tag{12.}$$

Which T_i is the time of each unit, Because of the negative sign, this is a one-sided right-hand test. The larger the statistic, the more likely it is to reject the "panel unit root" null hypothesis.

For the "inverse normal transformation":

$$Z \equiv \frac{1}{\sqrt{n}}\sum_{i=1}^{n} \phi^{-1}(p_i) \xrightarrow{d} N(0,1) \quad (T_i \to \infty) \tag{13.}$$

Where $\phi^{-1}(p_i)$ is the inverse function of the standard normal cumulative distribution function and is a one-sided left-hand test; while $p_i$is the P value of the unit root of the section member.

3.7.4 Panel cointegration tests

Suppose panel unit root tests show that all variables are cointegrated at I(1). In that case, this study shall use a cointegration test to investigate the long-run relationship among the variables. A two-panel cointegration test is used in this study, viz., first, the Pedroni cointegration test (Pedroni, 1999, 2004); secondly, the Kao cointegration test (Kao, 1999).

Pedroni Residual Cointegration Test, the method is based on the regression residuals of the cointegration equation to test the cointegration relationship between panel variables by constructing 7 statistics (Tiemei et al., 2006). The tester assumes that there is no cointegration relationship between the panel variables.

We consider the regression model as follows:

$$y_{it} = \alpha_i + \delta_{it} + x'_{it}\beta_i + \mu_{it} \tag{14.}$$

$$y_{it} = y_{i,t-1} + e_{it} \tag{15.}$$

$$x_{it} = x_{i,t-1} + \varepsilon_{it} \tag{16.}$$

Where $\beta_i \equiv (\beta_{1i}, \cdots \beta_{ki})', x_{it} = (x_{1,it}, \cdots x_{k,it})', t = 1, \cdots, T, i = 1, \cdots, N, k$ is the number of explanatory variables, α_i *and* δ_i is the individual trend effect for each cross-section.

In the Pedroni test, it is assumed that the cross-section individuals are independent of each other, and the error process $w_{it} = (e_{it}, \varepsilon_{it})'$ is stable, and the asymptotic covariance matrix is Ω_i, so:

$$\Omega_i = \lim_{T\to\infty} E\left[T^{-1}\left(\sum_{t=1}^{T} w_{it}\right)\left(\sum_{t=1}^{T} w'_{it}\right)\right] = \Omega_i^0 + \Gamma_i + \Gamma'_i \tag{17.}$$

With Ω_i^0 as a concurrent covariance, Γ_i is a weighted sum of auto-covariances. Under the condition that there is no cointegration relationship between variables under the null hypothesis, the residual sequence is a non-stationary sequence, and we obtain the residual sequence from $y_{it} = \alpha_i + \delta_{it} + x'_{it}\beta_i + \mu_{it}$; it is necessary to check if the residual series is stationary or not using the following regression:

$$\hat{u}_{it} = \rho_i \hat{u}_{i,t-1} + v_{it}, i = 1, \cdots, N \tag{18.}$$

Or:

$$\hat{u}_{it} = \rho_i \hat{u}_{i,t-1} + \sum_{j=1}^{p_i} \psi_{ij} \Delta \hat{u}_{i,t-1} + v_{it}, i = 1, \cdots, N \tag{19.}$$

Where ρ_i indicates the cross-section individual residual autoregressive coefficients. The following two hypotheses:

(1) $H_0: \rho_i = 1, H_1: (\rho_i = \rho) < 1$

(2) $H_0: \rho_i = 1, H_1: \rho_i < 1$

The first one is within-dimension and the second one is between dimension and there are seven statistics of the Pedroni Residual Cointegration Test.

3.7.5 Panel Fully Modified Least Squares model

If the long-run cointegration is significantly supported, the Panel Fully Modified Least Squares (FMOLS) model (Pedroni, 2001) will then be deployed to estimate the long-run coefficients of the variables. The FMOLS model is suitable to estimate a relationship when using small samples (Intisar et al., 2020). The FMOLS equation as follows:

$$Y_{it} = \delta_i + \beta_i X_{it} + \varepsilon_{it} \tag{20.}$$

Where Y indicates the financial performance and X indicates the corresponding vectorof environmental variables, while i stands for individual, t stands for time and ε stands for error term.

3.7.6 Autoregressive-Distributed Lag model

This study applies the Autoregressive-Distributed Lag (ARDL) model (Pesaran & Shin, 1995) to analyse the cointegration relationship between CEP and CFP. The ARDL model used in the Equations with factors does not strictly require the same level of integrated results as the panel unit root test, so both I (0) and I (1) are suitable for this model.

The production function of panel ARDL that ought to be analyzed for the bounds test method is presented as the following:

$$\Delta CFP_{it} = \beta_1 + \sum_{i=1}^{k} \alpha_{ij} \Delta CFP_{j,t-i} + \sum_{i=0}^{k} \beta_{ij} \Delta Emissionsale_{j,t-i} + \sum_{i=0}^{k} \chi_{ij} \Delta Disclosure_{j,t-i} + \sum_{i=0}^{k} \vartheta_{ij} \Delta Strategy_{j,t-i} + \theta_1 CFP_{j,t-1} + \theta_2 Emissionsale_{j,t-1} + \theta_3 Disclosure_{j,t-1} + \theta_4 Strategy_{j,t-1} + \varepsilon_{jt} \quad (21.)$$

where CFP is corporate financial performance, Emissionsale is emissions per sale, Disclosure is corporate information disclosure, Strategy is CSR strategy. Furthermore, t is time, i refers to the studied firms, Δ is the 1st variation factor, and k is the ideal lag length. In this study, financial performance is ROA, ROE and Tobin's Q. To investigate the long-term cointegration correlation between the determinants, the below assumptions are formed:

$H0: \theta_1 = \theta_2 = \theta_3 = \theta_4 = 0$ (There is no cointegration)

$Ha: \theta_1 \neq \theta_2 \neq \theta_3 \neq \theta_4 \neq 0$ (There is cointegration)

The following equation was estimated to examine the relationship between CEP and CFP, the generalized ARDL model is indicated as:

$$CFP_{it} = \sum_{j=1}^{p} \delta_{it} CFP_{i,t-j} + \sum_{j=0}^{q} \gamma'_{ij} X_{i,t-j} + \varphi_i + \varepsilon_{it} \qquad (22.)$$

Where CFP_{it} is the dependent variable (ROA, ROE and Tobin's Q), (X'_{it})' is a k×1 vector that is allowed to be purely I(0) or I(1) or as cointegration. δ_{ij} is the coefficient of the lagged dependent variable called scalar; γ_{ij} are k×1 coefficient vectors; φ_i is the unit-specific fixed effects; i = 1, 2, … N; t = 1, 2, …, T; p, q are optimal lag orders; lastly ε_{it} is the error term.

The re-parameterised ARDL Error Correction Model is specified as：

$$\Delta CFP_{it} = \theta_i \left[CFP_{i,t-1} - \lambda'_i X_{it} \right] + \sum_{j=1}^{p-1} \xi_{ij} \Delta CFP_{i,t-j} + \sum_{j=0}^{q-1} \gamma'_{ij} \Delta X_{i,t-j} + \varphi_i + \varepsilon_{it} \qquad (23.)$$

Where θ_i = -(1-δ_i), group-specific speed of adjustment coefficient (expected that $\theta_i < 0$); λ'_i is the vector of long-run relationships; error correction term (ECT) is $[Y_{i,t-1} - \lambda'_i X_{it}]$; ξ_{ij} and γ'_{ij} are the short-run dynamic coefficients.

If there is proof of a long-term correlation between the determinants results, the below long term and short term will be estimated as follows:

$$CFP_{it} = \beta_2 + \sum_{i=1}^{k} \alpha_{i2} CFP_{j,t-i} + \sum_{i=0}^{k} \beta_{i2} \Delta Emissionsale_{j,t-i} + \sum_{i=0}^{k} \chi_{i2} \Delta Disclosure_{j,t-i} + \sum_{i=0}^{k} \vartheta_{i2} \Delta Strategy_{j,t-i} + \varepsilon_{it2} \qquad (24.)$$

$$\Delta CFP_{it} = \beta_3 + \sum\nolimits_{i=1}^{k} \alpha_{i3}\Delta CFP_{j,t-i} + \sum\nolimits_{i=0}^{k} \beta_{i3}\Delta Emissionsale_{j,t-i} + \sum\nolimits_{i=0}^{k} \chi_{i3}\Delta Disclosure_{j,t-i} + \sum\nolimits_{i=0}^{k} \vartheta_{i3}\Delta Strategy_{j,t-i} + \gamma ECT_{j,t-i} + \varepsilon_{it3} \quad (25.)$$

The indicator γ points to the coefficient of the error correction term (ECT) in Equation (24) and can validate the quickness of changes of the determinants for assemblage to equilibrium. The ECT is formed as above in following equation:

$$ECT_{j,t} = CFP_{it} - \beta_2 - \sum\nolimits_{i=1}^{k} \alpha_{i2}CFP_{j,t-i} - \sum\nolimits_{i=0}^{k} \beta_{i2}\Delta Emissionsale_{j,t-i} - \sum\nolimits_{i=0}^{k} \chi_{i2}\Delta Disclosure_{j,t-i} - \sum\nolimits_{i=0}^{k} \vartheta_{i2}\Delta Strategy_{j,t-i} \quad (26.)$$

3.7.7 Dumitrescu Hurlin Panel Causality Test

The study subsequently used the Dumitrescu Hurlin Panel Causality test to examine the presence of casual relationships among the panel variables (Dumitrescu & Hurlin, 2012), which can be expressed as follows:

$$\Delta CFP_{it} = a_i + \sum_{j=1}^{j} \theta_i^{(j)} CFP_{i,t-j} + \sum_{j=1}^{j} \delta_i^{(j)} CEP_{i,t-j} + \omega \quad (27.)$$

Here j is the optimum lag interval, and CFP and CEP are variables to test whether CEP has a causal relationship with CFP.

3.8 Data Analysis in the short-term

As figure 3.3 showed, the short-term analysis is as follows: The VIF test was used to check variables in our model, then the Hausman test was used to choose a fixed or random effect, after that a Heteroskedasticity check and autocorrelation check were performed in the end.

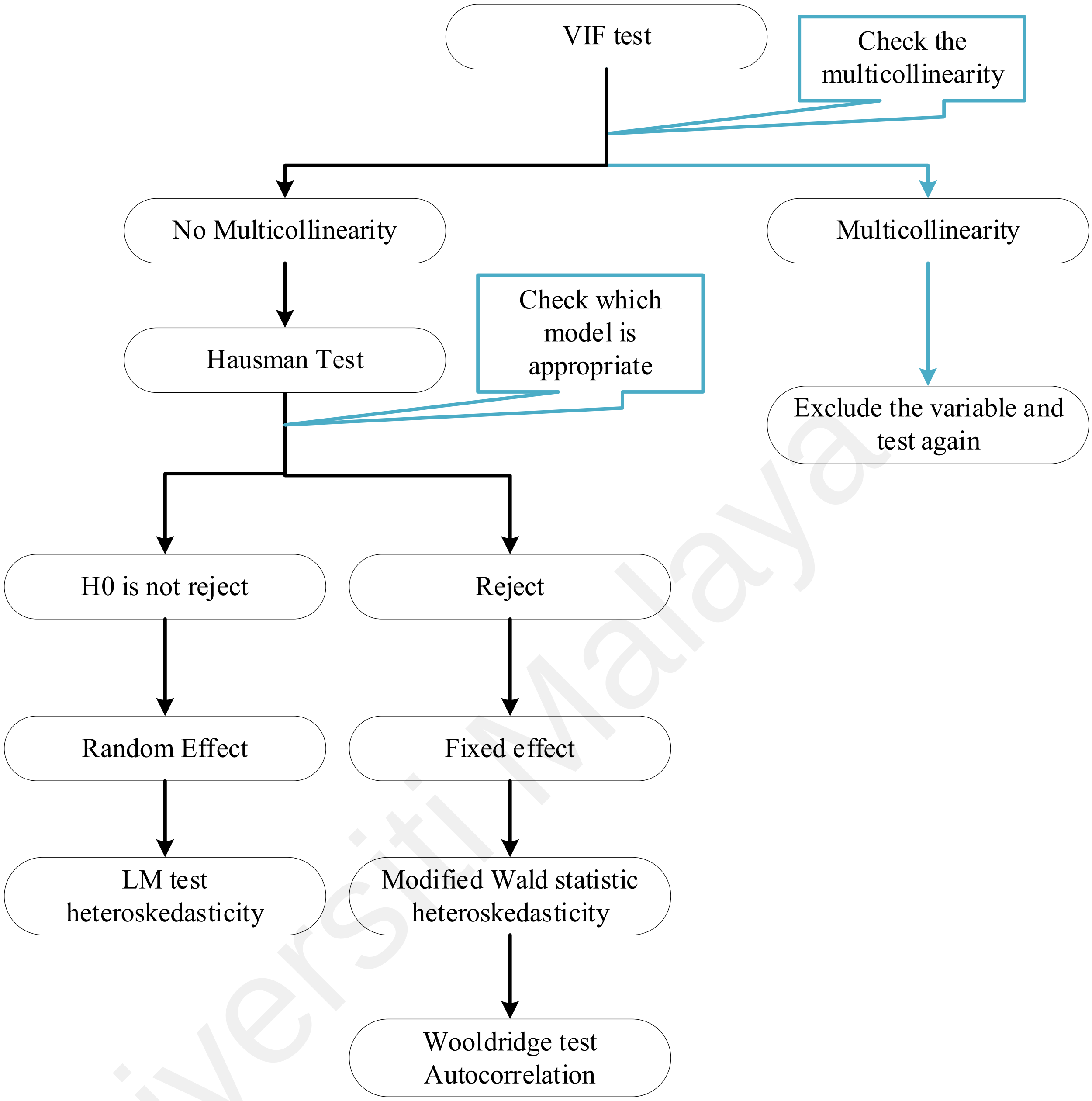

Figure 3. 3 Short term analysis process

3.8.1 Descriptive and VIF test

Before we conducted a fixed effect (FE) model of our data, the variance inflation factor (VIF) test was used in this study to check the multicollinearity. If the column rank of matrix X was less than K, then the explanatory variable was expressed linearly by other explanatory variables and there was multicollinearity.

If using the kth explanatory variable is regressed on the remaining explanatory variables $\{X_1, X_2 \dots, X_{k-1}\}$, when the coefficient of determination R_k^2 is high, it indicated that there was multicollinearity. To calculate the R_k^2 , the formula is as follows:

The Kth element on the main diagonal of the covariance matrix is:

$$Var(b_k|X) = \frac{\sigma^2}{(1 - R_k^2)S_{kk}} \tag{28.}$$

Which S_{kk} is the sum of squared deviations of x_k,

$$S_{kk} \equiv \sum\nolimits_{i=1}^{n} (x_{ik} - \bar{x}_k)^2 \tag{29.}$$

The variance

$$Var(b|X) = \sigma^2 (X'X)^{-1} \tag{30.}$$

The variance inflation factor (VIF) formula is as follows:

$$VIF_k \equiv \frac{1}{1 - R_k^2} \tag{31.}$$

If the value of VIF is high, then it indicates more multicollinearity.

3.8.2 Hausman test

In choosing from a fixed effect model and a random effect model, this study employed the Hausman test to check which one would be appropriate for our model. The statement of the Hypothesis is as follows:

H0: Random effect model is the appropriate estimator.

Ha: Fixed effect model is the appropriate estimator.

If H0 is rejected, we concluded that the random effect model was inappropriate.

3.8.3 Fixed and random effects models

This study used the fixed-effect model to estimate data, the formula is as follows:

$$Y_{it} = \beta X_{it}^{T} + \gamma_t + \alpha_i + \varepsilon_{it} \tag{32.}$$

Where Y_{it} is the dependent variable, βX_{it}^{T} are the observable variables that change over time; γ_t is the time fixed effect; α_i is an individual fixed effect.

If the Hausman test proves that a random effect is more appropriate for our model, we will conduct a random effect as follows:

$$Y_{it} = \beta X_{it} + \alpha + \mu_{it} + \varepsilon_{it} \tag{33.}$$

Where μ_{it} is between-entity error, ε_{it} is within-entity error.

Firstly, this study tested the relationship between top managers and environmental performance. Corporate environmental performance (CEP) falls within the dependent variable (emissions, ESG and CSR strategy); Top managers characteristics (TMT) are categorized as independent variables, Gender is gender diversity and was measured as the percentage of female directors on board; Egender is executive gender diversity, which was measured as the ratio of female executive female directors on board; Independent is the proportion of independent directors on the board; Committee is a dummy variable with the value of 1 if the firm has an environmental committee or sustainability committee and 0 otherwise. Bsize is the board size measured as the number of directors on the board.

$$CEP_{it} = \beta_0 + \beta_{01} TMT_{it} + \varepsilon_{\ it} \tag{34.}$$

Secondly, we included the moderating variable board size, the equation is as follow:

$$CEP_{it} = \beta_1 + \beta_{11} TMT_{it} + \beta_{12} Bsize_{it} + \varepsilon_{\ it} \tag{35.}$$

Thirdly, we included moderating variable and interaction variable:

$$CEP_{it} = \beta_2 + \beta_{21} TMT_{it} + \beta_{22} Bsize_{it} + \beta_{23} Interaction_{it} + \varepsilon_{\ it} \tag{36.}$$

To avoid multicollinearity in interaction terms in this study, we conducted a Centralized Processing Solution as follows:

$$Interaction_{it} = \left(TMT_{it} - \frac{\sum_{t=1}^{T_i} TMT_{it}}{T_i} \right) * \left(Bsize_{it} - \frac{\sum_{t=1}^{T_i} Bsize_{it}}{T_i} \right) \tag{37.}$$

Secondly, this study tested the relationship between environmental performance and financial performance. Corporate financial performance (CFP) was classified as a dependent variable (ROA, ROE and Tobin's Q); Corporate environmental performance (CEP) was indicated to be an independent variable (emissions per sale, ESG and CSR strategy). We also included control variables (foreign sale, income and leverage), and the moderating variable Firm size, measured by the number of employees.

$$CFP_{it} = \beta_0 + \beta_{01} CEP_{it} + \beta_{02} Control_{it} + \varepsilon_{\ it} \tag{38.}$$

Secondly, we included the moderating variable firm size, the equation is as follows:

$$CFP_{it} = \beta_1 + \beta_{11} CEP_{it} + \beta_{12} Control_{it} + \beta_{13} Fsize_{it} + \varepsilon_{\ it} \tag{39.}$$

Thirdly, we included a moderating variable and an interaction variable:

$$CFP_{it} = \beta_2 + \beta_{21} CEP_{it} + \beta_{22} Control_{it} + \beta_{23} Fsize_{it} + \beta_{24} Interaction_{it} + \varepsilon_{\ it} \tag{40.}$$

To avoid multicollinearity in interaction terms in this study, we conducted a Centralized Processing Solution as follows:

$$Interaction_{it} = \left(CEP_{it} - \frac{\sum_{t=1}^{T_i} CEP_{it}}{T_i} \right) * \left(Fsize_{it} - \frac{\sum_{t=1}^{T_i} Fsize_{it}}{T_i} \right) \quad (41.)$$

Thirdly, this study tested the relationship between Top managers' characteristics and financial performance. Corporate financial performance (CFP) was termed as a dependent variable (ROA, ROE and Tobin's Q); Top managers' characteristics (TMT) were identified as independent variables (gender diversity, executive gender diversity, independent director and environmental committee). We also included control variables (foreign sale, income capitalization, employee and leverage), and a moderating variable with board size, measured by the number of board directors.

$$CFP_{it} = \beta_0 + \beta_{01} TMT_{it} + \beta_{02} Control_{it} + \varepsilon_{\ it} \quad (42.)$$

Secondly, we included the moderating variable board size and the equation is as follows:

$$CFP_{it} = \beta_1 + \beta_{11} TMT_{it} + \beta_{12} Control_{it} + \beta_{13} Bsize_{it} + \varepsilon_{\ it} \quad (43.)$$

Thirdly, we included a moderating variable and an interaction variable:

$$CFP_{it} = \beta_2 + \beta_{21} TMT_{it} + \beta_{22} Control_{it} + \beta_{23} Bsize_{it} + \beta_{24} Interaction_{it} + \varepsilon_{\ it} \quad (44.)$$

To avoid multicollinearity in interaction terms in this study, we conducted a Centralized Processing Solution as follows and the formula was the same as (37).

3.8.4 Heteroskedasticity check

This study uses the Modified Wald statistic for groupwise heteroskedasticity (Greene, 2000).

After running the FE model estimation, this study conducts the heteroscedasticity check. We assume that the variances of the disturbance terms of different individuals are equal. The null hypothesis is:

H0: $\sigma_i^2 = \sigma^2$ $(i = 1, \ldots, n)$, (or constant variance)

Under the premise of the null hypothesis,

$$\frac{\hat{\sigma}_i^2 - \sigma^2}{\sqrt{Var(\hat{\sigma}_i^2)}} \xrightarrow{d} N(0,1) \tag{45.}$$

Where $\hat{\sigma}_i^2 = \sum_{t=1}^{T} e_{it}^2 / T$, $e_{it} = \varepsilon_{it}$, the formula can be transformed as:

$$\frac{(\hat{\sigma}_i^2 - \sigma^2)^2}{Var(\hat{\sigma}_i^2)} \xrightarrow{d} \chi^2(1) \tag{46.}$$

$$\widehat{Var(\hat{\sigma}_i^2)} = \frac{1}{T}\frac{1}{T-1}\sum_{t=1}^{T}(e_{it}^2 - \hat{\sigma}_i^2)^2 \tag{47.}$$

Then the Wald statistics expresses as follows:

$$W \equiv \sum_{i=1}^{n} \frac{(\hat{\sigma}_i^2 - \sigma^2)^2}{\widehat{Var(\hat{\sigma}_i^2)}} \xrightarrow{d} \chi^2(n) \tag{48.}$$

For the random effect model, this study used the breusch and pagan lagrangian multiplier (LM) to test heteroskedasticity (Greene, 2000).

3.8.5 Wooldridge test (Autocorrelation)

We apply the Wooldridge test to detect serial correlation problems; the above test result indicates that we significantly reject the null hypothesis and conclude that the data has the first-order autocorrelation. The Wooldridge test for autocorrelation in panel data, null hypothesis is as follows:

H0: No first-order autocorrelation ($Cov(\varepsilon_{it}, \varepsilon_{is}) = 0\ (t \neq s, \forall i)$)

This study test autocorrelation is as shown in the following steps:

$$y_{it} = x'_{it}\beta + \varepsilon_{it} \tag{49.}$$

After first-order difference can be obtained:

$$\Delta y_{it} = \Delta x'_{it}\beta + \Delta\varepsilon_{it} \tag{50.}$$

We assume that there is no within-group autocorrelation in $\{\varepsilon_{it}\}$, the variance and autocovariance are as follows:

$$Var(\Delta\varepsilon_{it}) = Var(\varepsilon_{it} - \varepsilon_{i,t-1}) = Var(\varepsilon_{it}) + Var(\varepsilon_{i,t-1}) = 2\sigma_\varepsilon^2 \tag{51.}$$

$$\begin{aligned} Cov(\Delta\varepsilon_{it}, \Delta\varepsilon_{i,t-1}) &= Cov(\varepsilon_{it} - \varepsilon_{i,t-1}, \varepsilon_{i,t-1} - \varepsilon_{i,t-2}) = -Cov(\varepsilon_{i,t-1}, \varepsilon_{i,t-1}) \\ &= -Var(\varepsilon_{i,t-1}) = -\sigma_\varepsilon^2 \end{aligned} \tag{52.}$$

So, the autocorrelation coefficient is:

$$Corr(\Delta\varepsilon_{it}, \Delta\varepsilon_{i,t-1}) = \frac{Cov(\Delta\varepsilon_{it}, \Delta\varepsilon_{i,t-1})}{Var(\Delta\varepsilon_{it})} = \frac{-\sigma_\varepsilon^2}{2\sigma_\varepsilon^2} = -0.5 \tag{53.}$$

We set e_{it} as a sample value of $\Delta\varepsilon_{it}$, conduct first-order autoregression of e_{it},

$$e_{it} = \rho e_{i,t-1} + error\ (i = 1, \cdots, n; t = 3, \cdots, T) \tag{54.}$$

In the end, t and F test are used to test the hypothesis: H_0: $\rho = -0.5$.

3.9 Summary of this chapter

This chapter we introduced the research paradigm, follow this we conduct the empirical study. We develop methodology in this study by variable measurement, sample selection, data collection and cleaning, and development the model for our data analysis both in short-term and long-term.

Table 3. 3 Summary of methodology

Research question	Methods
RQ1: TMT-CEP	Descriptive analysis, Correlation analysis, Variance inflation factor (VIF) test, Fixed effect model / Random effect model/ OLS, Modified Wald statistic, Breusch and pagan Lagrangian multiplier, Wooldridge test
RQ2: CEP-CFP	Descriptive analysis, Correlation analysis, Panel unit root test, Panel cointegration test, Panel Fully Modified Least Squares (FMOLS) model, Autoregressive-Distributed Lag (ARDL), Dumitrescu Hurlin Panel Causality Test
RQ3: TMT-CFP	Descriptive analysis, Correlation analysis, Variance inflation factor (VIF) test, Fixed effect model / Random effect model/ OLS, Modified Wald statistic, Breusch and pagan Lagrangian multiplier, Wooldridge test

CHAPTER 4: DATA ANALYSIS AND EMPIRICAL FINDINGS

4.1 Introduction

This chapter examines the top managers' characteristics, corporate environmental performance, and corporate financial nexus. The purpose is to conduct the research analysis to achieve the research objective by exploring the hypothesis. In section 4.2, this study explores the relationship between top managers' characteristics and corporate environmental performance by a fixed and random effect model and examines the moderating effect of board size on the relationship between top managers' characteristics and environmental performance. In section 4.3, this study examines the relationship between corporate environmental performance and corporate financial performance using the FMOLS and ARDL models. In addition, this section also includes fixed and random effect models to explore the short-term relationship between corporate environmental performance and corporate financial performance, and examines the moderating effect of firm size on the relationship between environmental performance and financial performance in the short term. Section 4.4 of this study, the environmental and financial performance nexus of different industries are explored by the FMOLS and ARDL models. In section 4.5 of this study, the relationship between top manager's' characteristics and corporate financial performance are examined; included in this is an examination of the moderating effect of board size on the relationship between top managers' characteristics and corporate financial performance.

4.2 Top management team and environmental performance

4.2.1 Descriptive statistics

Tables 4.1, 4.2 and 4.3 showed the descriptive statistics related to the variables used in our model, including 621 firms (130 firms from China, 166 firms from Japan and 325 firms from Germany) observed from 2010 to 2018. Here, emissions per sale, ESG, and CSR strategy are identified as dependent variables; also, gender diversity, executive gender diversity, independent director, and committee are indicated as independent variables; in this model, we include interaction items GENB, EGEB, INDB and COMB.

The descriptive results are reported in table 4.1 representing the Chinese sample, table 4.2 indicates Japanese information and table 4.3 represents German firms. The results from the tables showed that all of the VIF tests worked out to be less than three, so the variables here are without high multicollinearity.

Table 4. 1 Descriptive analysis (China)

Variable	Obs	Mean	Std. Dev.	Min	Max	VIF
EMI	1170	1.09	2.65	0.00	25.77	1.09
ESG	1170	34.41	16.35	1.96	100.00	2.24
STR	1170	36.53	34.64	0.00	100.00	3.31
GEN	1170	9.89	8.56	0.00	44.44	1.33
EGE	1170	11.73	9.74	0.00	57.14	1.42
IND	1170	36.68	9.34	0.00	83.33	1.15
COM	1170	0.29	0.46	0.00	1.00	1.94
Bsize	1170	12.03	4.16	6.00	39.00	1.7
GENB	1170	-0.03	0.40	-1.11	4.39	1.95
EGEB	1170	-0.10	0.37	-3.16	1.46	1.6
INDB	1170	-0.07	0.56	-2.00	6.03	1.72
COMB	1170	0.17	2.11	-7.88	18.38	1.19

EMI is emission per sale, ESG is environment, social and governance disclosure, STR is the corporate CSR strategy, GEN is the gender diversity, EGE is executive gender diversity, IND is independent director, COM is corporate environmental committee, Bsize is the board size, GENB is interaction item GEN*Bsize, EGEB interaction item EGE*Bsize, INDB is interaction item IND*Bsize, COMB is interaction item COM*Bsize.

Table 4. 2 Descriptive analysis (Japan)

Variable	Obs	Mean	Std. Dev.	Min	Max	VIF
EMI	1494	0.25	0.78	0.00	9.11	1.06
ESG	1494	52.68	17.95	4.85	91.71	2.53
STR	1494	53.06	29.52	0.00	99.66	2.29
GEN	1494	7.11	6.97	0.00	57.14	1.52
EGE	1494	1.49	3.47	0.00	28.57	1.52
IND	1494	21.29	15.30	0.00	87.50	1.73
COM	1494	0.84	0.37	0.00	1.00	1.42
Bsize	1494	12.59	3.86	4.00	26.00	1.12
GENB	1494	-0.02	0.29	-2.80	1.42	1.63
EGEB	1494	-0.01	0.13	-1.31	1.12	1.5

Table 4.2 continued

INDB	1494	-0.16	0.65	-4.36	3.01	1.45
COMB	1494	-0.03	1.49	-10.42	7.21	1.08

EMI is emission per sale, ESG is environment, social and governance disclosure, STR is the corporate CSR strategy, GEN is the gender diversity, EGE is executive gender diversity, IND is independent director, COM is corporate environmental committee, Bsize is the board size, GENB is interaction item GEN*Bsize, EGEB interaction item EGE*Bsize, INDB is interaction item IND*Bsize, COMB is interaction item COM*Bsize

Table 4. 3 Descriptive analysis (Germany)

Variable	Obs	Mean	Std. Dev.	Min	Max	VIF
EMI	2925	0.39	2.20	0.00	66.64	1.01
ESG	2925	50.71	19.33	2.48	93.27	2.56
STR	2925	48.59	31.80	0.00	99.88	2.49
GEN	2925	18.14	12.66	0.00	71.43	1.34
EGE	2925	13.01	12.65	0.00	70.00	1.2
IND	2925	56.22	25.74	0.00	80.00	1.25
COM	2925	0.69	0.47	0.00	2.00	1.57
Bsize	2925	11.18	4.02	2.00	38.00	1.47
GENB	2925	0.01	0.49	-2.59	4.15	1.42
EGEB	2925	-0.05	0.47	-2.95	3.19	1.26
INDB	2925	-0.26	1.26	-7.14	12.94	1.35
COMB	2925	0.48	1.88	-11.69	19.35	1.15

EMI is emission per sale, ESG is environment, social and governance disclosure, STR is the corporate CSR strategy, GEN is the gender diversity, EGE is executive gender diversity, IND is independent director, COM is corporate environmental committee, Bsize is the board size, GENB is interaction item GEN*Bsize, EGEB interaction item EGE*Bsize, INDB is interaction item IND*Bsize, COMB is interaction item COM*Bsize.

The average emissions per sale in Chinese corporations were revealed to equal 1.09 ton/ (1000 USD) whereas for Japanese corporations the results were indicated to equate to 0.25 ton/(1000 USD), and German results were listed as equaling 0.39 ton/(1000 USD), which demonstrates that the carbon reduction program of Japan and Germany are more efficient than for corporations in China. The average ESG disclosure score in China was 34.4, as compared to 52 in Japan and 50.4 in Germany (see figure 4.1). Public corporations in the sampled developed countries of Germany and Japan tended to exhibit higher disclosures of ESG information than public corporations in China. Lastly, China's mean CSR strategy practice score was 36.5 compared to 51.6 in Japan and 47.75 in

Germany (see figure 4.2), showing that Japanese and German firm-level CSR strategies are stronger than China's corporate CSR strategies.

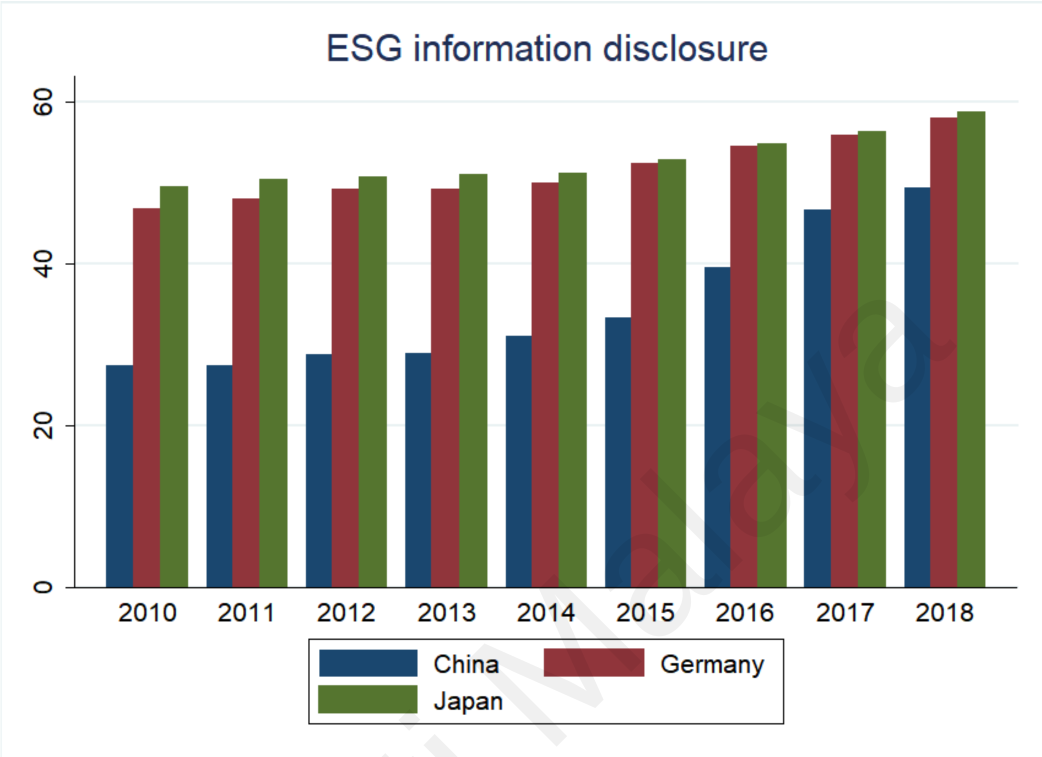

Figure 4. 1 ESG information disclosure

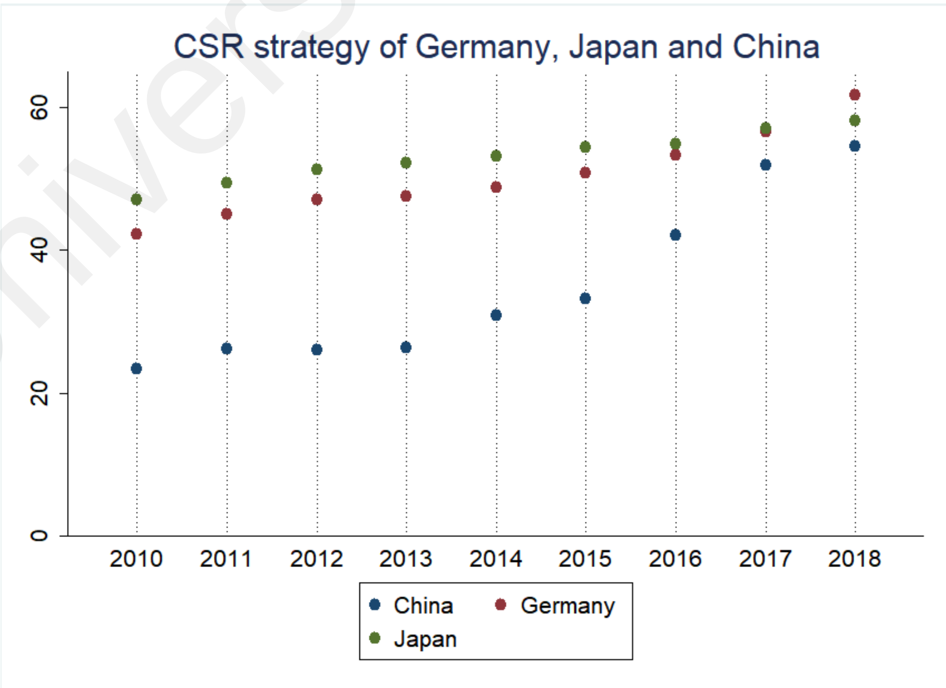

Figure 4. 2 CSR strategy

We move to the TMT characteristics performance, the mean of female directors on the board in Chinese corporations turned out to be 9.9%, with Japanese corporations indicating 7.2%, and German corporations represent 18%. It means that the ratio of female directors on the board of firms from Germany is higher than firms from Japan and China (see figure 4.3). Furthermore, this study also investigates the female executive directors on the board of corporations from these three countries. The results showed that female executive directors equaled 11.73% of firms from China, 1.56% of firms from Japan and 13% of firms from Germany; this indicated that even though the percentage of the female director group is similar in China and Japan, most of the female directors belong to the category of the non-executive director of corporations from Japan (see Figure 4.4). The Independent director ratio of samples from these three countries comes to 36.5% of Chinese corporations, 21.3% from Japanese corporations and 56.5% from German corporations separately. The mean of the dummy variable CSR committee is 0.29 of the sample from China, 0.81 of the sample from Japan and 0.68 of the sample from Germany. After the Paris Agreement was signed in 2015, the CSR committee quickly increased with respect to Chinese corporations (see figure 4.5). Most corporations from Japan and Germany established CSR committees to enhance corporate environmental performance among the respective countries.

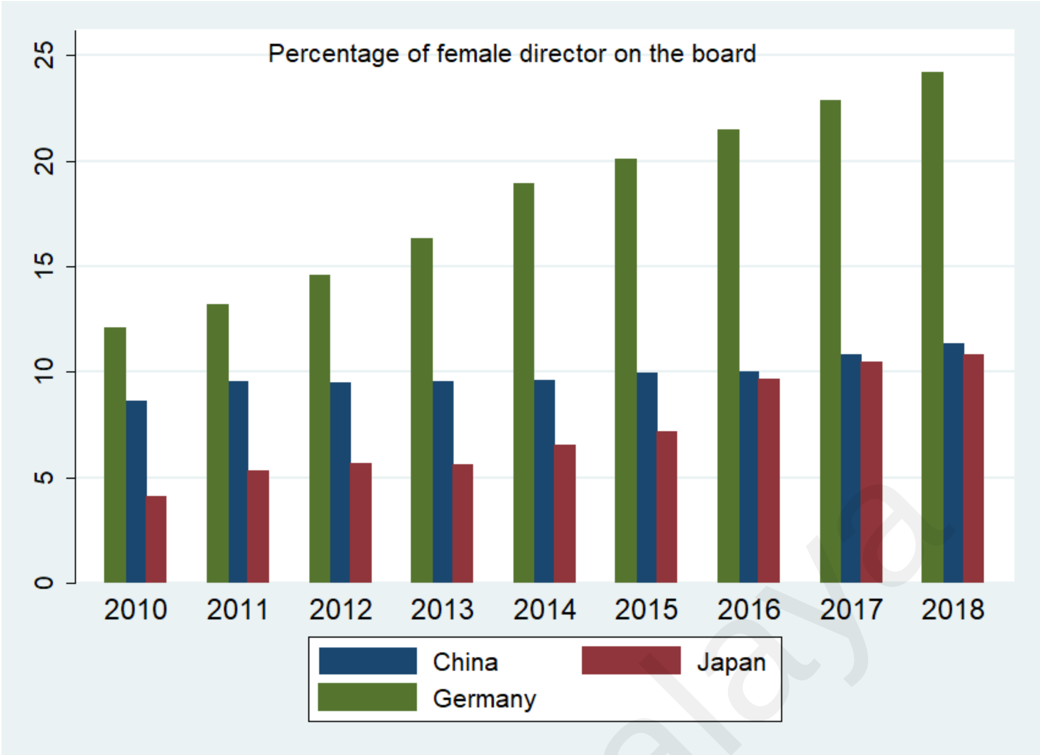

Figure 4. 3 Percentage of female director on the board of directors

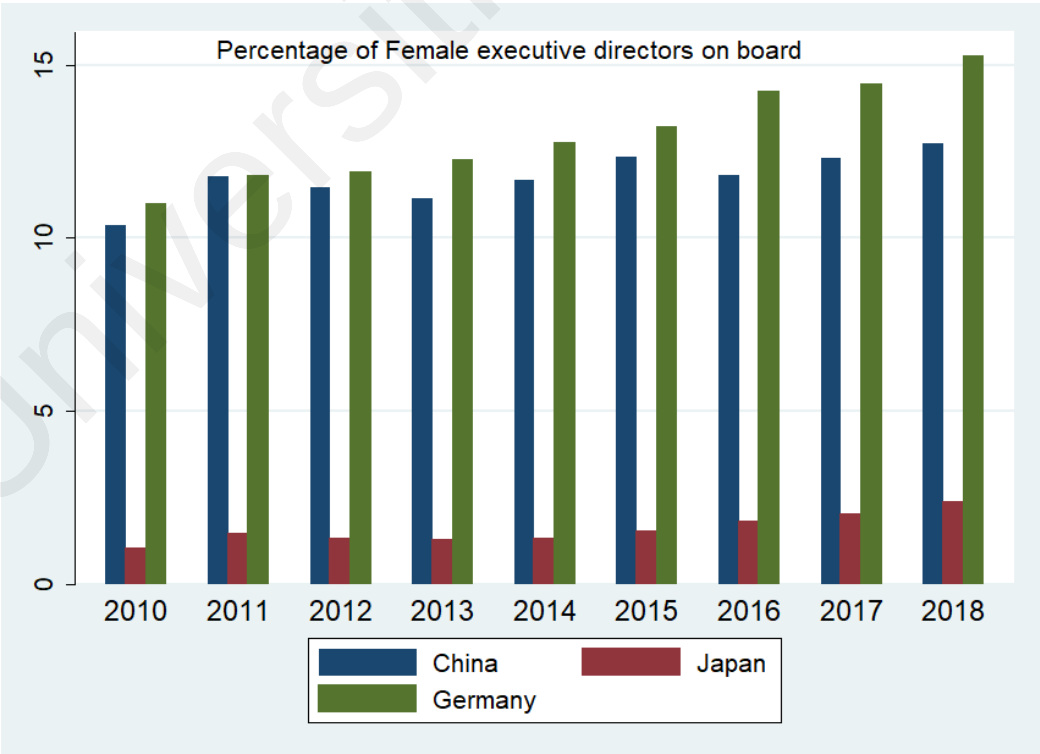

Figure 4. 4 Percentage of Female executive directors on board

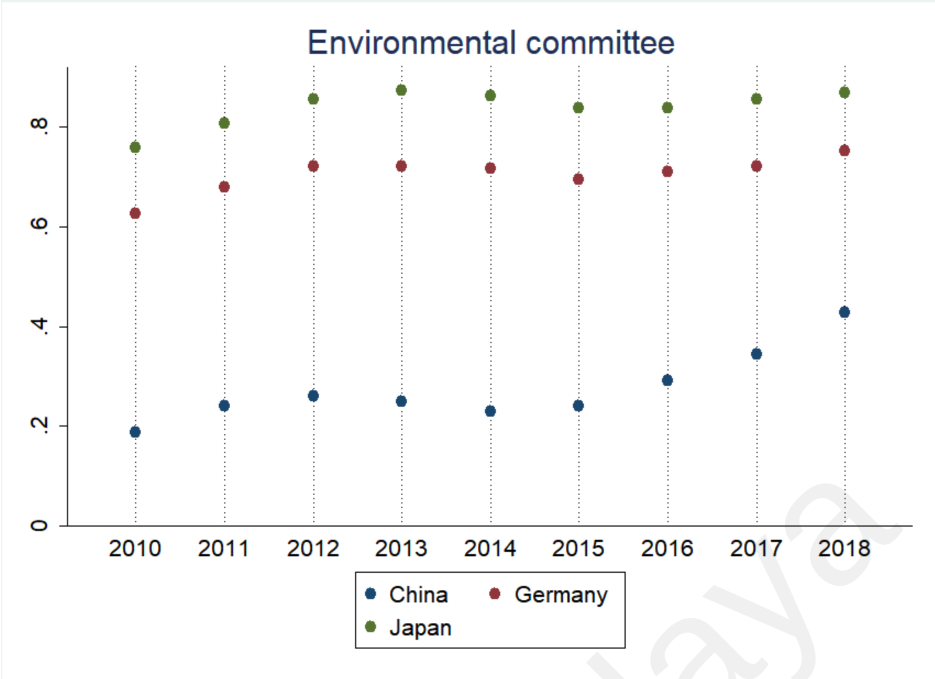

Figure 4. 5 Mean of Environmental committee

4.2.2 Correlation analysis

Table 4.4 represents the Pearson correlation matrix of the variables used in our model and reflect the sample from China; it is revealed that the gender diversity has a significantly negative association with CSR strategy ($r = -0.068$, $p < 0.05$), executive gender diversity also has a significantly negative association with emissions per sale ($r = -0.172$, $p < 0.01$), ESG disclosure ($r = -0.125$, $p < 0.01$) and CSR strategy ($r = -0.217$, $p < 0.01$). Independent director is significantly and positively associated with ESG disclosure ($r = 0.194$, $p < 0.01$) and CSR strategy ($r = 0.152$, $p < 0.01$). The Environmental committee is positively related with emissions per sale ($r = 0.054$, $p < 0.1$), ESG disclosure ($r = 0.493$, $p < 0.01$) and CSR strategy ($r = 0.677$, $p < 0.01$).

Table 4. 4 Correlation Analysis (China)

	EMI	ESG	STR	GEN	EGE	IND	COM	Bsize	GENB	EGEB	INDB	COMB
EMI	1											
ESG	0.050*	1										
STR	0.172***	0.718***	1									
GEN	-0.0310	0.0160	-0.068**	1								
EGE	-0.172***	-0.125***	-0.217***	0.360***	1							
IND	0.00700	0.194***	0.152***	0.088***	0.0240	1						
COM	0.054*	0.493***	0.677***	-0.096***	-0.179***	0.118***	1					
Bsize	0.052*	0.0460	0.232***	-0.071**	-0.243***	-0.183***	0.089***	1				
GENB	-0.0220	0.135***	0.146***	-0.225***	-0.169***	0.102***	0.0440	0.378***	1			
EGEB	0.0100	0.0370	-0.066**	-0.208***	-0.220***	-0.0450	-0.063**	-0.371***	-0.170***	1		
INDB	-0.0100	0.063**	0.062**	0.080***	-0.0290	0.098***	-0.0430	0.252***	0.582***	-0.304***	1	
COMB	-0.054*	-0.00200	0.051*	0.0440	-0.052*	-0.055*	0.073**	0.249***	-0.00100	-0.328***	0.0430	1

* is significant at the 0.1 level, ** is significant at 0.05, *** is significant at 0.01. EMI is emission per sale, ESG is environment, social and governance disclosure, STR is the corporate CSR strategy, GEN is the gender diversity, EGE is executive gender diversity, IND is independent director, COM is corporate environmental committee, Bsize is the board size, GENB is interaction item GEN*Bsize, EGEB interaction item EGE*Bsize, INDB is interaction item IND*Bsize, COMB is interaction item COM*Bsize.

Table 4.5 reveal the Pearson correlation of the sample from Japan and the result showed that gender diversity was significantly negative and associated with emissions per sale ($r = -0.086$, $p < 0.01$); while gender diversity is also positively related to ESG disclosure ($r = 0.166$, $p < 0.01$). Executive gender diversity is negatively associated with emissions per sales ($r = -0.099$, $p < 0.01$) and significantly and positively associated with ESG disclosure ($r = 0.169$, $p < 0.01$) and CSR strategy ($r = 0.089$, $p < 0.01$). Independent director is significantly and negatively associated with emissions per sale ($r = -0.137$, $p < 0.01$), and positively related with ESG disclosure ($r = 0.405$, $p < 0.01$) and CSR strategy ($r = 0.161$, $p < 0.01$); here the environmental committee is significantly and negatively associated with emissions per sale ($r = -0.097$, $p < 0.01$), and positively related to ESG disclosure ($r = 0.436$, $p < 0.01$) and CSR strategy ($r = 0.504$, $p < 0.01$).

Table 4. 5 Correlation Analysis (Japan)

	EMI	ESG	STR	GEN	EGE	IND	COM	Bsize	GENB	EGEB	INDB	COMB
EMI	1											
ESG	-0.120***	1										
STR	-0.071***	0.693***	1									
GEN	-0.086***	0.166***	-0.01	1								
EGE	-0.099***	0.169***	0.089***	0.409***	1							
IND	-0.137***	0.405***	0.161***	0.334***	0.215***	1						
COM	-0.097***	0.436***	0.504***	0.089***	0.060**	0.061**	1					
Bsize	0.125***	-0.049*	0.026	-0.090***	-0.065**	-0.276***	-0.023	1				
GENB	-0.019	-0.069***	0.04	-0.338***	-0.119***	-0.086***	0.035	-0.072***	1			
EGEB	-0.037	0.036	0.021	-0.132***	-0.367***	0.066**	-0.002	-0.044*	0.406***	1		
INDB	-0.086***	0.038	0.106***	-0.085***	0.059**	-0.269***	0.128***	-0.036	0.405***	0.212***	1	
COMB	-0.096***	0.133***	-0.004	0.037	-0.002	0.134***	0.04	-0.054**	0.122***	0.079***	0.009	1

* is significant at the 0.1 level, ** is significant at 0.05, *** is significant at 0.01. EMI is emission per sale, ESG is environment, social and governance disclosure, STR is the corporate CSR strategy, GEN is the gender diversity, EGE is executive gender diversity, IND is independent director, COM is corporate environmental committee, Bsize is the board size, GENB is interaction item GEN*Bsize, EGEB interaction item EGE*Bsize, INDB is interaction item IND*Bsize, COMB is interaction item COM*Bsize.

Table 4.6 reveals the Pearson correlation of the sample from Germany and the result showed that gender diversity was significantly and negatively associated with emissions per sale ($r = -0.035$, $p < 0.1$), gender diversity is positively related to ESG disclosure ($r = 0.290$, $p < 0.01$) and CSR strategy ($r = 0.140$, $p < 0.01$). Executive gender diversity is significantly and positively associated with ESG disclosure ($r = 0.037$, $p < 0.05$). Independent director is significantly and negatively associated with emissions per sale ($r = -0.039$, $p < 0.05$) and CSR strategy ($r = -0.042$, $p < 0.05$) and positively related with ESG disclosure ($r = 0.109$, $p < 0.01$). Environmental committee is significantly and negatively associated with emissions per sale ($r = -0.059$, $p < 0.01$) and positively related to ESG disclosure ($r = 0.492$, $p < 0.01$) and CSR strategy ($r = 0.555$, $p < 0.01$).

Table 4. 6 Correlation Analysis (Germany)

	EMI	ESG	STR	GEN	EGE	IND	COM	Bsize	GENB	EGEB	INDB	COMB
EMI	1											
ESG	-0.075***	1										
STR	-0.038**	0.728***	1									
GEN	-0.035*	0.290***	0.140***	1								
EGE	0.004	0.037**	-0.023	0.296***	1							
IND	-0.039**	0.109***	-0.042**	0.267***	0.178***	1						
COM	-0.059***	0.492***	0.555***	0.098***	-0.031*	-0.058***	1					
Bsize	0.015	0.297***	0.261***	0.012	-0.107***	-0.251***	0.255***	1				
GENB	-0.032*	-0.065***	-0.105***	-0.135***	-0.003	0.148***	-0.001	-0.109***	1			
EGEB	-0.01	-0.019	-0.014	-0.003	-0.205***	0.055***	0.006	-0.217***	0.319***	1		
INDB	-0.016	0.007	-0.039**	0.117***	0.042**	0.207***	0.016	-0.306***	0.382***	0.230***	1	
COMB	0.01	0.025	-0.080***	-0.001	0.005	0.02	-0.137***	0.158***	0.211***	0.034*	0.063***	1

* is significant at the 0.1 level, ** is significant at 0.05, *** is significant at 0.01. EMI is emission per sale, ESG is environment, social and governance disclosure, STR is the corporate CSR strategy, GEN is the gender diversity, EGE is executive gender diversity, IND is independent director, COM is corporate environmental committee, Bsize is the board size, GENB is interaction item GEN*Bsize, EGEB interaction item EGE*Bsize, INDB is interaction item IND*Bsize, COMB is interaction item COM*Bsize.

4.2.3 Panel data analysis

The VIF test from table 4.1–4.3 showed that all of our variables' VIF result is less than 3, so the variables are suitable for the regression analysis. Before the regression test, we conducted the Hausman test to check whether our model was suitable for the fixed effect or random-effect model. This study included the Modified Wald test (MWT) for groupwise heteroskedasticity in the fixed effect regression model and the Wooldridge test for autocorrelation in panel data; we also included the Breusch and pagan Lagrangian multiplier (LM) test to check the heteroskedasticity of random effect model.

Table 4.7 showed the regression of the fixed and random effect of TMT characteristics and Emissions per sale in samples from China, including firm and year fixed effect. From model 1 and model 3, we examined our hypothesis 1a, which is the impact of gender diversity on corporate carbon emissions performance. In models 1 and 3, we found a significantly negative result between GEN and EMI, EGE and EMI. Specifically, in model 1, the coefficient is -0.022 at 5% significance level, representing a negative impact of gender diversity on firm emissions per sale. Model 3, the coefficient is -0.024 at 1% significance level; this depicts that executive gender diversity is influential in decreasing the emissions per sale of Chinese listed firms. In models 2 and 4, we examined hypothesis 1aa, the moderating effect of board size on the relationship between gender diversity, executive gender diversity, and emissions per sale. From model 2 of table 4.7, the result showed that GEN showed a significantly negative impact on EMI (coefficient = -0.037) at 5% level and the moderating variable GENB indicated a negative impact on EMI (coefficient = -0.814) at a 5% significance level. This means that there is a strengthening effect concerning the board size impact for the relationship between GEN and EMI. Model 4 of this study highlighted that EGE revealed a significantly negative impact on EMI (coefficient = -0.020) at 1% level, and EGEB had a significantly positive impact on EMI (coefficient = 0.357) at 1% level; this means that there is a weakening effect of moderating variable board size on the relationship between EGE and EMI. Model 5 of table 4.7 examined hypothesis 2a, that is the impact of independent director on carbon performance. The result showed a negative impact of IND on EMI, the coefficient is -0.014 at 1% significance level, a 1% increase of independent director results with a decrease of 0.014 emissions per sale for the fixed effect model. Model 6 tested the hypothesis 2aa and the results showed the INDB does not significantly impact EMI. This means board size does not have moderating effect on the relationship between independent director and carbon performance. Models 7 and 8 test the hypotheses 3a and 3aa; the results showed that there was no impact created by the environment committee on carbon performance. The Hausman test in table 4.7 supported the fixed effect used in models 1–7; furthermore, the Hausman test and LM test showed the random effect was appropriate in model 8. The Modified Wald test showed that there was no Heteroskedasticity in our model. The MWT result supported our findings that there is first-order autocorrelation in our model.

Table 4. 7 The regression of TMT and Emission per sale (China)

VARIABLES	EMI							
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
GEN	-0.022**	-0.037**						
	(0.011)	(0.015)						
EGE			-0.024***	-0.020***				
			(0.007)	(0.007)				
IND					-0.014***	-0.014***		
					(0.005)	(0.005)		
COM							-0.134	0.006
							(0.381)	(0.182)
Bsize	-0.073**	-0.068**	-0.079***	-0.065**	-0.082***	-0.082***	-0.073**	-0.032
	(0.029)	(0.027)	(0.029)	(0.028)	(0.031)	(0.031)	(0.029)	(0.023)
GENB		-0.814**						
		(0.352)						
EGEB				0.357**				
				(0.180)				
INDB						0.012		
						(0.100)		
COMB								-0.098***
								(0.029)
Constant	2.183***	1.291***	2.319***	2.648***	2.600***	2.652***	2.004***	1.486***
	(0.439)	(0.277)	(0.397)	(0.475)	(0.509)	(0.728)	(0.425)	(0.342)
Observations	1,170	1,170	1,170	1,170	1,170	1,170	1,170	1,170
R-squared	0.695	0.698	0.695	0.696	0.694	0.694	0.693	

Table 4.7 continued

Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Modified Wald	9.4e+10***	9.3e+10***	4.9e+07***	2.5e+07***	7.7e+07***	7.5e+07***	9.4e+10***	9.6e+10***
Hausman (Chi2)	5.42	8.37	5.95	7.91	6.6	7.14	6.27	5.54
Hausman (p value)	0.067	0.039	0.051	0.048	0.037	0.068	0.044	0.136
Wooldridge	3.275*	3.384*	3.328	3.33	3.346	3.378	3.401	3.4
Wooldridge (p value)	0.073	0.068	0.070	0.070	0.070	0.068	0.068	0.068
LM test for RE								1966.07***
Model	FE	FE	FE	FE	FE	FE	FE	RE

GEN is the gender diversity, EGE is executive gender diversity, IND is independent director, COM is corporate environmental committee, Bsize is the board size, GENB is interaction item GEN*Bsize, EGEB interaction item EGE*Bsize, INDB is interaction item IND*Bsize, COMB is interaction item COM*Bsize. FE is Fixed effect , RE is random effect. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 4.8 showed the regression of fixed effect of TMT characteristics and ESG disclosure in Chinese samples, while including firm and year fixed effect. From model 1 and model 3, we examine our hypothesis 1b, which is the impact of gender diversity on corporate ESG disclosure. In models 1 and 3, we found a significantly positive result between GEN and ESG, EGE and ESG. Specifically, in model 1, the coefficient is 0.282 at the 1% significance level, representing the positive impact of gender diversity on ESG disclosure. For model 3, the coefficient is 0.104 at a 10% significance level, depicting that executive gender diversity is influential in increasing the ESG disclosure of Chinese listed firms. In models 2 and 4, we examine hypothesis 1bb, the moderating effect of board size on the relationship between gender diversity, executive gender diversity, and ESG disclosure. From model 2 and model 4, the results showed that interaction item GENB and EGEB does not have a significant impact on ESG disclosure, this means that the board size does not have a moderate impact on the relationship between gender diversity and ESG disclosure. Model 5 of table 4.8 examines hypothesis 2b, that is the impact of independent director on ESG disclosure. The result showed a positive impact of IND on ESG, the coefficient is 0.183 at 1% significance level, a 1% increase of independent director results in an increase of 0.183 ESG disclosure. Model 6 tests hypothesis 2bb, results showed the INDB does not significantly impact ESG. This means board size does not moderate the relationship between independent director and ESG disclosure. Models 7 and 8 test hypotheses 3b and 3bb. The result for model 7 showed that COM has a significantly positive impact on ESG (coefficient = 12.935) at 1% level, a 1% increase of environment committee results and an increase of 12.935 ESG disclosure. The result of model 8 showed that COM has a significantly positive impact on ESG (coefficient = 13.167) at 1% level, and COMB indicates a significantly negative impact on ESG (coefficient = -0.384) at 5% level, this means that there is a weakening effect of moderating variable board size on the relationship between COM and ESG. The

Hausman test in table 4.8 supported the fixed effected. The Modified Wald test showed that there was no Heteroskedasticity in our model. The MWT result supported our findings that there is first-order autocorrelation in our model.

Table 4. 8 The regression of TMT and ESG disclosure (China)

VARIABLES	ESG							
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
GEN	0.282***	0.265***						
	(0.064)	(0.071)						
EGE			0.104*	0.103*				
			(0.058)	(0.060)				
IND					0.183***	0.178***		
					(0.045)	(0.045)		
COM							12.935***	13.167***
							(1.123)	(1.095)
Bsize	-2.630***	-2.625***	-2.607***	-2.612***	-2.509***	-2.514***	-2.620***	-2.549***
	(0.171)	(0.168)	(0.164)	(0.164)	(0.161)	(0.158)	(0.166)	(0.165)
GENB		-0.885						
		(1.825)						
EGEB				-0.107				
				(1.544)				
INDB						-1.203		
						(1.062)		
COMB								-0.384**
								(0.174)
Constant	63.263***	62.293***	64.558***	64.459***	57.876***	52.727***	62.147***	59.945***
	(2.152)	(2.765)	(2.167)	(2.784)	(2.748)	(5.544)	(2.129)	(2.201)
Observations	1,170	1,170	1,170	1,170	1,170	1,170	1,170	1,170
R-squared	0.694	0.694	0.688	0.688	0.691	0.692	0.721	0.722

Table 4.8 continued

Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Modified Wald	4139.67***	3910.97***	6511.66***	6643.56***	3963.88***	3733.39***	8384.57***	7867.90***
Hausman (Chi2)	108.38	110.05	111.92	111.45	105.58	106.22	130.73	128.48
Hausman (p value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Wooldridge	216.539	224.154	210.993	217.469	230.275	230.648	194.959	195.244
Wooldridge (p value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Model	FE	FE	FE	FE	FE	FE	FE	FE

GEN is the gender diversity, EGE is executive gender diversity, IND is independent director, COM is corporate environmental committee, Bsize is the board size, GENB is interaction item GEN*Bsize, EGEB interaction item EGE*Bsize, INDB is interaction item IND*Bsize, COMB is interaction item COM*Bsize. FE is Fixed effect , RE is random effect. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 4.9 showed the fixed effect of TMT characteristics and CSR strategy in samples from China while including firm and year fixed effect. Using model 1 and model 3, we examine our hypothesis 1c, for the impact of gender diversity on corporate CSR strategy. In model 1, we found a significantly positive result between GEN and STR. Specifically, the coefficient is 0.240 at the 10% significance level, representing the positive impact of gender diversity on CSR strategy. From model 3, no significant impact of EGE on STR was observable. In models 2 and 4, we examine hypothesis 1cc, the moderating effect of board size on the relationship between gender diversity, executive gender diversity, and CSR strategy. From model 2 and model 4, the results showed that interaction item GEN and EGE do not significantly impact CSR strategy. This means the board size does not moderately impact the relationship between gender diversity and CSR strategy.

Model 5 examined hypothesis 2c, which is the impact of independent director on CSR strategy. The result showed that there is a positive impact of IND on STR. The coefficient is 0.198 at a 5% significance level, a 1% increase of independent directors' results in an increase of 0.198 CSR strategy. Model 6 tested hypothesis 2cc; results showed the INDB does not significantly impact STR. This revealed that board size does not moderate the relationship between independent directors and CSR strategy. Model 7 and 8 tested the hypotheses 3c and 3cc. The model 7 result showed that COM has a significantly positive impact on STR (coefficient = 36.811) at 1% level, a 1% increase of environment committee results in an increase of 36.811 CSR strategy. The result of model 8 showed that COM makes a significantly positive impact on STR (coefficient = 37.595) at 1% level, and COMB creates a significantly negative impact on STR (coefficient = -1.295) at 1% level, this means that there is a weakening effect of moderating variable board size on the relationship between environment committee and CSR strategy. The Hausman test in table 4.9 supported the fixed effected model. The Modified Wald test showed that there was no Heteroskedasticity in our model. The MWT result supported our findings that there is first-order autocorrelation in our model.

Table 4. 9 The regression of TMT and CSR strategy (China)

VARIABLES	STR							
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
GEN	0.240*	0.120						
	(0.123)	(0.140)						
EGE			0.136	0.151				
			(0.116)	(0.121)				
IND					0.198**	0.203**		
					(0.097)	(0.098)		
COM							36.811***	37.595***
							(2.512)	(2.261)
Bsize	-2.619***	-2.584***	-2.587***	-2.520***	-2.487***	-2.482***	-2.578***	-2.341***
	(0.336)	(0.324)	(0.330)	(0.331)	(0.333)	(0.336)	(0.335)	(0.329)
GENB		-6.455**						
		(3.201)						
EGEB				1.673				
				(3.096)				
INDB						1.218		
						(2.528)		
COMB								-1.295***
								(0.440)
Constant	65.661***	58.585***	66.054***	67.596***	59.181***	64.396***	56.783***	49.361***
	(4.208)	(5.082)	(4.245)	(5.296)	(5.808)	(11.936)	(4.331)	(4.429)
Observations	1,170	1,170	1,170	1,170	1,170	1,170	1,170	1,170
R-squared	0.703	0.704	0.703	0.703	0.703	0.703	0.764	0.767
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Modified Wald	19833.70***	24814.55***	25427.96***	25209.30***	28238.47***	26558.45***	14220.95***	17522.68***
Hausman (Chi2)	65.08	68.54	73.76	75.5	68.75	70.28	118	116.77
Hausman (p value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Wooldridge	153.89	149.472	154.144	153.545	157.251	156.466	121.015	115.963
Wooldridge (p value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Model	FE	FE	FE	FE	FE	FE	FE	FE

Table 4.10 showed the regression of both a fixed and random effect of TMT characteristics and Emissions per sale in samples from Japan, while including firm and year fixed effect. From model 1 and model 3, we examine our hypothesis 1a, that is the impact of gender diversity on corporate carbon emissions performance. In model 1 we found a positively significant result between GEN and EMI; specifically, the coefficient is 0.002 at the 5% significance level, representing a 1% increase of gender diversity, which increases 0.002 emissions per sale. In model 3 we can see that executive gender diversity does not impact EMI. In models 2 and 4, we examine hypothesis 1aa, the moderating effect of board size on the relationship between gender diversity, executive gender diversity, and emissions per sale. Models 2 and 4 of table 4.10 showed that GEN and EGE do not significantly impact EMI; additionally, the moderating variable GENB and EGEB do not impact EMI, which means that board size does not have a moderate effect on the relationship between GEN–EMI and EGE–EMI. Model 5 of table 4.10 examines hypothesis 2a, which is the impact of independent director on carbon performance. The result showed a positive impact of IND on EMI, the coefficient is 0.001 at a 1% significance level, a 1% increase of independent director results in a decrease of 0.001 emissions per sale of Japan's listed firms. Model 6 tests hypothesis 2aa, and the results showed that the INDB does not significantly impact EMI. This means board size does not moderate the relationship between independent director and carbon performance. Models 7 and 8 test the hypotheses 3a and 3aa. These results exhibit no impact of the environment committee on carbon performance, and board size does not impact on the COM–EMI relationship. The Hausman test in table 4.10 supported the fixed effect used in models 1,3,5–8, and the Hausman test and LM test showed the random-effect is appropriate in models 2 and 4. The Modified Wald test showed that there was no Heteroskedasticity in our model. The MWT result supported our findings that there is first-order autocorrelation in our model.

Table 4. 10 The regression of TMT and Emission per sale (Japan)

VARIABLES	EMI							
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
GEN	0.002**	0.001						
	(0.001)	(0.001)						
EGE			0.001	-0.000				
			(0.000)	(0.003)				
IND					0.001***	0.001***		
					(0.000)	(0.000)		
COM							-0.010	-0.009
							(0.038)	(0.039)
Bsize	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
GENB		-0.013						
		(0.023)						
EGEB				-0.027				
				(0.055)				
INDB						-0.001		
						(0.009)		
COMB								0.004
								(0.006)
Constant	0.228***	0.227***	0.236***	0.232***	0.217***	0.216***	0.245***	0.282***
	(0.023)	(0.065)	(0.023)	(0.065)	(0.024)	(0.037)	(0.032)	(0.064)
Observations	1,494	1,494	1,494	1,494	1,494	1,494	1,494	1,494
R-squared	0.968		0.968		0.968	0.968	0.968	0.968
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Modified Wald	1.1e+09***	1.4e+09***	3.0e+11***	1.7e+11***	1.5e+08***	1.5e+08***	3.0e+11***	9.4e+10***
Hausman (Chi2)	5.14	5.41	5.02	6.12	6.9	10.43	5.02	7.13
Hausman (p value)	0.077	0.144	0.081	0.106	0.032	0.015	0.081	0.068
Wooldridge	77.292	78.63	76.974	76.93	76.672	77.177	76.014	77.313
Wooldridge (p value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
LM test for RE		5463.37***		5452.87***				
Model	FE	RE	FE	RE	FE	FE	FE	FE

Table 4.11 showed the regression of fixed and random effect of TMT characteristics and ESG disclosure in samples from Japan, while include firm and year fixed effect. From model 1 and model 3, we examine our hypothesis 1b, that is the impact of gender diversity on corporate ESG disclosure. In models 1 and 3, we found a positively significant result between GEN and ESG, as well as EGE and ESG. Specifically, in model 1, the coefficient is 0.575 at the 1% significance level, representing the positive impact of gender diversity on ESG disclosure. For model 3 the coefficient is 0.909 at 1% significance level and it depicts that executive gender diversity is influential in that it can increase the ESG disclosure of Japanese listed firms. In models 2 and 4, we examine hypothesis 1bb, the moderating effect of board size on the relationship between gender diversity, executive gender diversity, and ESG disclosure. From model 2 and model 4, the results showed that the interaction item GENB and EGEB does not significantly impact ESG disclosure, so this means the board size does not have a moderate impact on the relationship between gender diversity and ESG disclosure. Model 5 of table 4.11 examined the hypothesis 2b, that is the impact of independent director on ESG disclosure. The result showed that there was a positive impact of IND on ESG, and the coefficient is 0.311 at 1% significance level, a 1% increase of independent director results in an increase of 0.311 ESG disclosure. Model 6 tests the hypothesis 2bb, and the results showed that IND positively impacted upon ESG (coefficient = 0.329) at 1% level; also INDB positively impacts on ESG (coefficient = 1.451) at 1% level, this means that there is a strengthening effect of moderating variable board size on the relationship between IND and ESG. Models 7 and 8 test the hypotheses 3b and 3bb. Model 7 showed a result that COM has a significantly positive impact on ESG (coefficient = 8.542) at 1% level, with a 1% increase of environment committee results at an increase of 8.542 ESG disclosure. The result of model 8 showed that COMB does not significantly impact on ESG, this means that board size does not have a moderate effect on the relationship between COM and ESG. The

Hausman test in table 4.11 supported the fixed effect used in models 5–8, and the Hausman and LM tests showed that the random effect is appropriate in model 1–4. The Modified Wald test showed that there was no Heteroskedasticity in our model. The MWT result supported our findings in that there is first-order autocorrelation in our model.

Table 4. 11 The regression of TMT and ESG disclosure (Japan)

VARIABLES	ESG							
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
GEN	0.575***	0.604***						
	(0.044)	(0.048)						
EGE			0.909***	0.977***				
			(0.113)	(0.121)				
IND					0.311***	0.329***		
					(0.030)	(0.030)		
COM							8.542***	8.637***
							(1.272)	(1.273)
Bsize	0.001	0.021	0.089	0.097	-0.015	0.007	0.102	0.103
	(0.096)	(0.097)	(0.099)	(0.100)	(0.115)	(0.114)	(0.119)	(0.117)
GENB		1.557						
		(1.067)						
EGEB				4.158				
				(2.620)				
INDB						1.451***		
						(0.555)		
COMB								0.408
								(0.267)
Constant	48.387***	49.459***	49.866***	50.373***	46.249***	49.716***	44.225***	48.459***
	(1.474)	(1.709)	(1.514)	(1.608)	(1.456)	(2.044)	(1.693)	(3.159)
Observations	1,494	1,494	1,494	1,494	1,494	1,494	1,494	1,494
R-squared					0.864	0.865	0.854	0.855
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Modified Wald	16648.11***	16557.65***	17994.58***	32530.50***	8331.64***	8323.30***	37330.03***	72118.34***
Hausman (Chi2)	1.49	2.07	0.96	2.82	8.28	13.06	22.65	24.08
Hausman (p value)	0.475	0.557	0.620	0.420	0.016	0.005	0.000	0.000
Wooldridge	85.409	85.803	88.549	88.716	80.733	79.922	122.135	130.06
Wooldridge (p value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
LM test for RE	4216.22***	4211.49***	4099.43***	4057.67***				
Model	RE	RE	RE	RE	FE	FE	FE	FE

Table 4.12 showed the regression of fixed effect of TMT characteristics and CSR strategy in samples from Japan, which include firm and year fixed effect. From model 1 and model 3, we examine our hypothesis 1c, that is the impact of gender diversity on corporate CSR strategy. In model 1, we found a positively significant result between GEN and STR. Specifically, the coefficient is 0.526 at the 1% significance level, representing a positive impact of gender diversity on CSR strategy. From the result of model 3, we can see that there is a significantly positive impact of EGE on STR (coefficient = 0.970) at 1% level. In models 2 and 4, we examined the hypothesis 1cc, the moderating effect of board size and the impact on the relationship between gender diversity, executive gender diversity and CSR strategy. From model 2 and model 4, the results showed that interaction items GENB and EGEB do not create significant impacts on CSR strategy, this means the board size does not have a moderate impact on the relationship between gender diversity and CSR strategy. Model 5 examined the hypothesis 2c, that is the impact of independent director on CSR strategy. The result showed that there is positive impact of IND on STR, with the coefficient 0.207 at 1% significance level, a 1% increase of independent director results in an increase of 0.207 CSR strategy. Model 6 tested the hypothesis 2cc and the results showed that the INDB does not significantly impact on STR, this means board size does not have a moderating effect on the relationship between independent director and CSR strategy. Models 7 and 8 tested the hypotheses 3c and 3cc, where the model 7 result showed COM has a significantly positive impact on STR (coefficient = 22.360) at 1% level, a 1% increase of environment committee results in an increase of 22.360 CSR strategy. The result of model 8 showed that COMB does not significantly impact on STR, this means that board size does not have a moderate impact on the relationship between environment committee and CSR strategy. The Hausman test in table 4.12 supported the fixed effect used in models 1,6–8, and the Hausman and LM tests showed the random effect is appropriate in models 2–5. The Modified Wald test showed that there was no Heteroskedasticity in our model. The MWT result supported our findings that there is first-order autocorrelation in our model.

Table 4. 12 The regression of TMT and CSR strategy (Japan)

VARIABLES	STR							
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
GEN	0.526***	0.479***						
	(0.101)	(0.100)						
EGE			0.970***	0.858***				
			(0.225)	(0.240)				
IND					0.207***	0.176***		
					(0.047)	(0.065)		
COM							22.360***	22.202***
							(2.455)	(2.405)
Bsize	0.149	0.181	0.245	0.232	0.195	0.145	0.218	0.217
	(0.236)	(0.200)	(0.198)	(0.198)	(0.198)	(0.237)	(0.223)	(0.225)
GENB		0.461						
		(2.221)						
EGEB				-6.940				
				(5.260)				
INDB						-1.128		
								-0.677
COMB								(0.523)
	47.440***	47.389***	48.521***	48.797***	46.983***	44.287***	31.545***	24.512***
Constant	(3.046)	(3.300)	(3.229)	(3.233)	(3.219)	(4.533)	(3.459)	(6.788)
Observations	1,494	1,494	1,494	1,494	1,494	1,494	1,494	1,494
R-squared	0.777					0.774	0.792	0.792
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Modified Wald	2.8e+05***	2.8e+05***	5.5e+05***	6.4e+05***	97537.37***	1.0e+05***	4.6e+05***	4.3e+05***
Hausman (Chi2)	5.29	6.06	0.17	3.12	2.39	13.68	19.05	19.5
Hausman (p value)	0.071	0.109	0.916	0.374	0.302	0.003	0.000	0.000
Wooldridge	250.428	251.027	255.761	256.395	246.71	249.173	255.128	254.292
Wooldridge (p value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
LM test for RE		3277.6***	3308.32***	3271.2***	3225.11***			
Model	FE	RE	RE	RE	RE	FE	FE	FE

Table 4.13 showed the regression of both a fixed and random effect of TMT characteristics and Emissions per sale in samples from Germany, while including firm and year fixed effect. From model 1 and model 3, we examined our hypothesis 1a, that is the impact of gender diversity on corporate carbon emissions performance. In models 1 and 3, we found GEN and EGE does not significantly impact on EMI. In models 2 and 4, we examine the hypothesis 1aa, the moderating effect of board size impact on the relationship between gender diversity, executive gender diversity and emissions per sale. From the models 2 and 4 of table 4.13, the results showed that GEN and EGE do not significantly impact on EMI, the moderating variables GENB and EGEB do not impact on EMI, this means that board size does not have a moderate effect on the relationship between GEN–EMI and EGE–EMI. Model 5 of table 4.13 examined the hypothesis 2a, that is the impact of independent director on carbon performance. The result showed that there was a positive impact of IND on EMI, the coefficient is 0.004 at 5% significance level, a 1% increase of independent director results with a decrease of 0.004 emissions per sale of German listed firms. Model 6 tests the hypothesis 2aa, results showed the INDB does not significantly impact on EMI, so this indicated that board size does not have a moderating effect on the relationship between independent director and carbon performance. Models 7 and 8 test the hypotheses 3a and 3aa, the results showed that there was no impact of environment committee on carbon performance, and board size does not impact upon the COM–EMI relationship. The Hausman test in table 4.13 supported the fixed effect used in the models. The Modified Wald test showed that there was no Heteroskedasticity in our model. The MWT result supported our findings in that there is first-order autocorrelation in our model.

Table 4. 13 The regression of TMT and Emission per sale (Germany)

VARIABLES	EMI							
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
GEN	0.003	0.004						
	(0.004)	(0.004)						
EGE			0.003	0.001				
			(0.006)	(0.006)				
IND					0.004**	0.005**		
					(0.002)	(0.002)		
COM							-0.335	-0.336
							(0.251)	(0.268)
Bsize	-0.055	-0.051	-0.054	-0.059	-0.056	-0.047	-0.051	-0.050
	(0.034)	(0.032)	(0.034)	(0.037)	(0.034)	(0.031)	(0.031)	(0.031)
GENB		0.124						
		(0.078)						
EGEB				-0.140				
				(0.101)				
INDB						0.045		
						(0.028)		
COMB								-0.002
								(0.031)
Constant	0.956**	1.128**	0.958**	0.819**	0.778**	0.950**	1.184**	1.166**
	(0.399)	(0.498)	(0.410)	(0.326)	(0.338)	(0.420)	(0.527)	(0.476)
Observations	2,925	2,925	2,925	2,925	2,925	2,925	2,925	2,925
R-squared	0.443	0.444	0.443	0.444	0.444	0.444	0.445	0.445
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Modified Wald	3.9e+10***	3.3e+12***	7.3e+17***	7.3e+17***	6.2e+09***	2.2e+10***	2.0e+12***	2.0e+12***
Hausman (Chi2)	8.25	11.86	6.43	6.93	9.04	9.64	7.49	7.52
Hausman (p value)	0.016	0.008	0.040	0.074	0.011	0.022	0.024	0.057
Wooldridge	5.467	5.457	5.502	5.505	5.461	5.462	5.468	5.469
Wooldridge (p value)	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
Model	FE	FE	FE	FE	FE	FE	FE	FE

Table 4.14 showed the regression of the fixed effect of TMT characteristics and ESG disclosure in samples from Germany, while including firm and year fixed effect. From model 1 and model 3, we examine our hypothesis 1b, that is the impact of gender diversity on corporate ESG disclosure. In models 1 and 3, we found that a positively significant result between GEN and ESG, as well as EGE and ESG. Specifically, with model 1, the coefficient is 0.355 at the 1% significance level, representing the positive impact of gender diversity on ESG disclosure. For model 3, the coefficient is 0.157 at 1% significance level, it depicts that executive gender diversity is influential and increases the ESG disclosure of German listed firms. In models 2 and 4, we examine the hypothesis 1bb, the moderating effect of board size impact on the relationship between gender diversity, executive gender diversity and ESG disclosure. The result of model 2 showed that GEN positively impacts on ESG (coefficient = 0.341) at 1% level, GENB has a significantly negative impact on ESG (coefficient = -1.041) at 10% level, this means board size has a weakening moderate impact on the GEN–ESG relationship. The result of model 4 showed that the interaction item EGEB does not significantly impact on ESG disclosure, this means the board size does not have a moderate impact on the relationship between executive gender diversity and ESG disclosure. Model 5 of table 4.14 examined the hypothesis 2b, that is the impact of independent director on ESG disclosure. The result showed that there is a positive impact of IND on ESG, the coefficient is 0.227 at 1% significance level, a 1% increase of independent director results in an increase of 0.227 ESG disclosure. Model 6 tested the hypothesis 2bb and the results showed that the INDB has no significant impact on ESG, this means board size does not have a moderate impact on the relationship between IND and ESG. Models 7 and 8 test the hypotheses 3b and 3bb, where the result of model 7 showed that COM has a significantly positive impact on ESG (coefficient = 6.964) at 1% level, a 1% increase of environment committee results in an increase of 6.964 ESG disclosure. The result of model 8 showed that COMB does not significantly impact on ESG, this means that board size does not have a moderate effect on the relationship between COM and ESG. The Hausman test in table 4.14 supported the fixed effect of these models. The Modified Wald test showed that there was no Heteroskedasticity in our model. The MWT result supported our findings that there is first-order autocorrelation in our model.

Table 4. 14 The regression of TMT and ESG disclosure (Germany)

VARIABLES	ESG							
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
GEN	0.355***	0.341***						
	(0.021)	(0.022)						
EGE			0.157***	0.149***				
			(0.022)	(0.024)				
IND					0.227***	0.227***		
					(0.020)	(0.020)		
COM							6.964***	6.861***
							(0.795)	(0.835)
Bsize	-0.200*	-0.237**	-0.101	-0.118	-0.172*	-0.184	-0.183	-0.176
	(0.104)	(0.107)	(0.117)	(0.116)	(0.099)	(0.120)	(0.120)	(0.124)
GENB		-1.041*						
		(0.560)						
EGEB				-0.562				
				(0.558)				
INDB						-0.064		
						(0.310)		
COMB								-0.134
								(0.228)
Constant	46.504***	45.067***	49.799***	49.243***	39.854***	39.609***	47.920***	46.929***
	(1.250)	(1.471)	(1.356)	(1.510)	(1.628)	(2.146)	(1.387)	(2.461)
Observations	2,925	2,925	2,925	2,925	2,925	2,925	2,925	2,925
R-squared	0.859	0.859	0.843	0.843	0.854	0.854	0.848	0.848
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Modified Wald	43711.71***	39163.97***	51659.36***	53431.10***	34668.14***	35239.66***	51668.76***	55436.02***
Hausman (Chi2)	58.29	60.05	49.27	53.8	78.69	80.16	96.99	101.51
Hausman (p value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Wooldridge	281.785	281.734	312.085	312.098	304.484	305.686	312.088	311.928
Wooldridge (p value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Model	FE	FE	FE	FE	FE	FE	FE	FE

Table 4.15 showed the regression of the fixed effect of TMT characteristics and CSR strategy in samples from Germany; this included firm and year fixed effect. From model 1 and model 3, we examined our hypothesis 1c, that is the impact of gender diversity on corporate CSR strategy. In model 1, we found a positively significant result between GEN and STR. Specifically, the coefficient is 0.453 at the 1% significance level, representing the positive impact of gender diversity on CSR strategy. From the result of model 3, we can see that there is a significantly positive impact of EGE on STR (coefficient = 0.104) at 1% level. In models 2 and 4, we examined the hypothesis 1cc, the moderating effect of board size impact on the relationship between gender diversity, executive gender diversity and CSR strategy. From model 2, the result showed that GEN has a significantly positive impact on STR, and GENB negatively impacts on STR, this means that board size has a weakening moderate effect on the GEN–STR relationship. The result of model 4 showed that EGEB does not significantly impact on CSR strategy, which means the board size does not have a moderate impact on the relationship between executive gender diversity and CSR strategy. Model 5 examined the hypothesis 2c, that is the impact of independent director on CSR strategy. The result showed that there is a positive impact of IND on STR, the coefficient is 0.210 at 1% significance level, a 1% increase of independent director results with an increase of 0.21% CSR strategy. Model 6 tested the hypothesis 2cc and the results showed the INDB does not significantly impact on STR, this means board size does not have a moderating effect on the relationship between independent director and CSR strategy. Models 7 and 8 test the hypotheses 3c and 3cc where the model 7 result showed that COM has a significantly positive impact on STR (coefficient = 21.599) at 1% level, a 1% increase of environment committee results with an increase of 21.599% CSR strategy. The result of model 8 showed that COMB does not significantly impact on STR, this means that board size does not have a moderate impact on the relationship between environment committee and CSR strategy. The Hausman test in table 4.15 supported the fixed effect used in these models. The Modified Wald test showed that there was no Heteroskedasticity in our model. The MWT result supported our findings that there is first-order autocorrelation in our model.

Table 4. 15 The regression of TMT and CSR strategy (Germany)

VARIABLES	STR							
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
GEN	0.453***	0.419***						
	(0.039)	(0.041)						
EGE			0.104**	0.085*				
			(0.043)	(0.044)				
IND					0.210***	0.216***		
					(0.034)	(0.035)		
COM							21.599***	21.480***
							(1.749)	(1.972)
Bsize	0.029	-0.063	0.154	0.112	0.089	0.214	-0.097	-0.088
	(0.185)	(0.184)	(0.192)	(0.197)	(0.186)	(0.224)	(0.180)	(0.185)
GENB		-2.572**						
		(1.022)						
EGEB				-1.383				
				(1.022)				
INDB						0.644		
						(0.634)		
COMB								-0.155
								(0.595)
	40.049***	36.496***	45.513***	44.144***	35.780***	38.241***	34.661***	33.518***
Constant	(2.147)	(2.801)	(2.226)	(2.394)	(2.674)	(3.501)	(2.307)	(4.536)
Observations	2,925	2,925	2,925	2,925	2,925	2,925	2,925	2,925
R-squared	0.789	0.790	0.779	0.779	0.782	0.783	0.804	0.804
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Modified Wald	6.6e+05***	1.1e+06***	3.4e+06***	3.7e+06***	1.9e+06***	1.4e+06***	4.9e+06***	1.2e+07***
Hausman (Chi2)	30.88	32.9	27.76	31.05	42.82	41.93	53.14	53.93
Hausman (p value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Wooldridge	45.249	45.227	46.516	46.455	46.424	46.423	48.39	48.722
Wooldridge (p value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Model	FE	FE	FE	FE	FE	FE	FE	FE

4.3 Corporate environmental performance and corporate financial performance

4.3.1 Descriptive statistics

Tables 4.16, 4.17 and 4.18 showed the descriptive statistics related to the variables used in our model, including 621 firms (130 firms from China, 166 firms from Japan and 325 firms from Germany) that were observed from 2010 to 2018. Here ROA, ROE and Tobin's Q are identified as dependent variables, emissions per sale, ESG, and CSR strategy are classified as independent variables, leverage, income, sales, and foreign sale are grouped as control variables, and in this study, we include a moderate variable of employee as firm size. The average ROA is 5.07% for corporations from China, 3.06% for Japan, and 6.18% for Germany. In comparison, the average ROE is 10.5% for corporations in China, 5.45% for corporations in Japan and 9.69% for corporations from Germany (See Kecerdasan and Ikep, 2020). Tobin's Q, (which represents the relationship between market valuation and the intrinsic value, showed a mean of 1.36 for corporations in China, a mean of 1.25 for corporations in Japan, and 1.94 for Germany. The mean values of ROA, ROE, Tobin's Q, and emissions per sale are high for the Chinese corporations. In contrast, the mean ROE, Tobin's Q, and emissions per sale values for Japan's corporations vary disparately amongst the different industries.

Table 4. 16 Descriptive analysis (China)

Variable	Obs	Mean	Std. Dev.	Min	Max	VIF
ROA	1170	5.07	5.72	-28.75	74.67	3.25
ROE	1170	10.49	12.02	-154.03	85.78	2.54
Tobin's Q	1170	1.36	0.63	0.39	8.91	1.57
EMI	1170	1.09	2.65	0.00	25.77	1.22
ESG	1170	34.41	16.35	1.96	100	2.19
STR	1170	36.53	34.64	0.00	100	2.48
FSALE	1170	0.21	0.32	0.00	1.00	1.07
LGINC	1170	15.10	0.56	10.08	17.72	2.38
LEVER	1170	39.06	22.47	0.00	158.58	1.43
LGEM	1170	10.05	1.40	5.24	13.22	4.1

Table 4.16 continued

LGSA	1170	15.70	1.51	11.82	19.95	4.97
EMIE	1170	0.24	2.12	-17.16	13.85	1.29
ESGE	1170	7.42	23.98	-74.22	141.63	2.1
STRE	1170	18.13	51.20	-176.85	183.22	2.48

ROA is return on asset, ROE is return on equity, EMI is emission per sale, ESG is environment, social and governance disclosure, STR is the corporate CSR strategy, FSALE is percentage of foreign sale, LGINC is log(income), LEVER is leverage, LGSA is log(sale), LGEM is log(employee). EMIE, ESGE and STRE is interaction items, EMIE = EMI*LGEM, ESGE=ESG*LGEM, STRE=STR*LGEM

Table 4. 17 Descriptive analysis (Japan)

Variable	Obs	Mean	Std. Dev.	Min	Max	VIF
ROA	1494	3.06	3.77	-25.12	22.20	2.13
ROE	1494	5.45	30.07	-737.08	174.64	1.21
Tobin's Q	1494	1.25	0.55	0.56	6.60	1.66
EMI	1494	0.25	0.78	0.00	9.11	2.44
ESG	1494	52.68	17.95	4.85	91.71	2.40
STR	1494	53.06	29.52	0.00	99.66	2.12
FSALE	1494	0.31	0.28	0.00	1.00	1.54
LGINC	1494	16.57	0.44	0.00	17.15	1.09
LEVER	1494	35.85	23.77	0.00	129.71	1.79
LGEM	1494	9.89	1.10	6.47	12.86	0.26
LGSA	1494	16.09	1.08	13.29	18.75	3.62
EMIE	1494	-0.06	0.69	-8.92	2.09	2.23
ESGE	1494	10.08	19.22	-72.27	97.84	1.87
STRE	1494	13.44	29.57	-113.38	129.31	1.84

ROA is return on asset, ROE is return on equity, EMI is emission per sale, ESG is environment, social and governance disclosure, STR is the corporate CSR strategy, FSALE is percentage of foreign sale, LGINC is log(income), LEVER is leverage, LGSA is log(sale), LGEM is log(employee). EMIE, ESGE and STRE is interaction items, EMIE = EMI*LGEM, ESGE=ESG*LGEM, STRE=STR*LGEM

Table 4. 18 Descriptive analysis (Germany)

Variable	Obs	Mean	Std. Dev.	Min	Max	VIF
ROA	2925	6.18	14.98	-59.58	297.37	4.84
ROE	2925	9.69	445.58	-22991.20	3929.04	1.11
Tobin's Q	2925	1.94	3.61	0.29	91.20	4.72
EMI	2925	0.39	2.20	0.00	66.64	4.33
ESG	2925	50.71	19.33	2.48	93.27	2.52
STR	2925	48.59	31.80	0.00	99.88	2.27
FSALE	2925	0.41	0.38	0.00	1	1.14
LGINC	2925	16.59	0.14	14.10	17.91	1.24
LEVER	2925	45.77	165.95	-1325.34	7864.71	1.01
LGEM	2925	9.15	1.75	0.00	13.30	3.96

Table 4.18 continued

LGSA	2924	15.21	1.61	8.96	18.94	4.28
EMIE	2925	-0.42	11.74	-441.75	14.12	4.25
ESGE	2925	15.92	36.71	-98.19	432.33	2.23
STRE	2925	23.68	55.04	-143.11	444.70	2.25

ROA is return on asset, ROE is return on equity, EMI is emission per sale, ESG is environment, social and governance disclosure, STR is the corporate CSR strategy, FSALE is percentage of foreign sale, LGINC is log(income), LEVER is leverage, LGSA is log(sale), LGEM is log(employee). EMIE, ESGE and STRE is interaction items, EMIE = EMI*LGEM, ESGE=ESG*LGEM, STRE=STR*LGEM

4.3.2 Correlation analysis

Table 4.19 presented the Pearson correlation matrix with the variables used in our model and it reflects the sample from China; it revealed that emissions per sale is significantly negative in association with ROE (r=-0.055, p<0.1) and Tobin's Q (r=-0.088, p<0.01), while ESG is significantly negative in association with ROA (r=-0.200, p<0.01), ROE (r=-0.102, p<0.01) and Tobin's Q (r=-0.174, p<0.01). CSR strategy is negatively related with ROA (r=-0.164, p<0.01), ROE (r=-0.075,p<0.05) and Tobin's Q ($r = -0.130, p < 0.01$). The correlation result from China was evident and the result showed that environmental performance had a negative association with corporate financial performance.

Table 4. 19 Correlation (China)

	ROA	ROE	Tobin's Q	EMI	ESG	STR	FSALE	LGINC	LEVER	LGEM	LGSA	EMIE	ESGE	STRE
ROA	1													
ROE	0.677***	1												
Tobin's Q	0.528***	0.253***	1											
EMI	-0.032	-0.055*	-0.088***	1										
ESG	-0.200***	-0.102***	-0.174***	0.050*	1									
STR	-0.164***	-0.075**	-0.130***	0.172***	0.718***	1								
FSALE	-0.083***	-0.070**	-0.084***	-0.124***	0.034	0.016	1							
LNINC	0.078***	0.363***	-0.108***	-0.018	0.280***	0.330***	-0.099***	1						
LEVER	-0.454***	-0.180***	-0.313***	0.151***	0.264***	0.278***	0.013	0.055*	1					
LNEM	-0.199***	0.045	-0.081***	0.065**	0.325***	0.375***	-0.088***	0.495***	0.179***	1				
LNSA	-0.260***	0.025	-0.205***	0.072**	0.376***	0.467***	-0.109***	0.571***	0.257***	0.856***	1			
EMIE	0.095***	-0.036	-0.021	0.287***	-0.050*	-0.060**	-0.035	-0.234***	0.007	-0.329***	-0.278***	1		
ESGE	-0.028	0.009	0.021	-0.027	0.089***	0.170***	-0.005	0.367***	-0.013	0.170***	0.209***	-0.066**	1	
STRE	-0.038	-0.016	-0.008	-0.033	0.169***	0.271***	0.012	0.475***	0.022	0.271***	0.322***	-0.085***	0.718***	1

* is significant at the 0.1 level, ** is significant at 0.05, *** is significant at 0.01. ROA is return on asset, ROE is return on equity, EMI is emission per sale, ESG is environment, social and governance disclosure, STR is the corporate CSR strategy, FSALE is percentage of foreign sale, LGINC is log(income), LEVER is leverage, LGSA is log(sale), LGEM is log(employee). EMIE, ESGE and STRE is interaction items, EMIE = EMI*LGEM, ESGE=ESG*LGEM, STRE=STR*LGEM

Table 4.20 represented the Pearson correlation matrix of the variables used in our model. The sample from Japan revealed that emissions per sale is significantly negative in association with ROA $(r = -0.149, p < 0.01)$, ROE $(r = -0.073, p < 0.01)$ and Tobin's Q $(r = -0.130, p < 0.01)$. ESG disclosure has a positive association with Tobin's Q$(r = 0.094,\ p < 0.01)$. CSR strategy is negatively associated with ROA$(r = -0.061, p < 0.05)$.

Table 4. 20 Correlation (Japan)

	ROA	ROE	Tobin's Q	EMI	ESG	STR	FSALE	LGINC	LEVER	LGEM	LGSA	EMIE	ESGE	STRE
ROA	1													
ROE	0.371***	1												
Tobin's Q	0.570***	0.093***	1											
EMI	-0.149***	-0.073***	-0.130***	1										
ESG	0.02	0.02	0.094***	-0.120***	1									
STR	-0.061**	0.014	-0.009	-0.071***	0.693***	1								
FSALE	0.155***	0.009	0.206***	-0.165***	0.393***	0.279***	1							
LNINC	0.153***	0.141***	0.015	-0.070***	0.107***	0.082***	0.033	1						
LEVER	-0.512***	-0.138***	-0.353***	0.326***	0.083***	0.196***	-0.204***	-0.04	1					
LNEM	-0.170***	-0.028	-0.156***	-0.074***	0.510***	0.413***	0.289***	0.034	0.259***	1				
LNSA	-0.271***	-0.052**	-0.283***	0.027	0.386***	0.389***	-0.006	0.021	0.407***	0.791***	1			
EMIE	0.096***	-0.023	0.094***	-0.695***	-0.067***	-0.083***	0.005	-0.071***	-0.234***	-0.145***	-0.144***	1		
ESGE	-0.090***	-0.01	-0.178***	-0.056**	-0.069***	-0.100***	0.021	0.083***	-0.04	0.148***	0.161***	-0.044*	1	
STRE	-0.099***	-0.014	-0.129***	-0.074***	-0.107***	-0.176***	-0.078***	0.060**	-0.059**	0.053**	0.076***	-0.019	0.655***	1

* is significant at the 0.1 level, ** is significant at 0.05, *** is significant at 0.01. ROA is return on asset, ROE is return on equity, EMI is emission per sale, ESG is environment, social and governance disclosure, STR is the corporate CSR strategy, FSALE is percentage of foreign sale, LGINC is log(income), LEVER is leverage, LGSA is log(sale), LGEM is log(employee). EMIE, ESGE and STRE is interaction items, EMIE = EMI*LGEM, ESGE=ESG*LGEM, STRE=STR*LGEM

Table 4.21 represented the Pearson correlation matrix of the variables used in our model and the sample from Germany revealed that emissions per sale is significantly negative in association with ROA $(r = -0.035, p < 0.1)$ and ROE $(r = -0.140, p < 0.01)$. ESG disclosure has a negative association with ROA$(r = -0.082,\ p < 0.01)$ and Tobin's Q$(r = -0.067,\ p < 0.01)$. CSR strategy showed a negative association with ROA$(r = -0.082, p < 0.01)$ and Tobin's Q$(r = -0.097, p < 0.01)$.

Table 4. 21 Correlation (Germany)

	ROA	ROE	Tobin's Q	EMI	ESG	STR	FSALE	LGINC	LEVER	LGEM	LGSA	EMIE	ESGE	STRE
ROA	1													
ROE	0.207***	1												
Tobin's Q	0.879***	0.164***	1											
EMI	-0.035*	-0.140***	-0.028	1										
ESG	-0.082***	0.02	-0.067***	-0.075***	1									
STR	-0.082***	0.018	-0.097***	-0.038**	0.728***	1								
FSALE	-0.002	-0.024	-0.025	-0.013	0.306***	0.205***	1							
LNINC	0.083***	0.03	-0.019	-0.021	0.207***	0.185***	0.065***							
LEVER	-0.049***	-0.01	-0.018	-0.006	0.02	0.019	0.028	-0.012	1					
LNEM	-0.138***	-0.002	-0.151***	-0.108***	0.470***	0.425***	0.227***	0.271***	0.025	1				
LNSA	-0.153***	0.026	-0.173***	-0.089***	0.518***	0.490***	0.188***	0.351***	0.02	0.850***	1			
EMIE	0.009	0.029	0.011	-0.865***	0.015	0.026	-0.024	-0.013	0.009	0.092***	0.052***	1		
ESGE	0.040**	-0.006	0.034*	0.042**	0.093***	0.048***	0.056***	0.103***	-0.013	-0.145***	-0.024	-0.089***	1	
STRE	0.048***	0	0.085***	0.081***	0.053***	-0.025	-0.014	0.109***	-0.003	-0.169***	-0.069***	-0.114***	0.728***	1

* is significant at the 0.1 level, ** is significant at 0.05, *** is significant at 0.01. ROA is return on asset, ROE is return on equity, EMI is emission per sale, ESG is environment, social and governance disclosure, STR is the corporate CSR strategy, FSALE is percentage of foreign sale, LGINC is log(income), LEVER is leverage, LGSA is log(sale), LGEM is log(employee). EMIE, ESGE and STRE is interaction items, EMIE = EMI*LGEM, ESGE=ESG*LGEM, STRE=STR*LGEM

4.3.3 Panel unit root test

An advantage of the Philips-Perron (PP) test is that it is non-parametric. It does not require a selection of the level of serial correlation as in ADF. It rather takes the same estimation scheme as with ADF test, but corrects the statistics to conduct autocorrelations and heteroscedasticity (HAC type corrections). The main disadvantage of the PP test is that it is based on asymptotic theory. Therefore, it works well only in large samples and that is indeed luxury; if not it comes at the expense of financial time series data. It also shares disadvantages with ADF tests, such as sensitivity to structural breaks and poor small sample power, which can too often result in unit root conclusions.

This study used four different panel unit root tests to check for the stationarity of the variables shown in table 4.22–4.25. Table 4.22 showed the variable panel unit root test results of corporations in China whereby ROA, ROE, and Tobin's Q variables are stationary in all four tests, which means that the financial indicators are integrated at order zero, the independent variable, emissions per sale is not stationary in the IPS and ADF-Fisher tests; CSR strategy is not stationary in LLC, IPS and PP-Fisher tests; furthermore ESG information disclosure is not stationary at the order zero level but becomes stationary after the first difference, which means that the environmental indicators are integrated at order one.

Table 4. 22 Unit root test (China) (130 firms)

	Level				First			
	LLC	IPS	ADF - Fisher	PP - Fisher	LLC	IPS	ADF - Fisher	PP - Fisher
ROA	-37.341	-6.531	411.053	627.095	-37.706	-8.683	489.801	911.034
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ROE	-16.554	-3.579	357.933	462.078	-17.880	-5.268	413.424	838.790
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOBINQ	-8.786	-3.505	364.898	1092.380	-21.055	-6.812	452.291	1324.080
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 4.22 continued

EMISSION SALE	-40.732	0.221	226.637	304.736	-31.577	-3.514	378.849	799.908
	0.000	0.587	0.933	0.030	0.000	0.000	0.000	0.000
ESG	0.527	6.109	160.039	200.790	-18.016	-2.788	338.502	687.857
	0.701	1.000	1.000	0.997	0.000	0.003	0.001	0.000
STRATEGY	1.794	1.487	294.968	222.178	-4.513	-4.677	402.489	725.061
	0.964	0.932	0.022	0.879	0.000	0.000	0.000	0.000

Table 4.23 showed the variable panel unit root test results of corporations in Japan, whereby ROA and ROE are stationary in all four tests. This indicates ROA and ROE are integrated at order zero. Tobin's Q is not stationary in the IPS and ADF-Fisher tests but instead becomes stationary after the first difference. This means that Tobin's Q is integrated at order one. The independent variable, emissions per sale and CSR strategy are stationary in all four tests, which means emissions per sale and CSR strategy are integrated at order zero. ESG information disclosure is not stationary at IPS but becomes stationary after the first difference; The meaning here is that ESG information disclosure is integrated at order one.

Table 4. 23 Unit root test (Japan) (166 firms)

	Level				First			
	LLC	IPS	ADF-Fisher	PP-Fisher	LLC	IPS	ADF-Fisher	PP-Fisher
ROA	-55.453	-3.390	404.975	544.742	-29.727	-10.043	688.211	1244.820
	0.000	0.000	0.004	0.000	0.000	0.000	0.000	0.000
ROE	-77.508	-4.924	399.859	589.285	-48.540	-11.812	711.810	1365.220
	0.000	0.000	0.006	0.000	0.000	0.000	0.000	0.000
TOBINQ	-10.362	0.757	328.980	473.135	-12.793	-4.011	466.495	1116.870
	0.000	0.775	0.537	0.000	0.000	0.000	0.000	0.000
EMISSIONSALE	-807.511	-45.793	440.102	445.189	-494.376	-26.639	559.190	868.482
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ESG	-12.142	0.590	378.492	490.713	-14.348	-4.729	495.978	1164.200
	0.000	0.722	0.040	0.000	0.000	0.000	0.000	0.000

Table 4.23 continued

STRATEGY	-14.419	-2.624	439.931	551.091	-27.888	-7.897	603.861	1126.990
	0.000	0.004	0.000	0.000	0.000	0.000	0.000	0.000

Table 4.24 showed the variable panel unit root test results of corporations in Germany whereby ROA, ROE and Tobin's Q are stationary in all four tests, which means that the financial performance (ROA, ROE and Tobin's Q) is integrated at order zero. The independent variable, emissions per sale and CSR strategy are stationary in all four tests, therefore emissions per sale and CSR strategy are integrated at order zero. ESG information disclosure is not stationary during IPS and ADF-Fisher tests but becomes stationary after the first difference; this means that ESG information disclosure is integrated at order one.

Table 4. 24 Unit root test (Germany) (325 firms)

	Level				First			
	LLC	IPS	ADF-Fisher	PP-Fisher	LLC	IPS	ADF-Fisher	PP-Fisher
ROA	-57.580	-4.732	806.464	1256.540	-29.923	-10.027	1147.610	2527.330
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ROE	-29.923	-10.027	1147.610	2527.330	-37.195	-11.236	1202.130	2730.340
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOBINQ	-14.831	-1.325	743.275	969.607	-30.337	-8.192	1012.800	2146.960
	0.000	0.093	0.006	0.000	0.000	0.000	0.000	0.000
EMISSIONSALE	-862.454	-50.066	859.963	1107.930	-521.955	-34.123	1166.580	2124.720
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ESG	-13.916	1.623	674.560	874.342	-29.494	-8.864	1093.130	2519.280
	0.000	0.948	0.245	0.000	0.000	0.000	0.000	0.000
STRATEGY	-70.921	-7.970	888.715	1048.260	-67.272	-11.668	1116.010	2138.450
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

4.3.4 Panel cointegration analysis

This study used the Pedroni Residual Cointegration Test and Kao test to examine the cointegration relationship between the explanatory variables and the three dependent variables, ROA, ROE and Tobin's Q respectively, to examine the null hypothesis to identify if no cointegration existed among these variables.

The Pedroni Residual Cointegration Test results of the sample of corporations from China from 2010 to 2018 are presented in table 4.25. In all of the three models shown in table 4.25, four of the seven tests are significant at 1% level, which showed that cointegration exists in all three models, viz., ROA: emissions per sale, information disclosure, and CSR strategy (model 1), ROE: emissions per sale, information disclosure, and CSR strategies (model 2), and Tobin's Q: emissions per sale, information disclosure, and CSR strategy (model 3) in the long term. Table 4.26 showed the Pedroni Residual Cointegration Test results of the sample containing Japanese corporations from 2010 to 2018. The results indicated that all three models are significant at a 1% level, demonstrating long-term cointegration among all three models. Table 4.27 showed the Pedroni Residual Cointegration Test results of the sample containing German corporations from 2010 to 2018. The results indicated that all the three models are significant at a 1% level, demonstrating the presence of long term cointegration among all three models.

Table 4. 25 Pedroni Residual Cointegration Test (China)

Dependent variable	ROA	ROE	Tobin's Q
Alternative hypothesis: common A.R. coefs. (Within-dimension)			
Panel v-Statistic	-5.274	-4.281	-2.927
Panel rho-Statistic	5.886	4.845	4.371
Panel PP-Statistic	-11.385***	-13.641***	-18.744***
Panel ADF-Statistic	-10.513***	-4.723***	-1.450*

Table 4.25 continued

Alternative hypothesis: individual A.R. coefs. (Between-dimension)			
Group rho-Statistic	11.939	12.108	9.529
Group PP-Statistic	-18.022***	-13.939***	-31.023***
Group ADF-Statistic	-7.528***	-6.085***	-2.769***

* is significant at the 0.1 level, ** is significant at 0.05, *** is significant at 0.01.

Table 4. 26 Pedroni Residual Cointegration Test (Japan)

Dependent variable	ROA	ROE	Tobin's Q
Alternative hypothesis: common A.R. coefs. (Within-dimension)			
Panel v-Statistic	-4.474	-3.854	-5.457
Panel rho-Statistic	8.334	3.448	7.930
Panel PP-Statistic	-8.683***	-36.174***	-9.691***
Panel ADF-Statistic	-4.876***	-4.184***	-3.591***
Alternative hypothesis: individual A.R. coefs. (Between-dimension)			
Group rho-Statistic	13.386	13.127	-5.457
Group PP-Statistic	-21.244***	-23.122***	7.930***
Group ADF-Statistic	-8.415***	-6.914***	-9.691***

* is significant at the 0.1 level, ** is significant at 0.05, *** is significant at 0.01.

Table 4. 27 Pedroni Residual Cointegration Test (Germany)

Dependent variable	ROA	ROE	Tobin's Q
Alternative hypothesis: common A.R. coefs. (Within-dimension)			
Panel v-Statistic	-7.698	-16.704	-7.497
Panel rho-Statistic	10.100	6.405	10.160
Panel PP-Statistic	-18.970***	-111.586***	-14.433***
Panel ADF-Statistic	-7.226***	-24.352***	-4.003***
Alternative hypothesis: individual A.R. coefs. (Between-dimension)			
Group rho-Statistic	-7.497	17.266	17.883
Group PP-Statistic	10.160***	-36.946***	-25.545***
Group ADF-Statistic	-14.433***	-7.902***	-3.285***

* is significant at the 0.1 level, ** is significant at 0.05, *** is significant at 0.01.

The Kao test in the results of table 4.28 showed that all three models are significant, thereby enabling the rejection of the null hypothesis that there is no cointegration in the corporate CSR performance and corporate financial performance nexus. In the next step, we will further investigate the cointegration relationship between environmental and economic variables.

Table 4. 28 Kao cointegration test

Dependent variable	ROA	ROE	Tobin's Q
China	-7.627***	-5.563***	-6.986***
Japan	-3.695***	2.116**	4.443***
Germany	-5.888***	10.291***	-11.152***

* is significant at the 0.1 level, ** is significant at 0.05, *** is significant at 0.01.

4.3.5 Fully Modified Least Squares (FMOLS) Test

The Fully Modified Least Squares (FMOLS) test results in table 4.29 showed that emissions per sale has a significantly positive impact on financial performance (ROA at 1% level, ROE at 10% level, and Tobin's Q at 5% level). Here, it is indicated that a 1% increase in emissions per sale will result in an increase in ROA by 0.27%, an increase in ROE by 0.32% and an increase in Tobin's Q by 0.03%. Also, while ESG information disclosure has a significantly positive impact on financial performance, it showed a positive impact on ROA, ROE and Tobin's Q. Specifically, a 1% increase in ESG information disclosure shall raise ROA by 0.16%, raise ROE by 0.31% and improve Tobin's Q by 0.04% in the China sample of corporations in the long run. Meanwhile, CSR strategies showed a significant negative impact on financial performance at a 1% level. A 1% increase in CSR strategy will lead to a 0.05% decrease in ROA, with a 0.07% decrease in ROE and a decrease in Tobin's Q by 0.009%.

Table 4. 29 Panel Fully Modified Least Squares (FMOLS), China

	Dependent Variable: ROA	Dependent Variable: ROE	Dependent Variable: TOBINQ
EMISSIONSALE	0.2693***	0.3242*	0.029**
ESG	0.1567***	0.3084***	0.0399***
STRATEGY	-0.0517***	-0.0766***	-0.0087***
R-squared	-0.2145	-0.1606	-1.372
Adjusted R^2	-0.2169	-0.1629	-1.377

* is significant at the 0.1 level, ** is significant at 0.05, *** is significant at 0.01.

The Fully Modified Least Squares (FMOLS) test results in table 4.30 showed that emissions per sale had a significantly negative impact on financial performance (ROA at 5% level, ROE at 10% level). That means that a 1% increase in emissions per sale will result in a decrease in ROA by 0.40%, and a decrease in ROE by 2.10%. Also, while ESG information disclosure has a significantly positive impact on financial performance, it showed a positive impact on ROA, ROE and Tobin's Q. Specifically, a 1% increase in ESG information disclosure shall raise ROA by 0.08%, raise ROE by 0.12% and improve Tobin's Q by 0.03% in the Chinese sample of corporations in the long run. Meanwhile, CSR strategies significantly and negatively impact financial performance (ROA and Tobin's Q). A 1% increase in CSR strategy will lead to a 0.03% decrease in ROA and a 0.005% decrease in Tobin's Q.

Table 4. 30 Panel Fully Modified Least Squares (FMOLS), Japan

	Dependent Variable: ROA	Dependent Variable: ROE	Dependent Variable: TOBINQ
EMISSIONSALE	-0.4045**	-2.0985*	0.0171
ESG	0.0820***	0.1220**	0.0268***
STRATEGY	-0.0279***	-0.0224	-0.0053***
R-squared	-0.0373	0.00235	-0.35617
Adjusted R^2	-0.0389	0.00084	-0.35822

* is significant at the 0.1 level, ** is significant at 0.05, *** is significant at 0.01.

The FMOLS test results in table 4.31 showed that emissions per sale had a significant negative impact on financial performance ROE at a 1% level. That means that a 1%

increase in emissions per sale will result in a decrease in ROE by 27.87%. Also, while ESG information disclosure has a significant positive impact on financial performance, it showed a positive impact on ROA, ROE and Tobin's Q. Specifically, a 1% increase in ESG information disclosure shall raise ROA by 0158%, raise ROE by 0.10% and improve Tobin's Q by 0.05% in the German sample of corporations in the long run. Meanwhile, CSR strategies significantly and negatively impact financial performance (ROA and Tobin's Q). A 1% increase in CSR strategy will lead to a 0.06% decrease in ROA and a 0.02% decrease in Tobin's Q.

Table 4. 31 Panel Fully Modified Least Squares (FMOLS), Germany

	Dependent Variable: ROA	Dependent Variable: ROE	Dependent Variable: TOBINQ
EMISSIONSALE	-0.0884	-27.8706***	0.0039
ESG	0.1564***	0.0970***	0.0546***
STRATEGY	-0.0644***	0.1315***	-0.0237***
R-squared	-0.0334	0.019918	-0.04234
Adjusted R^2	-0.0342	0.019163	-0.04314

* is significant at the 0.1 level, ** is significant at 0.05, *** is significant at 0.01.

4.3.6 Panel Autoregressive-Distributed Lag (ARDL) Test

Table 4.32-4.34 showed the Autoregressive-Distributed Lag (ARDL) test results of the three models among the sample of corporations from China, Japan and Germany. This study will use the optimal lag to run our model, and we select optimal lag by Akaike information criterion (AIC) (Akaike, 1974). As the data used in this study involve short panels, so the lags used here are set as 1.

Table 4.32 showed the Autoregressive-Distributed Lag (ARDL) test results of the three models among the sample of corporations in China. Emissions per sale have a significant positive impact on ROA, ROE and Tobin's Q in the long term. A 1% increase in emissions per sale would increase ROA by 0.27%, ROE by 0.24% and Tobin's Q by 0.02% in the Chinese sample of corporations. ESG information disclosure significantly impacts ROA, ROE, and Tobin's Q at a 1% level. A 1% increase in ESG information disclosure raises ROA by 0.12%, ROE by 0.24% and Tobin's Q by 0.05% in the Chinese sample of corporations. However, the CSR strategy showed a negative impact on ROE and Tobin's Q. A 1% rise in CSR strategy shall lower ROE by 0.14 and lower Tobin's Q by 0.02% in China's sample of corporations in the long term. However, CSR strategy showed no significant impact on ROA in the sample of corporations from China.

The short-term results of the ARDL model in table 4.32 showed that emissions per sale had a significant negative impact on financial performance (ROA, ROE). A 1% increase in emissions per sale shall reduce ROA by 71.29% and reduce ROE by 181.69% in the sample of Chinese corporations. Similarly, ESG information disclosure also significantly and negatively impact ROA and ROE. A 1% increase in information disclosure will reduce ROA by 0.07% and reduce ROE by 0.29% in the Chinese sample of corporations in the short run. But there is not any evidence to support the short-term relationship between corporate environmental performance (Emissions per sale, ESG information disclosure and CSR strategy) and Tobin's Q. CSR strategy showed no significant impact on financial performance (ROA and ROE) and marketing financial performance (Tobin's Q) in the short term. The error correction term (ECTt-1) here is negative between -1 to 0. It is statistically significant at the 1% level, revealing that the system is converging to equilibrium and that the estimated model is stable. [18]

[18] see Chandio *et al.* (2019).

Table 4. 32 Autoregressive-Distributed Lag (ARDL) Test (China)

	Dependent Variable: ROA	Dependent Variable: ROE	Dependent Variable: TOBINQ
		Long Run Equation	
EMISSIONSALE	0.2694***	0.2360**	0.0249***
ESG	0.1237***	0.3936***	0.0457***
STRATEGY	-0.0040	-0.1436***	-0.0158***
		Short Run Equation	
COINTEQ01	-0.4626***	-0.3123***	-0.1894***
D(EMISSIONSALE)	-71.2861***	-181.6876**	-2.6417
D(ESG)	-0.0716**	-0.2862**	-0.0043
D(STRATEGY)	0.0131	0.0729	0.0031

* is significant at the 0.1 level, ** is significant at 0.05, *** is significant at 0.01. ARDL model is based on the lag order of three which was selected by the Akaike Information Criterion.

The ARDL test findings presented the long-run and short-run results of Japan's sample of corporations in table 4.33. A reduction in emissions per sale will significantly improve ROA, ROE, and Tobin's Q. A 1% reduction in emissions per sale will raise ROA by 0.89% and ROE by 5.83%, and Tobin's Q by 0.10% in the long term. Information disclosure significantly and positively impacts ROA, ROE and Tobin's Q at the 1% level. A 1% increase in information disclosure will improve ROA by 0.04%, ROE by 0.13%, and Tobin's Q by 0.02%. In comparison, CSR strategy showed a negative link with ROA, ROE and Tobin's Q. A 1% increase in CSR strategy shall reduce ROA by 0.0001%, reduce ROE by 0.04% and reduce Tobin's Q by 0.004.

The short-term results of the ARDL test were shown in table 4.33 and it was illustrated that emissions per sale had a significant negative impact on ROA. A 1% increase in emissions per sale shall reduce ROA by 54.47% in the sample of Japan's corporations. However, emissions per sale have no significant impact on ROE and Tobin's Q. Also, information disclosure and CSR strategy do not significantly influence ROA, ROE and

Tobin's Q in the short term. The error correction term (ECTt-1) here is negative and ranges between -1 to 0, which is statistically significant at 1% level. This implies that the system is converging to equilibrium and the estimated model is stable.

Table 4. 33 Autoregressive-Distributed Lag (ARDL) Test (Japan)

	Dependent Variable: ROA	Dependent Variable: ROE	Dependent Variable: TOBINQ
		Long Run Equation	
EMISSIONSALE	-0.8855***	-5.8260***	0.0976***
ESG	0.0367***	0.1276***	0.0207***
STRATEGY	-0.0001***	-0.0434***	-0.0040***
		Short Run Equation	
COINTEQ01	-0.6702***	-0.6666***	-0.2911***
D(EMISSIONSALE)	-54.4734*	-356.0374	0.0136
D(ESG)	0.0349	0.2677	-0.0038
D(STRATEGY)	0.0053	0.2832	0.0010

* is significant at the 0.1 level, ** is significant at 0.05, *** is significant at 0.01. ARDL model is based on the lag order of three which was selected by the Akaike Information Criterion.

The ARDL test findings presented the long-run and short-run results of the German sample of corporations in table 4.34. A reduction in emissions per sale will significantly improve ROA and ROE. A 1% reduction in emissions per sale will raise ROA by 0.41% and ROE by 9.81% in the long term. However, a reduction of emissions per sale has a negative impact on Tobin's Q, as a 1% reduction in emissions per sale will decrease Tobin's Q by 0.04%. ESG information disclosure significantly and positively impacts ROA, ROE and Tobin's Q at the 1% level. A 1% increase in ESG information disclosure will improve ROA by 0.14%, ROE by 0.19%, and Tobin's Q by 0.05%. While CSR strategy showed a negative link with ROA and Tobin's Q. A 1% increase in CSR strategy shall reduce ROA by 0.04% and reduce Tobin's Q by 0.03%.

The short-term results of the ARDL test shown in table 4.34 illustrated that there is no evidence to support any short run relationship between corporate environmental performance (emissions per sale, ESG information disclosure and CSR strategy) and financial performance (ROA, ROE and Tobin's Q). The error correction term (ECTt-1) here is negative and ranges between -1 to 0, which is statistically significant at 1% level. This implies that the system is converging to equilibrium and the estimated model is stable.

Table 4. 34 Autoregressive-Distributed Lag (ARDL) Test (Germany)

	Dependent Variable: ROA	Dependent Variable: ROE	Dependent Variable: TOBINQ
		Long Run Equation	
EMISSIONSALE	-0.4088***	-9.8076***	0.0354***
ESG	0.1449***	0.1916***	0.0485***
STRATEGY	-0.0408***	0.0949***	-0.0280***
		Short Run Equation	
COINTEQ01	-0.3011***	-0.3538***	-0.0887***
D(EMISSIONSALE)	-222.1796	-1529.9880	-42.9496
D(ESG)	-0.0292	-0.6380	0.0001
D(STRATEGY)	0.1217	0.7852	0.0038

* is significant at the 0.1 level, ** is significant at 0.05, *** is significant at 0.01. ARDL model is based on the lag order of three which was selected by the Akaike Information Criterion.

4.3.7 Causality Test

This study will use the optimal lag for our model to be run, and we selected optimal lag by Akaike information criterion (AIC) (Akaike, 1974). As the data used in this study involved short panels, the lags used here are set as 1.

Table 4.35 presented the results of the Dumitrescu Hurlin causality test of three models[19]. The variables emissions per sale and ROA, showed a unidirectional causal

[19] See Dumitrescu and Hurlin (2012).

relationship in the sample of corporations from China and a bidirectional causal relationship in the sample of corporations from Japan and Germany. ESG information disclosure had no significant causality relationship with ROA in the Chinese sample, but had a significant causal relationship in the Japanese and German samples. There was a bidirectional causality relationship between ROA and information disclosure in the Japanese sample. CSR strategy and ROA had a bidirectional relationship in both samples of corporations in Germany and Japan, but showed a unidirectional causal relationship in the sample of corporations in China.

Table 4.35 also demonstrated the causality test of financial performance (ROE) and environmental performance (emissions per sale, ESG disclosure and CSR strategy). Emissions per sale showed no significant causality association with ROE in the sample of corporations from China. Meanwhile, emissions per sale showed bidirectional causality relations with ROE in the Japanese and German sample of corporations. ESG information disclosure showed bidirectional causality relations with ROE in all three samples. CSR strategy and ROE had a bidirectional relationship in both samples of corporations in Germany and Japan, but showed a unidirectional causal relationship in the sample of corporations in China.

As table 4.35 showed, there was no causal relationship between emissions per sale and Tobin's Q in China, however, emissions per sale showed a bidirectional causal relationship with Tobin's Q in Japan and Germany. While ESG information disclosure had a significant bidirectional causality relationship with Tobin's Q in China, Japan and Germany. While CSR strategy had no significant causality relationship with Tobin's Q in the Chinese sample of corporations, it showed a significant unidirectional causality relationship with Tobin's Q in the Japanese and German samples of corporations.

Table 4. 35 Dumitrescu Hurlin Panel Causality

	China			Japan			Germany		
Null Hypothesis:	W-Stat.	Zbar-Stat.	Prob.	W-Stat.	Zbar-Stat.	Prob.	W-Stat.	Zbar-Stat.	Prob.
ROA-CEP									
EMI ROA	2.273	1.451	0.147	2.296	1.719	0.086	2.357	2.639	0.008
ROA EMI	2.671	2.400	0.016	2.798	3.092	0.002	2.977	5.010	0.000
ESG ROA	2.097	1.028	0.304	2.571	2.472	0.013	3.086	5.428	0.000
ROA ESG	2.451	1.876	0.061	3.006	3.660	0.000	2.046	1.451	0.147
STR ROA	2.702	2.475	0.013	2.581	2.498	0.013	2.282	2.352	0.019
ROA STR	1.997	0.789	0.430	3.377	4.675	0.000	2.127	1.760	0.078
ROE-CEP									
EMI ROE	2.208	1.295	0.195	2.400	2.005	0.045	2.214	2.093	0.036
ROE EMI	3.069	3.354	0.001	2.489	2.247	0.025	2.821	4.413	0.000
ESG ROE	3.057	3.325	0.001	2.628	2.628	0.009	3.076	5.388	0.000
ROE ESG	2.783	2.669	0.008	2.575	2.482	0.013	2.306	2.446	0.014
STR ROE	3.121	3.478	0.001	2.980	3.590	0.000	2.572	3.461	0.001
ROE STR	2.235	1.359	0.174	3.440	4.846	0.000	2.979	5.018	0.000
Tobin's Q-CEP									
EMI TOBINQ	1.594	-0.173	0.863	3.283	4.417	0.000	1.860	0.739	0.460
TOBINQ EMI	1.685	0.044	0.965	3.334	4.558	0.000	3.185	5.808	0.000
ESG TOBINQ	2.697	2.464	0.014	2.582	2.503	0.012	2.151	1.851	0.064
TOBINQ ESG	2.650	2.350	0.019	3.200	4.190	0.000	2.509	3.220	0.001
STR TOBINQ	1.687	0.048	0.962	3.026	3.716	0.000	2.082	1.590	0.112
TOBINQ STR	1.507	-0.383	0.702	2.127	1.259	0.208	2.426	2.903	0.004

4.3.8 Moderating effect of firm size on the CEP–CFP nexus

Before the regress test, we conducted the Hausman test to check that our model was suitable for testing by a fixed effect model, random effect model or OLS regression. This study included a Modified Wald test (MWT) for groupwise heteroskedasticity in a fixed effect regression model and the Wooldridge test for autocorrelation in panel data, we also included the breusch and pagan lagrangian multiplier (LM) test to check for the random effect model.

Table 4.36 showed the regression of both the fixed and random effects of CEP and ROA in the samples from China and included a firm and year fixed effect. From model 1 to model 3, the regression result was consistent with the short run with the ARDL model. In models 4 to 6, we examined the hypotheses 4aa, 5aa and 6aa. The results showed that

ESG and ESGE significantly impacted on ROA, so the firm size was impacted on by the ESG–ROA relationship in China, so H5aa is supported. But the results showed that firm size did not have an impact on EMI–ROA and STR–ROA relationships in China. The Hausman test in table 4.36 supported the fixed effect used for all models and the Modified Wald test showed that there was no Heteroskedasticity in our model. The MWT result supported our findings that there was first-order autocorrelation in our model.

Table 4. 36 Regression for CEP and ROA (China)

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES			ROA			
EMI	-0.125***			-0.126***		
	(0.043)			(0.046)		
ESG		-0.046***			-0.037***	
		(0.012)			(0.011)	
STR			-0.009			-0.004
			(0.006)			(0.005)
FSALE	-1.071*	-0.426	-0.855	-1.014	-0.296	-0.803
	(0.628)	(0.613)	(0.632)	(0.618)	(0.642)	(0.643)
LGINC	4.804***	5.035***	4.887***	5.159***	5.327***	5.148***
	(1.336)	(1.424)	(1.387)	(1.506)	(1.569)	(1.516)
LEVER	-0.152***	-0.143***	-0.150***	-0.143***	-0.137***	-0.143***
	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)
LGEM				-1.644***	-1.488***	-1.556***
				(0.500)	(0.508)	(0.499)
EMIE				0.036		
				(0.065)		
ESGE					0.015*	
					(0.009)	
STRE						0.004
						(0.004)
Constant	-61.169***	-63.692***	-62.374***	-50.387**	-53.866**	-51.229**
	(20.247)	(21.502)	(20.972)	(21.072)	(21.859)	(21.209)
Observations	1,170	1,170	1,170	1,170	1,170	1,170
R-squared	0.572	0.577	0.572	0.577	0.583	0.577
Year	Yes	Yes	Yes	Yes	Yes	Yes
Firm	Yes	Yes	Yes	Yes	Yes	Yes
Modified Wald	5.5e+06***	2.1e+05***	1.4e+05***	5.0e+05***	2.5e+05***	1.6e+05***
Hausman (Chi2)	48.81	43.78	44.59	35.82	33.01	33.33
Hausman (p value)	0.000	0.000	0.000	0.000	0.000	0.000
Wooldridge	10.255	10.132	10.211	10.255	10.132	10.211
Wooldridge (p value)	0.002	0.002	0.002	0.002	0.002	0.002
Model	FE	FE	FE	FE	FE	FE

FE is Fixed effect, RE is random effect. * is significant at the 0.1 level, ** is significant at 0.05, *** is significant at 0.01.

Table 4.37 showed the regression of both a fixed and random effect of CEP and ROE in samples from China, while included a firm and year fixed effect. From model 1 to model 3, the regression result was consistent with the short run with the ARDL model. In models 4 to 6, we examined the hypotheses 4bb, 5bb and 6bb. The results showed that firm size did not have an impact on EMI–ROE, ESG–ROE and STR–ROE relationships in China. The Hausman test in table 4.37 supported the fixed effect used for all models and the Modified Wald test showed that there was no Heteroskedasticity in our model. The MWT result supported our findings that there was first-order autocorrelation in our model.

Table 4. 37 Regression for CEP and ROE (China)

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES				ROE		
EMI	-0.365***			-0.359***		
	(0.085)			(0.091)		
ESG		-0.060***			-0.050**	
		(0.023)			(0.023)	
STR			-0.022**			-0.018*
			(0.010)			(0.010)
FSALE	1.032	1.924	1.579	1.117	1.837	1.389
	(1.856)	(1.877)	(1.883)	(1.837)	(1.881)	(1.861)
LGINC	17.881***	18.175***	18.085***	18.454***	18.631***	18.643***
	(2.710)	(2.845)	(2.824)	(2.992)	(3.068)	(3.083)
LEVER	-0.260***	-0.248***	-0.255***	-0.246***	-0.237***	-0.242***
	(0.051)	(0.052)	(0.051)	(0.051)	(0.052)	(0.051)
LGEM				-2.792***	-2.476**	-2.706***
				(0.947)	(0.981)	(0.983)
EMIE				-0.020		
				(0.114)		
ESGE					-0.001	
					(0.013)	
STRE						-0.009
						(0.006)
Constant	-249.199***	-252.605***	-252.215***	-230.374***	-235.386***	-233.878***
	(40.915)	(42.778)	(42.544)	(41.318)	(42.439)	(42.557)
Observations	1,170	1,170	1,170	1,170	1,170	1,170
R-squared	0.518	0.519	0.518	0.522	0.522	0.521
Year	Yes	Yes	Yes	Yes	Yes	Yes
Firm	Yes	Yes	Yes	Yes	Yes	Yes
Modified Wald	3.7e+05***	6.3e+05***	2.1e+05***	1.4e+06***	2.8e+06***	1.2e+06***
Hausman (Chi2)	86.79	89.69	90.36	75.44	79.69	81.12

Table 4.37 continued

Hausman (p value)	0.000	0.000	0.000	0.000	0.000	0.000
Wooldridge	10.244	10.411	10.329	10.28	10.438	10.36
Wooldridge (p value)	0.002	0.002	0.002	0.002	0.002	0.002
LM test for RE						
Model	FE	FE	FE	FE	FE	FE

FE is Fixed effect, RE is random effect. * is significant at the 0.1 level, ** is significant at 0.05, *** is significant at 0.01.

Table 4.38 showed the regression of both a fixed and random effect of CEP and Tobin's Q in samples from China and included both a firm and year fixed effect. For models 4 to 6, we examined the hypotheses 4cc, 5cc and 6cc. The results showed that firm size does not have a moderate impact on EMI–Tobin's Q relationship. The results showed that firm size had a moderate impact on ESG–Tobin's Q, and STR–Tobin's Q relationships in China, so H5cc and H6cc are supported. The Hausman test in table 4.38 supported the fixed effect use in models 2,3,5, and 6, the Hausman and LM test also showed the random effect is appropriate in models 1 and 4. The Modified Wald test showed that there was no Heteroskedasticity in our model.

Table 4. 38 Regression for CEP and Tobin's Q (China)

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES			Tobin's Q			
EMI	-0.014*			-0.014*		
	(0.008)			(0.008)		
ESG		-0.008***			-0.008***	
		(0.001)			(0.001)	
STR			-0.003***			-0.002***
			(0.001)			(0.001)
FSALE	-0.216***	-0.142	-0.198**	-0.221***	-0.111	-0.180**
	(0.079)	(0.087)	(0.088)	(0.079)	(0.091)	(0.090)
LGINC	-0.025	0.099*	0.083*	-0.009	0.113*	0.085*
	(0.044)	(0.052)	(0.048)	(0.047)	(0.059)	(0.050)
LEVER	-0.008***	-0.006***	-0.007***	-0.008***	-0.006***	-0.007***
	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)
LGEM				-0.027	-0.053	-0.051
				(0.026)	(0.056)	(0.053)
EMIE				-0.005		
				(0.010)		
ESGE					0.003***	

Table 4.38 continued

					(0.001)	
STRE						0.001**
						(0.000)
Constant	2.125***	0.425	0.532	2.149***	0.703	0.958
	(0.668)	(0.787)	(0.729)	(0.677)	(0.914)	(0.824)
Observations	1,170	1,170	1,170	1,170	1,170	1,170
R-squared		0.541	0.530		0.546	0.533
Year	Yes	Yes	Yes	Yes	Yes	Yes
Firm	Yes	Yes	Yes	Yes	Yes	Yes
Modified Wald	7.8e+06***	4.0e+05***	1.9e+06***	4.3e+06***	4.7e+05***	2.0e+06***
Hausman (Chi2)	5.83	12.98	10.48	8.58	14.38	12.47
Hausman (p value)	0.213	0.011	0.033	0.198	0.026	0.052
Wooldridge	58.497	56.3	59.726	61.376	59.176	62.702
Wooldridge (p value)	0.000	0.000	0.000	0.000	0.000	0.000
LM test for RE	708.15***			700.36***		
Model	RE	FE	FE	RE	FE	FE

FE is Fixed effect, RE is random effect. * is significant at the 0.1 level, ** is significant at 0.05, *** is significant at 0.01.

Table 4.39 showed the regression of both a fixed and random effect of CEP and ROA in samples from Japan, while a firm and year fixed effect were included. For models 4 to 6, we examined the hypotheses 4aa, 5aa and 6aa. The results showed that ESG and ESGE significantly impact on ROA, so the firm size has an impact on the ESG–ROA relationship in Japan, hence H5aa is supported. But the results showed that firm size does not have an impact on EMI–ROA and STR–ROA relationships in Japan. The Hausman test in table 4.39 supported the fixed effect used for all models and the Modified Wald test showed that there was no Heteroskedasticity in our model.

Table 4. 39 Regression for CEP and ROA (Japan)

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES			ROA			
EMI	-0.758**			-1.194**		
	(0.385)			(0.604)		
ESG		0.017**			0.014*	
		(0.008)			(0.009)	
STR			0.013***			0.012***
			(0.004)			(0.004)
FSALE	2.978***	2.702***	2.743***	2.908***	2.752***	2.799***
	(0.693)	(0.694)	(0.684)	(0.711)	(0.718)	(0.706)

Table 4.39 continued

LGINC	0.937**	0.885**	0.901**	0.935**	0.938**	0.911**
	(0.377)	(0.381)	(0.378)	(0.375)	(0.382)	(0.379)
LEVER	-0.158***	-0.157***	-0.158***	-0.158***	-0.158***	-0.158***
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
LGEM				-0.029	-0.177	-0.167
				(0.372)	(0.392)	(0.392)
EMIE				-0.912		
				(0.647)		
ESGE					-0.017***	
					(0.007)	
STRE						-0.004
						(0.003)
Constant	-7.518	-7.696	-7.734	-7.115	-6.510	-6.175
	(6.318)	(6.347)	(6.317)	(7.235)	(7.409)	(7.352)
Observations	1,494	1,494	1,494	1,494	1,494	1,494
R-squared	0.642	0.642	0.644	0.643	0.644	0.644
Year	Yes	Yes	Yes	Yes	Yes	Yes
Firm	Yes	Yes	Yes	Yes	Yes	Yes
Modified Wald	1.8e+05***	2.6e+05***	2.5e+05***	1.8e+05***	2.7e+05***	2.5e+05***
Hausman (Chi2)	68.13	65.29	68.07	72.96	67.14	68.8
Hausman (p value)	0.000	0.000	0.000	0.000	0.000	0.000
Wooldridge	23.814	23.543	23.598	23.922	23.474	23.549
Wooldridge (p value)	0.000	0.000	0.000	0.000	0.000	0.000
LM test for RE Model	FE	FE	FE	FE	FE	FE

FE is Fixed effect, RE is random effect. * is significant at the 0.1 level, ** is significant at 0.05, *** is significant at 0.01.

Table 4.40 showed the regression of the random effect of CEP and ROE in samples from Japan. In models 4 to 6, we examined the hypotheses 4bb, 5bb and 6bb. The results showed firm size had a strengthening and moderate impact on the EMI–ROE relationship and consequently, H5bb is supported. The Hausman and LM test in table 4.40 supported the random effect model used.

Table 4. 40 Regression for CEP and ROE (Japan)

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES				ROE		
EMI	-1.018			-4.906***		
	(1.143)			(1.645)		
ESG		0.058			0.051	
		(0.051)			(0.057)	
STR			0.047			0.041

Table 4.40 continued

			(0.030)			(0.032)
FSALE	-2.753	-4.041	-4.096	-3.823	-4.014	-4.332
	(3.044)	(3.318)	(3.191)	(3.269)	(3.389)	(3.325)
LGINC	8.330***	8.193***	8.184***	7.370***	8.330***	8.315***
	(1.741)	(1.750)	(1.744)	(1.755)	(1.759)	(1.749)
LEVER	-0.173***	-0.190***	-0.198***	-0.172***	-0.193***	-0.201***
	(0.037)	(0.036)	(0.037)	(0.040)	(0.038)	(0.039)
LGEM				-0.453	0.152	0.118
				(0.885)	(0.953)	(0.892)
EMIE				-6.019***		
				(1.782)		
ESGE					-0.039	
					(0.044)	
STRE						-0.028
						(0.028)
	-	-	-	-	-	-
Constant	125.266***	125.316***	124.293***	104.008***	128.186***	126.798***
	(28.930)	(28.917)	(28.918)	(30.355)	(30.202)	(29.941)
Observations	1,494	1,494	1,494	1,494	1,494	1,494
R-squared						
Year	Yes	Yes	Yes	Yes	Yes	Yes
Firm	Yes	Yes	Yes	Yes	Yes	Yes
Modified Wald	1.2e+08***	6.1e+07***	1.3e+08***	1.8e+08***	5.9e+07***	9.7e+07***
Hausman (Chi2)	61.77	56.5	55.98	64.72	56.54	55.88
Hausman (p value)	0.000	0.000	0.000	0.000	0.000	0.000
Wooldridge	2.513	2.315	2.404	3.072	2.406	2.503
Wooldridge (p value)	0.115	0.130	0.123	0.082	0.123	0.116
LM test for RE	14.07***	14.38***	14.38***	12.67***	14.13***	14.00***
Model	RE	RE	RE	RE	RE	RE

FE is Fixed effect, RE is random effect. * is significant at the 0.1 level, ** is significant at 0.05, *** is significant at 0.01.

Table 4.41 showed the regression of both a fixed and random effect of CEP and Tobin's Q in samples from Japan. With models 4 to 6, we examined the hypotheses 4cc, 5cc and 6cc. These results showed that firm size had a moderate impact on EMI–Tobin's Q and ESG–Tobin's Q relationships. The results also showed that firm size does not have a moderate impact on STR–Tobin's Q relationships in Japan. The Hausman test in table 4.41 supported the fixed effect used in models 2–6, and the Hausman and LM tests showed that the random-effect is appropriate in model 1. The Modified Wald test showed that there was no Heteroskedasticity in our models.

Table 4. 41 Regression for CEP and Tobin's Q (Japan)

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES			Tobin's Q			
EMI	-0.004			-0.070**		
	(0.035)			(0.030)		
ESG		0.005***			0.004***	
		(0.001)			(0.001)	
STR			0.002***			0.002***
			(0.001)			(0.000)
FSALE	0.459***	0.507***	0.549***	0.476***	0.441***	0.467***
	(0.076)	(0.113)	(0.114)	(0.113)	(0.114)	(0.112)
LGINC	0.003	-0.011*	-0.001	0.005	0.005	0.002
	(0.019)	(0.006)	(0.004)	(0.004)	(0.005)	(0.004)
LEVER	-0.006***	-0.005***	-0.006***	-0.006***	-0.006***	-0.006***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
LGEM				0.164**	0.119*	0.149**
				(0.064)	(0.065)	(0.067)
EMIE				-0.106**		
				(0.046)		
ESGE					-0.004***	
					(0.001)	
STRE						-0.000
						(0.000)
Constant	1.297***	1.195***	1.205***	-0.371	-0.099	-0.265
	(0.329)	(0.098)	(0.093)	(0.635)	(0.657)	(0.668)
Observations	1,494	1,494	1,494	1,494	1,494	1,494
R-squared		0.732	0.730	0.730	0.736	0.732
Year	Yes	Yes	Yes	Yes	Yes	Yes
Firm	Yes	Yes	Yes	Yes	Yes	Yes
Modified Wald	1.4e+06***	5.7e+05***	3.8e+06***	1.2e+06***	5.6e+05***	1.2e+06***
Hausman (Chi2)	4.91	9.59	7.98	21.49	20.06	20.54
Hausman (p value)	0.296	0.048	0.092	0.002	0.003	0.002
Wooldridge	47.399	46.581	47.364	46.868	46.186	46.768
Wooldridge (p value)	0.000	0.000	0.000	0.000	0.000	0.000
LM test for RE	2442.34***					
Model	RE	FE	FE	FE	FE	FE

FE is Fixed effect, RE is random effect. * is significant at the 0.1 level, ** is significant at 0.05, *** is significant at 0.01.

Table 4.42–4.44 showed the fixed, random and OLS regression from German firms and the results showed that firm size does not have a moderate effect on the CEP–CFP relationships in Germany.

Table 4. 42 Regression for CEP and ROA (Germany)

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES			ROA			
EMI	-0.122			-0.289		
	(0.108)			(0.245)		
ESG		-0.008			-0.005	
		(0.017)			(0.017)	
STR			-0.000			0.001
			(0.008)			(0.009)
FSALE	0.053	0.003	-0.035	0.185	0.418	0.217
	(1.106)	(1.086)	(1.093)	(1.000)	(1.005)	(1.003)
LGINC	18.355***	18.429***	18.397***	17.777***	18.255***	18.062***
	(4.266)	(4.300)	(4.289)	(1.437)	(1.438)	(1.441)
LEVER	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
LGEM				-1.240***	-1.632***	-1.419***
				(0.273)	(0.301)	(0.294)
EMIE				-0.019		
				(0.041)		
ESGE					-0.035***	
					(0.008)	
STRE						-0.012**
						(0.005)
Constant	-298.187***	-299.023***	-298.884***	-277.239***	-280.957***	-280.211***
	(70.782)	(71.186)	(71.104)	(23.873)	(23.829)	(23.898)
Observations	2,925	2,925	2,925	2,925	2,925	2,925
R-squared	0.781	0.781	0.781			
Year	Yes	Yes	Yes	Yes	Yes	Yes
Firm	Yes	Yes	Yes	Yes	Yes	Yes
Modified Wald	4.6e+09***	3.8e+09***	4.3e+09***	9.9e+08***	9.9e+08***	6.1e+08***
Hausman (Chi2)	8.24	10.44	11.71	5.62	5.49	5.93
Hausman (p value)	0.083	0.034	0.020	0.467	0.483	0.431
Wooldridge	4.306	4.309	4.317	4.222	4.227	4.234
Wooldridge (p value)	0.039	0.039	0.039	0.041	0.041	0.040
LM test for RE				6431.80***	6430.55***	6424.60***
Model	FE	FE	FE	RE	RE	RE

FE is Fixed effect, RE is random effect. * is significant at the 0.1 level, ** is significant at 0.05, *** is significant at 0.01.

Table 4. 43 Regression for CEP and ROE (Germany)

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES			ROE			
EMI	-28.336***			-159.453		
	(3.714)			(207.538)		
ESG		0.571			0.801	
		(0.490)			(0.542)	

Table 4.43 continued

STR			0.312			0.397
			(0.288)			(0.309)
FSALE	-32.199	-40.780	-37.380	-93.875	-37.777	-34.572
	(21.779)	(24.974)	(24.368)	(101.178)	(25.200)	(24.729)
LGINC	89.483	88.631	91.066	113.985**	104.241*	103.557*
	(56.679)	(61.023)	(60.832)	(48.172)	(62.784)	(62.957)
LEVER	-0.025	-0.021	-0.021	-0.012	-0.020	-0.020
	(0.049)	(0.050)	(0.050)	(0.019)	(0.050)	(0.050)
LGEM				-2.701	-5.814	-4.604
				(23.551)	(6.132)	(6.001)
EMIE				-25.296		
				(30.833)		
ESGE					-0.186	
					(0.250)	
STRE						-0.059
						(0.164)
Constant	-1,449.145	-1,471.584	-1,499.576	-1,765.922**	-1,687.250	-1,668.535
	(939.667)	(1,007.829)	(1,006.601)	(702.111)	(1,028.297)	(1,031.405)
Observations	2,925	2,925	2,925	2,925	2,925	2,925
R-squared	0.137	0.135	0.136	0.171	0.136	0.137
Year	Yes	Yes	Yes	Yes	Yes	Yes
Firm	Yes	Yes	Yes	Yes	Yes	Yes
Modified Wald	1.6e+12***	7.1e+10***	1.7e+10***	5.2e+11***	4.4e+10***	1.8e+10***
Hausman (Chi2)	21.86	2.42	5.05	34.31	16.19	19.46
Hausman (p value)	0.000	0.659	0.282	0.000	0.013	0.004
Wooldridge	2.057	0.375	0.449	40.102	0.287	0.368
Wooldridge (p value)	0.153	0.541	0.503	0.000	0.593	0.545
LM test for RE	0.25	7.02***	7.34***		7.03***	7.44***
Model	OLS	RE	RE	FE	RE	RE

FE is Fixed effect, RE is random effect. * is significant at the 0.1 level, ** is significant at 0.05, *** is significant at 0.01.

Table 4. 44 Regression for CEP and Tobin's Q (Germany)

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES			Tobin's Q			
EMI	-0.002			-0.006		
	(0.016)			(0.049)		
ESG		0.002			0.003	
		(0.003)			(0.003)	
STR			0.001			0.001
			(0.002)			(0.002)
FSALE	-0.073	-0.088	-0.080	-0.065	-0.044	-0.059
	(0.204)	(0.205)	(0.204)	(0.204)	(0.204)	(0.204)
LGINC	0.180	0.169	0.174	0.185	0.226	0.205
	(0.280)	(0.280)	(0.280)	(0.280)	(0.280)	(0.281)
LEVER	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
LGEM				-0.070	-0.176***	-0.116*

Table 4.44 continued

				(0.058)	(0.065)	(0.063)
EMIE				-0.000		
				(0.008)		
ESGE					-0.006***	
					(0.002)	
STRE						-0.002*
						(0.001)
Constant	-1.010	-0.941	-0.945	-0.464	-0.241	-0.388
	(4.645)	(4.646)	(4.650)	(4.672)	(4.661)	(4.675)
Observations	2,925	2,925	2,925	2,925	2,925	2,925
Number of id	325	325	325	325	325	325
Year	Yes	Yes	Yes	Yes	Yes	Yes
Firm	Yes	Yes	Yes	Yes	Yes	Yes
Modified Wald	2.7e+10***	4.0e+09***	5.2e+09***	2.9e+10***	3.7e+09***	6.3e+09***
Hausman (Chi2)	1.81	3.73	6.24	10.36	9.88	10.93
Hausman (p value)	0.770	0.445	0.182	0.110	0.130	0.091
Wooldridge	6.913	6.953	6.912	6.913	6.962	6.909
Wooldridge (p value)	0.009	0.009	0.009	0.009	0.009	0.009
LM test for RE	8274.87***	8257.03***	8207.98***	8163.91***	8181.01***	8095.98***
Model	RE	RE	RE	RE	RE	RE

FE is Fixed effect, RE is random effect. * is significant at the 0.1 level, ** is significant at 0.05, *** is significant at 0.01.

4.4 Corporate environmental performance and Corporate financial performance in different industries

4.4.1 Descriptive statistics

This study selected samples from different industries and then we separated them into 18 industries. The results from figure 6.1 showed that the electricity, energy, Steel and other metals, construction, Oil and gas, chemical, transportation, food and manufacturing industries all have high emissions per sale. Emissions per sale in service, retail, electronic communication, pharmaceutical, high technology, financial service, equipment and health industries were all at a low level. This study also investigated the CEP–CFP relationship in high-level carbon emissions industries (327 firms) and low carbon industries (210 firms).

Table 4. 45 Firms from different Industries

Industries	Emissions per sales (average)	Number of Firms
Chemical	0.4991	11
Construction	0.7891	44
Electricity	3.14556	28
Electronic Communications	0.0451	31
Energy	1.28343	10
Equipment	0.0216	6
Financial service	0.0278	58
Food	0.2865	31
Health	0.0104	7
High technology	0.0348	6
Manufacturing	0.1118	129
Oil and gas	0.6282	18
Other	0.0277	8
Pharmaceutical	0.045	21
Retail	0.0575	31
Service	0.0602	42
Steel & other metal	0.9262	23
Transportation	0.4493	33

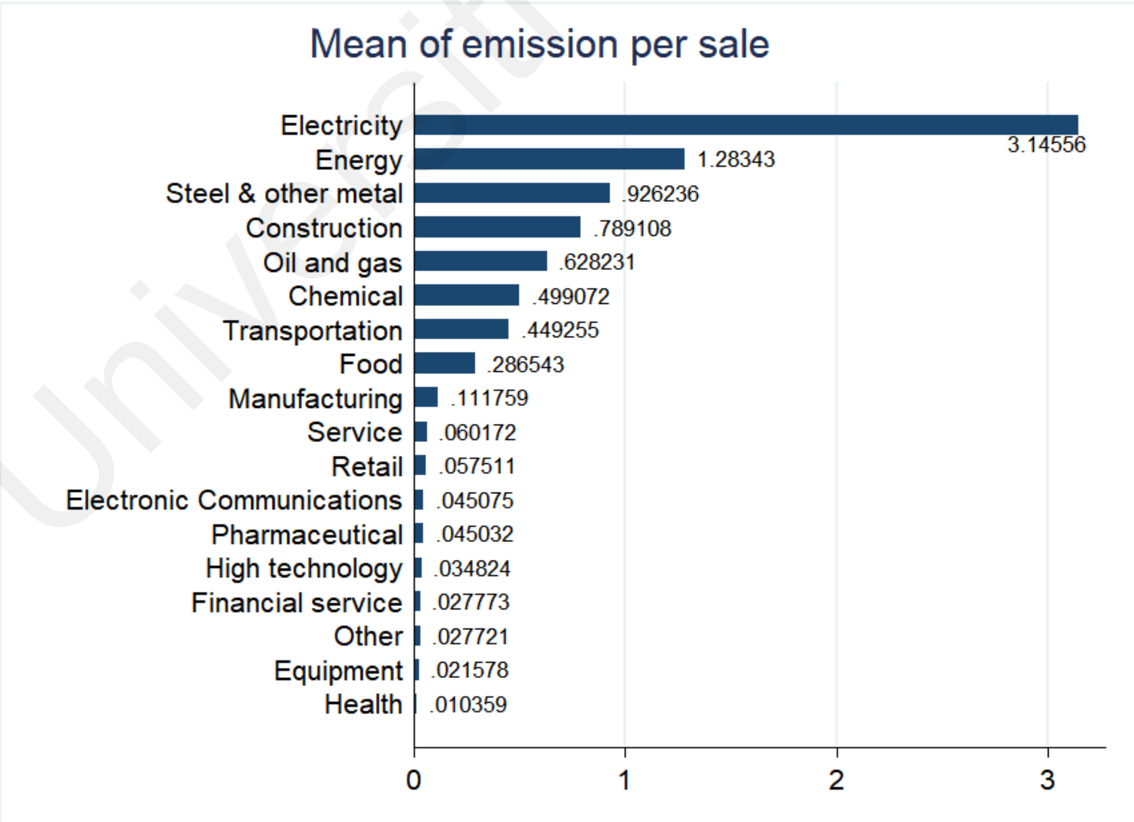

Figure 4. 6 Mean values of emission per sales in different industries

In the tables, 4.46 and 4.47 showed the descriptive statistics of the independent variables and the dependent variables in our model. The high emissions per sale in this study included 327 firms. Here ROA ROE and Tobin's Q are classified as dependent variables; additionally, emissions per sale, ESG, CSR strategy, gender, independent, committee, and executive gender are grouped as independent variables; also, leverage, income, market capitalization, employee and foreign sale are set as control variables; for this study we designated moderate variables as board size, firm asset, employee and sales.

The results of tables 4.46 and 4.47 showed that the mean of ROA was similar in high emissions per sale industries (4.46) and low emissions per sale industries (4.47). The mean of ROE was an 8.07 percentage in high emissions per sale industries and an 11.7 percentage in low emissions per sale industries, so it is easy to understand that the low emissions per sale industries find it more efficient to use capital to generate profit than high emissions per sale industries. The mean Tobin's Q was 1.421 in high emissions per sale industries and 1.548 in low emissions per sale industries. The mean emissions per sale of high emissions industries was 0.648 and 0.00424 in the low emissions per sale firms. This indicated an obvious difference between the industries in the carbon emissions per sale. In addition, environmental performance was indicated to be better in low emissions industries than the higher emissions industries, as the ESG information disclosure was 50.85 for low emissions per sale industries and 47.53 with high emissions per sale industries. The CSR strategy was 49.23 in low emissions per sale industries and 47.92 in high emissions per sale industries. In conclusion, the corporate environmental performance was usually better in low emissions industries than high emissions industries.

The independent variables TMT characteristics here showed that the proportion of female director on the board of low emissions industries (15.65%) was more significant than high emissions per sale industries (11.94%) with the proportion of executive female director at 10.99% in low emissions industries and 7.84% in high emissions per sale industries. The proportion of independent director was 45.83% in low emissions per sale industries and 38.77% in high carbon emissions industries. From the mean of environmental committee out of our sample, the statistical result showed that low emissions industries (0.696) was greater than the high emissions industries (0.652). In conclusion, the TMT characteristics (gender diversity, independent director and CSR committee) exhibited better performance for firms with low emissions per sales.

Table 4. 46 Descriptive statistics (High emission industry)

	(1)	(2)	(3)	(4)	(5)
VARIABLES	N	mean	sd	min	max
ROA	2,943	4.467	5.918	-28.75	74.67
ROE	2,943	8.067	26.92	-737.1	237.4
Tobin's Q	2,943	1.421	0.812	0.291	8.910
EMI	2,943	0.648	1.708	5.73e-05	25.77
ESG	2,943	47.53	19.54	2.483	100
STR	2,943	47.92	31.70	0	100

Table 4. 47 Descriptive statistics (Low emission industry)

	(1)	(2)	(3)	(4)	(5)
VARIABLES	N	mean	sd	min	max
ROA	1,890	4.648	5.633	-22.87	47.46
ROE	1,890	11.70	17.83	-295.5	276.1
Tobin's Q	1,890	1.548	0.879	0.478	7.338
EMI	1,890	0.0424	0.102	6.44e-06	1.835
ESG	1,890	50.85	19.42	4.457	93.27
STR	1,890	49.23	32.50	0	99.76

4.4.2 Panel unit root test

Table 4.48 showed the variable panel unit root test results of corporations in high emissions industries, whereby ROA, ROE, Tobin's Q, Emissionsale and Strategy were stationary in all four tests, which means that the ROA, ROE, Tobin's Q, Emissionsale and Strategy were integrated at order zero. ESG was not stationary in the IPS tests but became stationary after the first difference. This meant that ESG was integrated at order one. Table 4.49 showed the variable panel unit root test results of corporations in low emissions industries, whereby all of variables were stationary at I(0).

Table 4. 48 Result of Unit root test (High emission industries)

	Level				First Difference			
	LLC	IPS	ADF - Fisher	PP - Fisher	LLC	IPS	ADF - Fisher	PP - Fisher
ROA	-40.86	-9.49	1087.92	1250.28	-61.97	-25.47	1956.01	2449.24
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROE	-81.43	-12.27	1119.82	1151.22	-70.70	-26.56	1997.32	2576.87
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tobin's Q	-29.66	-9.60	1197.16	1419.72	-54.25	-22.25	1800.45	2433.60
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Emission sale	-51.83	-6.83	907.23	939.08	-63.41	-20.83	1651.77	2038.07
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ESG	-17.03	-0.43	819.28	796.83	-58.68	-24.79	1939.42	2436.68
	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.00
STR	-56.23	-12.94	1126.75	971.53	-56.22	-24.27	1816.10	2128.13
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Automatic selection of maximum lags based on AIC: 0 to 1

Table 4. 49 Result of Unit root test (Low emission industries)

	Level				First Difference			
	LLC	IPS	ADF -Fisher	PP -Fisher	LLC	IPS	ADF -Fisher	PP -Fisher
ROA	-87.30	-13.17	753.57	796.30	-45.86	-19.58	1234.51	1590.20
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ROE	-24.03	-8.85	770.73	856.83	-47.25	-21.14	1291.46	1681.21
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tobin's Q	-27.80	-5.84	616.30	689.24	-39.60	-18.16	1195.56	1545.87
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Emission sale	-1023.25	-90.01	661.53	646.28	-127.05	-19.70	1047.06	1208.03
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ESG	-18.37	-2.20	581.46	581.81	-43.27	-16.81	1141.93	1419.61
	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
STR	-51.07	-9.30	709.51	649.42	-49.27	-19.91	1226.59	1375.14
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Automatic selection of maximum lags based on AIC: 0 to 1

4.4.3 Panel cointegration analysis

The Pedroni Residual Cointegration Test and Kao test were used here to examine the cointegration relationship between environmental variables (Emissions per sale, ESG disclosure and CSR strategy) and financial indicators (ROA, ROE and Tobin's Q). The null hypothesis stipulates that no cointegration relationship exists among these variables.

The Pedroni Residual Cointegration Test results of the sample of high emissions per sale industries and low emissions per sale industries were shown in tables 4.50 and 4.51. The results showed that both equations of CEP and CFP variables in high and low emissions per sale industries have cointegration relationships.

Table 4. 50 Pedroni Residual Cointegration Test (High Emission industry)

Dependent variable	ROA	ROE	Tobin's Q
Alternative hypothesis: common A.R. coefs. (Within-dimension)			
Panel v-Statistic	-6.63625	-6.4934	-6.73132
Panel rho-Statistic	9.747644	6.717096	10.17313
Panel PP-Statistic	-17.163***	-42.761***	-14.6487***
Panel ADF-Statistic	-8.3671***	-9.7324***	-2.03782**
Alternative hypothesis: individual A.R. coefs. (Between-dimension)			
Group rho-Statistic	18.88034	19.01955	18.14226
Group PP-Statistic	-29.9699***	-29.446***	-27.5236***
Group ADF-Statistic	-9.96057***	-9.30239***	-1.8536**

* is significant at the 0.1 level, ** is significant at 0.05, *** is significant at 0.01.

Table 4. 51 Pedroni Residual Cointegration Test (Low Emission industry)

Dependent variable	ROA	ROE	Tobin's Q
Alternative hypothesis: common A.R. coefs. (Within-dimension)			
Panel v-Statistic	-2.82255	-5.9777	-6.33455
Panel rho-Statistic	6.897741	7.187696	8.079686

Table 4.51 continued

Panel PP-Statistic	-17.1059***	-18.495***	-14.4399***
Panel ADF-Statistic	-2.50228***	-6.4691***	-5.79895***
Alternative hypothesis: individual A.R. coefs. (Between-dimension)			
Group rho-Statistic	13.78853	13.3204	13.8863
Group PP-Statistic	-27.8854***	-31.3476***	-26.7491***
Group ADF-Statistic	-8.4734***	-6.24788***	-5.46865***

* is significant at the 0.1 level, ** is significant at 0.05, *** is significant at 0.01.

The Kao test in table 4.52 provided results that indicated both models were significant, thereby enabling the rejection of the null hypothesis that there was no cointegration in the corporate environmental performance and corporate financial performance nexus. In the next step, we further investigated the cointegration relationship between environmental and economic variables.

Table 4. 52 Kao cointegration test

Dependent variable	ROA	ROE	Tobin's Q
High emissionsale	-6.1416***	1.67026**	-5.69956***
Low emissionsale	-2.1875**	-3.86617***	-6.94929***

* is significant at the 0.1 level, ** is significant at 0.05, *** is significant at 0.01.

4.4.4 Fully Modified Least Squares (FMOLS) Test

The Fully Modified Least Squares (FMOLS) test results that were indicated in table 4.53 showed that emissions per sale had a significant positive impact on financial performance (ROA at 1% level, ROE at 1% level Tobin's Q at 5% level). That meant that a 1% increase in emissions per sale resulted in an increase in ROA by 0.25%, an increase in ROE by 0.28% and an increase in Tobin's Q by 0.04%. Also, while ESG information disclosure had a significant positive impact on financial performance, it showed a positive impact on ROA, ROE and Tobin's Q. Specifically, a 1% increase in ESG information disclosure raised ROA by 0.02%, raised ROE by 0.13% and improved Tobin's Q by 0.03% in the sample of high emissions per sale corporations in the long run. Meanwhile, CSR strategies showed a significant negative impact on financial performance at a 1% level. A 1% increase in CSR strategy led to a 0.03% decrease in ROA, a 0.04% decrease in ROE and a decrease in Tobin's Q by 0.007%.

Table 4. 53 Panel Fully Modified Least Squares (High Emission)

	Dependent Variable: ROA	Dependent Variable: ROE	Dependent Variable: TOBINQ
EMISSIONSALE	0.2535***	0.2865***	0.0399**
ESG	0.0222***	0.1333***	0.0319***
STRATEGY	-0.0295***	-0.0391***	-0.0075***
R-squared	-0.6224	-0.0186	-0.4415
Adjusted R^2	-0.6237	-0.0194	-0.4426

* is significant at the 0.1 level, ** is significant at 0.05, *** is significant at 0.01.

The Fully Modified Least Squares (FMOLS) test results in table 4.54 showed that emissions per sale had a significantly positive impact on financial performance for ROE and Tobin's Q at 1% level. The results showed that a 1% increase in emissions per sale resulted in an increase in ROE by 2.32% and an increase in Tobin's Q by 0.81%. However, the emissions per sale negatively impacted on corporate financial performance ROA, a 1% increase in emissions per sale indicated a reduction of 0.48% for financial performance ROA. While ESG information disclosure had a significantly positive impact on financial performance for ROE and Tobin's Q. Specifically, a 1% increase in ESG information disclosure raised ROE by 0.16% and improved Tobin's Q by 0.03% in the sample of high emissions per sale corporations in the long run. Meanwhile, CSR strategies showed a significantly negative impact on financial performance at a 1% level. A 1% increase in CSR strategy led to a 0.04% decrease in ROA, 0.04% as well as a decrease in ROE and a decrease in Tobin's Q by 0.009%.

Table 4. 54 Panel Fully Modified Least Squares (Low Emission)

	Dependent Variable: ROA	Dependent Variable: ROE	Dependent Variable: TOBINQ
EMISSIONSALE	-0.48199***	2.32089***	0.81725***
ESG	0.03119	0.16465***	0.03413***
STRATEGY	-0.04135	-0.03722***	-0.0087***
R-squared	0.7693	-0.1028	-0.3510
Adjusted R^2	0.6919	-0.1042	-0.3526

* is significant at the 0.1 level, ** is significant at 0.05, *** is significant at 0.01.

With a review of table 4.53 and table 4.54, it is possible to observe that they highlighted the difference in the emissions per sale influence on accounting based financial performance, specifically with ROA in that the low emissions per sale industry usually provided products or services without fossil fuel consumption. The sales in the high emissions per sale industry were more reliant on products in which the production process required high fossil energy consumption. There was not significant amounts of assets such as factory buildings and other materials in the low emissions per sale industry, so the revenue did not rely on fossil fuel consumption.

4.4.5 Panel Autoregressive-Distributed Lag (ARDL) Test

The ARDL test findings presented the long-run and short-run results of high emissions per sale sample of corporations in table 4.55. A reduction in emissions per sale significantly improved ROA, ROE, and Tobin's Q. A 1% reduction in emissions per sale raised ROA by 0.23% and ROE by 0.60%, and Tobin's Q by 0.04% in the long term. Information disclosure significantly and positively impacted ROA, ROE and Tobin's Q at the 1% level. A 1% increase in information disclosure improved ROA by 0.15%, ROE by 0.12%, and Tobin's Q by 0.16%. In comparison, CSR strategy showed a negative link with ROA, ROE and Tobin's Q. A 1% increase in CSR strategy shall reduce ROA by 0.0001%, reduce ROE by 0.07% and reduce Tobin's Q by 0.005%.

The short-term results of the ARDL test shown in table 4.55 illustrated that emissions per sale had a significant negative impact on ROA. A 1% increase in emissions per sale reduced ROA by 38.88% in the sample of high emissions per sale corporations. However, emissions per sale had no significant impact on ROE and Tobin's Q. Also, information disclosure did not significantly influence ROA or ROE but had a negative impact on Tobin's Q in the short term. CSR strategy positively impacted on corporate accounting based financial performance, which involved ROA and ROE. A 1% increase in CSR strategy improved ROA by 0.047% and improved ROE by 0.29%. The error correction term (ECTt-1) here is negative and ranged between -1 to 0, which was statistically significant at 1% level. This implied that the system was converging to equilibrium and the estimated model was stable.

Table 4. 55 Autoregressive-Distributed Lag Model (High Emission)

	Dependent Variable: ROA	Dependent Variable: ROE	Dependent Variable: TobinQ
		Long Run Equation	
EMISSIONSALE	0.235374***	0.60773***	0.043568***
ESG	0.046952***	0.1156***	0.01763***
STRATEGY	-0.00122	-0.07045***	-0.00507***
		Short Run Equation	
COINTEQ01	-0.35659***	-0.6672***	-0.68734***
D(EMISSIONSALE)	-38.8848**	-154.5	5.795421
D(ESG)	0.025062	0.0347	-0.00944***
D(STRATEGY)	0.046759**	0.2860**	0.0029

* is significant at the 0.1 level, ** is significant at 0.05, *** is significant at 0.01. ARDL model is based on the lag order of three which was selected by the Akaike Information Criterion.

The ARDL test findings presented the long-run and short-run results of low emissions per sale sample of corporations in table 4.56. A reduction in emissions per sale significantly improved ROE, and Tobin's Q. A 1% reduction in emissions per sale raised ROE by 7.16%, and Tobin's Q by 0.11% in the long term; A 1% reduction in emissions per sale reduced ROA by 5.6%. Information disclosure significantly and positively impacted ROA, ROE and Tobin's Q at the 1% level. A 1% increase in information disclosure improved ROA by 0.09%, ROE by 0.2%, and Tobin's Q by 0.0001%. In comparison, CSR strategy showed a negative link with ROA, ROE and Tobin's Q. A 1% increase in CSR strategy reduced ROA by 0.02%, reduced ROE by 0.01% and reduced Tobin's Q by 0.00001%.

The short-term results of the ARDL test shown in table 4.56 illustrated that the emissions per sale had a significant negative impact on ROA. A 1% increase in emissions per sale reduced ROA by 188.43% in the sample of high emissions per sale corporations. However, emissions per sale had no significant impact on ROE and Tobin's Q. Also, information disclosure and CSR strategy did not significantly influence ROA, ROE and Tobin's Q in the short term. The error correction term (ECTt-1) here was negative and ranged between -1 to 0, which is statistically significant at 1% level. This implies that the system is converging to equilibrium and the estimated model is stable.

Table 4. 56 Autoregressive-Distributed Lag Model (Low Emission)

	Dependent Variable: ROA	Dependent Variable: ROE	Dependent Variable: TOBINQ
		Long Run Equation	
EMISSIONSALE	-5.63237***	7.161633***	0.109121
ESG	0.093244***	0.205664***	0.000167***
STRATEGY	-0.01809***	-0.01051**	-9.41E-05***
		Short Run Equation	
COINTEQ01	-0.25179***	-0.3629***	-0.62689***
D(EMISSIONSALE)	-188.435***	-335.337	-5.73216
D(ESG)	-0.0167	-0.03449	-0.00468
D(STRATEGY)	0.008552	0.027355	0.00131

* is significant at the 0.1 level, ** is significant at 0.05, *** is significant at 0.01. ARDL model is based on the lag order of three which was selected by the Akaike Information Criterion.

4.5 Top management team and corporate financial performance

The VIF test from table 4.57–4.59 showed that all of our variables' VIF result was less than 3, so the variables were suitable for the regression analysis. Before the regress test, we conducted the Hausman test to check whether our model was suitable for the fixed effect or random-effect model. This study included the Modified Wald test (MWT) (Greene, 2000) for groupwise heteroskedasticity in the fixed effect regression model and the Wooldridge test (Wooldridge, 2002, 2010) for autocorrelation in panel data; the breusch and pagan lagrangian multiplier (LM) test was also included to check the heteroskedasticity for random effect model.

4.5.1 Multiple Regression Analysis (China)

Table 4.57 showed the regression of the fixed and random effect of top management team characteristics and financial performance from China, including both a firm and year fixed effect. The results showed that gender diversity did not have significant impact on corporate financial performance, which included ROA, ROE and Tobin's Q; also board size did not have a moderate impact on the relationship between gender diversity and financial performance. From models 1 and 2, we found that executive gender diversity had a significantly negative impact on ROA (coefficient=-0.076, $p<0.05$). The results from models 4 and 5 showed that executive gender diversity had a negative impact on the ROE (coefficient=-0.130, $p<0.05$). The results from models 7 and 8 showed that executive gender diversity had a significantly negative impact on Tobin's Q (coefficient=-0.004, $p<0.1$). The Independent director negatively impacted ROA (coefficient=-0.083, $p<0.01$, models 1 and 2) and Tobin's Q (coefficient=-0.009, $p<0.01$, models 7 and 8). Environmental committee negatively impacted ROA (coefficient=-1.002, $p<0.05$), ROE (coefficient=-2.315, $p<0.05$) and Tobin's Q (coefficient=-0.199, $p<0.01$).

The results of models 3, 6 and 9 included the interaction item and the results demonstrated a moderating effect of board size on the relationship between top managers' characteristics and corporate financial performance. From model 3, we can see that board size had a weakening and moderating influence on the negative relationship between independent director and ROA. From model 6 and 9, we can see that board size did not have a moderating influence on the relationship between top managers' characteristics and financial performance (ROE and Tobin's Q).

The Hausman test in table 4.57 supported the fixed effect used in models 1–9. The Modified Wald test showed that there was no Heteroskedasticity in our model. The MWT result supported our findings that there was first-order autocorrelation in our model.

Table 4. 57 Multiple Regression Analysis (China)

VARIABLES	(1) roa	(2) roa	(3) roa	(4) roe	(5) roe	(6) roe	(7) tobinq	(8) tobinq	(9) tobinq
GEN	0.005	0.022	-0.009	0.031	0.070	-0.032	-0.007	-0.006	-0.008
	(0.039)	(0.036)	(0.032)	(0.067)	(0.061)	(0.062)	(0.005)	(0.005)	(0.005)
EGE	-0.091***	-0.076**	-0.051	-0.160***	-0.130**	-0.081	-0.004*	-0.004*	-0.003
	(0.034)	(0.033)	(0.032)	(0.061)	(0.058)	(0.062)	(0.002)	(0.002)	(0.002)
IND	-0.087***	-0.083***	-0.065**	-0.058	-0.050	-0.013	-0.009***	-0.009***	-0.008***
	(0.027)	(0.027)	(0.026)	(0.063)	(0.063)	(0.055)	(0.002)	(0.002)	(0.002)
COM	-0.959*	-1.002**	-0.550	-1.988*	-2.315**	-1.722	-0.167***	-0.199***	-0.184***
	(0.518)	(0.457)	(0.456)	(1.203)	(1.126)	(1.131)	(0.043)	(0.038)	(0.041)
Bsize			0.399***			0.823***			0.033***
			(0.092)			(0.221)			(0.009)
GENB			-1.977***			-5.906***			-0.096*
			(0.649)			(1.561)			(0.054)
EGEB			2.101***			3.205**			0.083*
			(0.577)			(1.578)			(0.043)
INDB			1.488***			2.630**			0.061
			(0.437)			(1.338)			(0.041)
COMB			0.072			0.393			0.005
			(0.091)			(0.288)			(0.007)
LEVER		-0.154***	-0.143***		-0.295***	-0.273***		-0.006***	-0.005***
		(0.016)	(0.016)		(0.054)	(0.055)		(0.001)	(0.001)
LGCAP		3.071***	3.308***		6.478***	7.117***		0.571***	0.588***
		(0.318)	(0.321)		(0.941)	(0.983)		(0.045)	(0.047)
FSALE		-0.016**	-0.012*		0.004	0.015		-0.004***	-0.004***
		(0.007)	(0.006)		(0.020)	(0.019)		(0.001)	(0.001)

Table 4.57 continued

Constant	9.572***	-33.268***	-42.827***	14.767***	-77.414***	-99.374***	1.852***	-6.859***	-7.633***
	(1.174)	(4.902)	(5.174)	(2.455)	(13.631)	(14.898)	(0.106)	(0.662)	(0.746)
Observations	1,170	1,170	1,170	1,170	1,170	1,170	1,170	1,170	1,170
R-squared	0.478	0.581	0.606	0.338	0.429	0.457	0.525	0.649	0.658
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
VIF (mean)	1.1	1.15	1.42	1.1	1.15	1.42	1.1	1.15	1.42
F-test	9.88***	43.53***	32.19***	2.97**	25.58***	19.89***	10.04***	59.98***	38.04***
Hausman	12.78**	72.55***	97.4***	9.72**	65.45***	89.63***	7.51*	143.88***	160.58***
Modified Wald	82859.80***	19154.72***	30868.02***	2.1e+05***	26619.85***	34403.34***	3.5e+05***	4.7e+05***	74744.19***
Wooldridge	13.319***	11.539***	11.545***	11.913***	4.759**	5.316**	52.553***	144.553***	147.277***
LM test for RE									
Model	FE	FE	FE	FE	FE	FE	FE	FE	FE

Robust standard errors in parentheses, ***, **, * Indicate that the estimated coefficient is statistically significant at the 1%, 5%, and 10% level, which is *** p<0.01, ** p<0.05, * p<0.1.
GEN is gender diversity, EGE is executive gender diversity, IND is independent director, COM is environmental committee, Bsize is board size, LEVER is leverage, LGINC is log(income), LGCAP is log(capitalization), LGEM is log(employee), FSALE is foreign sales. The interaction variable here GENB = GEN*Bsize, INDB = IND * Bsize, COMB= COM*Bsize.

4.5.2 Multiple Regression Analysis (Japan)

Table 4.58 showed the regression of the fixed and random effect of top management team characteristics and financial performance from Japan, including both a firm and year fixed effect. The results showed that did not have a significant impact on corporate financial performance (ROA, ROE and Tobin's Q). From models 7 and 8, we found that executive gender diversity had a significantly positive impact on Tobin's Q (coefficient=0.012, $p<0.1$). The Independent director positively impacted on ROA (coefficient=0.030,$p<0.05$, model 2), ROE (coefficient=0.321,$p<0.01$, model 5) and Tobin's Q (coefficient=-0.003, $p<0.05$, model 8). Environmental committee positively impacted on ROA (coefficient=0.547, $p<0.1$, model 2) and Tobin's Q (coefficient=0.139, $p<0.01$, model 8).

The results of models 3, 6 and 9 included the interaction item and the results demonstrated a moderating effect of board size on the relationship between top managers' characteristics and corporate financial performance. From models 3, 6 and 9, we can see that board size does not have a moderating influence on the relationship between independent director and ROA, ROE and Tobin's Q.

The Hausman test in table 4.58 supported the fixed effect used in models 1–9. The Modified Wald test showed that there was no Heteroskedasticity in our model. The MWT result supported our findings that there was first-order autocorrelation in our model.

Table 4. 58 Multiple Regression Analysis (Japan)

VARIABLES	(1) roa	(2) roa	(3) roa	(4) roe	(5) roe	(6) roe	(7) tobinq	(8) tobinq	(9) tobinq
GEN	0.036*	0.029	0.040*	-0.043	0.034	0.046	0.002	-0.001	0.001
	(0.020)	(0.019)	(0.022)	(0.205)	(0.205)	(0.258)	(0.003)	(0.003)	(0.003)
EGE	0.078	0.080	0.037	0.621	0.657	0.556	0.012*	0.012*	0.010
	(0.056)	(0.053)	(0.051)	(0.406)	(0.425)	(0.493)	(0.006)	(0.006)	(0.006)
IND	0.039***	0.030**	0.027*	0.300***	0.321***	0.324**	0.005***	0.003**	0.002
	(0.012)	(0.013)	(0.014)	(0.110)	(0.119)	(0.135)	(0.002)	(0.001)	(0.002)
COM	0.853***	0.547*	0.522*	2.370	1.773	1.536	0.151***	0.139***	0.134***
	(0.328)	(0.315)	(0.307)	(1.663)	(1.099)	(1.123)	(0.047)	(0.045)	(0.045)
Bsize			0.037			-0.310			-0.005
			(0.042)			(0.597)			(0.005)
GENB			0.627			1.309			0.042
			(0.481)			(3.043)			(0.053)
EGEB			-2.448***			-5.786			-0.114
			(0.896)			(7.383)			(0.138)
INDB			-0.026			0.004			-0.078**
			(0.209)			(1.767)			(0.032)
COMB			-0.031			-0.656			-0.002
			(0.063)			(0.486)			(0.010)
LGINC		0.993**	1.009**		3.665	3.730		-0.005	-0.003
		(0.485)	(0.484)		(4.893)	(4.886)		(0.007)	(0.008)
LGEM		-0.961*	-0.957*		-9.742**	-9.231**		0.098	0.107
		(0.511)	(0.503)		(4.365)	(4.629)		(0.066)	(0.066)
FSALE		0.036***	0.036***		0.010	0.024		0.005***	0.005***
		(0.008)	(0.008)		(0.066)	(0.057)		(0.001)	(0.001)

Table 4.58 continued

Constant	1.150***	-6.421	-7.130	-3.537	31.259	28.766	0.990***	0.023	-0.035
	(0.370)	(9.586)	(9.606)	(2.306)	(101.134)	(100.978)	(0.043)	(0.666)	(0.695)
Observations	1,494	1,494	1,494	1,494	1,494	1,494	1,494	1,494	1,494
R-squared	0.543	0.560	0.563	0.185	0.190	0.190	0.723	0.729	0.732
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
VIF (mean)	1.17	1.17	1.33	1.17	1.17	1.33	1.17	1.17	1.33
F-test	10.73***	13.86***	8.66***	2.96**	2.84***	1.77*	12.65***	11.46***	7.77***
Hausman	9.72**	8.09*	27.38***	7.33*	50.5***	52.35***	5.18*	18.48**	22.97**
Modified Wald	8.7e+05***	7.5e+05***	8.9e+05***	5.1e+07***	2.9e+07***	1.9e+07***	1.1e+06***	6.1e+06***	3.3e+06***
Wooldridge	12.844***	12.781***	12.709***	3.225*	2.29*	2.249*	51.488***	51.018***	50.658***
LM test for RE									
Model	FE	FE	FE	FE	FE	FE	FE	FE	FE

Robust standard errors in parentheses, ***, **, * Indicate that the estimated coefficient is statistically significant at the 1%, 5%, and 10% level, which is *** p<0.01, ** p<0.05, * p<0.1.

GEN is gender diversity, EGE is executive gender diversity, IND is independent director, COM is environmental committee, Bsize is board size, LEVER is leverage, LGINC is log(income), LGCAP is log(capitalization), LGEM is log(employee), FSALE is foreign sales. The interaction variable here GENB = GEN*Bsize, INDB = IND * Bsize, COMB= COM*Bsize.

4.5.3 Multiple Regression Analysis (Germany)

Table 4.59 showed the regression of the fixed and random effect of top management team characteristics and financial performance from German firms, including both firm and year fixed effects. The results showed that gender diversity positively impacted on ROA (coefficient=0.053, $p<0.01$, model 2) and Tobin's Q (coefficient=0.013, $p<0.01$, model 8). The executive gender diversity positively impacted on ROA (coefficient=0.1, $p<0.01$, model 2) and Tobin's Q (coefficient=0.017, $p<0.01$, model 8). Independent director and environmental committee did not have a significant impact on corporate financial performance (ROA, ROE and Tobin's Q).

The results of models 3, 6 and 9 included the interaction item and the results demonstrated a moderating effect of board size on the relationship between top managers' characteristics and corporate financial performance. From models 3, 6 and 9, we determined that board size did not have a moderating influence on the relationship between top managers' characteristics and financial performance (ROE and Tobin's Q).

The Hausman test in table 4.59 supported the random effect used in models 1–9. The LM test showed the random-effect was appropriate in our model.

Table 4. 59 Multiple Regression Analysis (Germany)

VARIABLES	(1) roa	(2) roa	(3) roa	(4) roe	(5) roe	(6) roe	(7) tobinq	(8) tobinq	(9) tobinq
GEN	0.049***	0.053***	0.051**	0.125	0.171	0.180	0.013***	0.013***	0.011***
	(0.019)	(0.019)	(0.020)	(0.743)	(0.749)	(0.781)	(0.004)	(0.004)	(0.004)
EGE	0.103***	0.100***	0.095***	0.567	0.523	0.435	0.017***	0.017***	0.015***
	(0.021)	(0.021)	(0.022)	(0.729)	(0.739)	(0.769)	(0.004)	(0.004)	(0.004)
IND	-0.016	-0.016	-0.014	0.189	0.254	0.215	-0.004	-0.004	-0.003
	(0.013)	(0.013)	(0.013)	(0.361)	(0.367)	(0.381)	(0.003)	(0.003)	(0.003)
COM	-0.908	-0.653	-0.668	9.548	13.144	19.184	-0.113	-0.099	-0.086
	(0.568)	(0.571)	(0.582)	(19.032)	(19.762)	(20.632)	(0.109)	(0.110)	(0.111)
Bsize			-0.021			-2.087			0.000
			(0.093)			(2.754)			(0.018)
GENB			-0.084			-4.277			-0.128
			(0.509)			(21.016)			(0.097)
EGEB			-0.389			-7.052			-0.159
			(0.516)			(20.571)			(0.098)
INDB			0.195			-0.399			0.073
			(0.249)			(8.130)			(0.048)
COMB			-0.063			4.585			0.012
			(0.125)			(4.936)			(0.024)
LEVER		-0.002*	-0.002*		-0.024	-0.022		0.000	0.000
		(0.001)	(0.001)		(0.050)	(0.050)		(0.000)	(0.000)
LGEM		-0.990***	-0.961***		1.150	2.249		-0.067	-0.063
		(0.275)	(0.280)		(5.556)	(5.915)		(0.057)	(0.058)
FSALE		0.002	0.001		-0.351	-0.380		-0.001	-0.001
		(0.010)	(0.010)		(0.249)	(0.253)		(0.002)	(0.002)

Table 4.59 continued

Constant	5.461***	14.319***	14.402***	-17.212	-18.537	-7.802	1.772***	2.399***	2.390***
	(1.105)	(2.710)	(2.786)	(26.800)	(55.916)	(57.882)	(0.245)	(0.572)	(0.588)
Observations	2,925	2,925	2,925	2,925	2,925	2,925	2,925	2,925	2,925
R-squared	325	325	325	325	325	325	325	325	325
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
VIF (mean)	1.1	1.12	1.26	1.1	1.12	1.26	1.1	1.12	1.26
F-test	8.00***	5.86***	3.55***	1.23***	1.23***	1.23***	47.95***	47.13***	46.75***
Hausman	5.15	5.18	8.25	2.24	5.05	5.74	8.76*	12.57*	15.77
Modified Wald	5.8e+07***	2.9e+07***	2.1e+07***	7.5e+10***	5.2e+10***	2.0e+10***	1.5e+08***	1.4e+08***	9.1e+08***
Wooldridge	3.918*	3.883*	3.954*	2.126	0.431	0.569	6.941***	6.927***	8.219***
LM test for RE	6236.03***	6186.41***	6132.46***	6.94***	6.63***	6.49***	8129.45***	8098.31***	8038.31***
Model	RE	RE	RE	RE	RE	RE	RE	RE	RE

Robust standard errors in parentheses, ***, **, * Indicate that the estimated coefficient is statistically significant at the 1%, 5%, and 10% level, which is *** p<0.01, ** p<0.05, * p<0.1.

GEN is gender diversity, EGE is executive gender diversity, IND is independent director, COM is environmental committee, Bsize is board size, LEVER is leverage, LGINC is log(income), LGCAP is log(capitalization), LGEM is log(employee), FSALE is foreign sales. The interaction variable here GENB = GEN*Bsize, INDB = IND * Bsize, COMB= COM*Bsize.

CHAPTER 5: DISCUSSION

5.1 Introduction

This chapter compiled the findings from the empirical results from chapter 4. In section 5.2, includes a discussion on the relationship between top managers' characteristics and corporate environmental performance, and the moderating effect of board size on the relationship between top managers' characteristics and environmental performance. In section 5.3, centers on a discussion regarding the relationship of corporate environmental performance and corporate financial performance over the long term and short term, and the moderating effect of firm size on the relationship between environmental performance and financial performance in the short term. In addition, this section discussion covers the differences between the environmental and financial nexus across the various industries. In section 5.4 of this study, the relationship between top manangers' characteristics and corporate financial performance, as well as the moderating effect of board size on the relationship of top managers' characteristics and corporate financial performance are all highlighted. In section 5.5, a summary of the result of our results has been detailed.

5.2 Discussion on the relationship between top management team and corporate environmental performances

The result of the fixed and random effect model showed that there was a unique impact of top management team characteristics on corporate environmental performance of the samples from the three different countries. The hypotheses 1a and 1d were supported from the Chinese samples in that the percentage of female director and the percentage of executive female directors have positively impacted carbon emissions reduction (see table 4.7, negative impact on emissions per sale) and which resulted in being consistent with (Haque, 2017; D. Khan & Ullah, 2019; L. Liao et al., 2015; Post et al., 2011), although this yielded an opposite result from the Japanese samples, in that the percentage of female director negatively impact carbon emissions reduction in Japan. Also, the result did not support 1a from the German evidence, which demonstrated that a percentage of female director did not impact carbon emissions reduction (see table 4.13). The hypotheses H1b, H1c, H1e and H1f was supported from all three samples; the percentage of female director and female executive director benefit a firm to increase environmental information reporting (Isabel María García-Sánchez et al., 2019; Lu & Herremans, 2019; Tapver, 2019; Ullah et al., 2017), and social and environmental practice (Atif et al., 2020; Celis et al., 2015; Jizi, 2017; Yasser et al., 2017).

After moderating based on the board size in the Chinese sample, the results showed board size had strengthened the moderation of the positive relationship between the percentage of female director and carbon emissions reduction, but weakened the moderate impact on the positive relationship between executive gender diversity and carbon reduction. Evidence from Japan and Germany do not support the moderate effect of board size on gender diversity and executive gender diversity on carbon performance. So, hypothesis 1aa was supported in China, but not in Japan or Germany. The results also showed that board size had a weakening influence on the positive relationship between the percentage of female director and ESG disclosure and CSR strategy in the German sample; however, it did not appear so in China and Japan. The results showed that board size had a weakening impact on the positive relationship between female director and environmental performance (ESG disclosure and CSR strategy), especially with firms that had a high level of female director ratio.

The resultant percentage of independent director positively impacted on carbon reduction in China and this result was consistent with the previous study that the percentage of independent director enhanced corporate disclosure and enhanced environmental performance (Grace & Odoemelam, 2018; L. Liao et al., 2015), but negatively impacted the carbon reduction of Japan and Germany; these results aligned with (Pucheta-Martínez et al., 2019) regarding the presence of independent director on boards reaches a tipping point, that it will decrease corporate environmental disclosure. The consistent results from three samples showed that the high percentage of independent director on the board were beneficial for corporate ESG disclosure; again the results remained consistent with previous research (Armstrong et al., 2014; Cuadrado-Ballesteros et al., 2015; Pucheta-Martínez et al., 2019). The results of the three samples also showed that the percentage of independent directors enhanced the effectiveness of boardroom process and corporate environmental management practice, such as CSR strategies; this result was supported by (C. M. Dalton & Dalton, 2005; I. M. García-Sánchez et al., 2019). When the interaction variable was included, the result showed that board size only had a moderate strengthening effect on Independent director and ESG disclosure of the Japanese sample.

Environment committee did not exhibit any impact on the carbon reduction of the three countries, so H3a was rejected. Environment committee positively impacted ESG disclosure and CSR strategy and hence, H3b and H3c were supported. The results were consistent with the findings (L. Liao et al., 2015; Michals, 2009) that the setting of an environmental committee is a beneficial undertaking to enhance relationships with outside stakeholders and was shown to be consistent with (Clarkson et al., 2015; Peters & Romi, 2014; Walls et al., 2012) that an environmental committee would be beneficial for environmental information disclosure and increase corporate environmental practices. However, the result was not supported (Dietz & Hope, 2007) from the standpoint that an environmental committee did not prove to be helpful in aiding with carbon reduction and fossil energy consumption. The result showed that board size had a moderate influence on committee–ESG and committee–strategy relationships of China, however this effect did not appear in Japan and Germany.

5.3 Discussion on the relationship between corporate environmental performance and corporate financial performance

This study explored the relationship between the corporate environmental performance and corporate financial performance of three countries' samples over the long term using the FMOLS and ARDL models. The short-term relationship of environmental performance and financial performance was also examined by utilizing a fixed effect and random effect model; moreover, the moderating effect of firm size on the relationship between environmental performance and financial performance in these three countries was explored. Additionally, this study also separated the high carbon emissions industries and low emissions industries and explored the different relationships amongst environmental performance and financial performance in different emissions industries.

Firstly, this study explored the long-term relationship between corporate environmental performance and corporate financial performance. The resultant empirical analysis of the Chinese firms were consistent in the FMOLS and ARDL test. The result showed that in the long run, emissions per sale had a significantly positive impact on corporate financial performance, both in accounting-based financial performance (ROA, ROE) and marketing-based financial performance Tobin's Q, this meant that carbon emissions reduction negatively impacted corporate financial performance in China and the result was consistent with the previous study such as (Filbeck & Gorman, 2004; Shen et al., 2019), but produced results counter to those from (Ganda, 2018; Z. He et al., 2017). The high emissions per sales related to the financial performance showed that China, as an emerging market, without significant mandatory laws and regulations was able to encourage companies to reduce carbon emissions. There were not official punishments for firms which caused substantial pollution to the environment as many firms still fit the old models of pursuing profit while ignoring environmental responsibility. However, the results of the FMOLS and ARDL models from the Japanese and German samples showed differences to China; the corporate emissions per sale negatively influenced the accounting-based financial performance (ROA and ROE) in long run and this result was consistent with previous research (L.-J. Liu & Liang, 2017; Rokhmawati et al., 2017; Wagner, 2005). It indicated that the emissions per sale reduction increased the accounting-based financial performance but not as marketing-based financial performance (Tobin's Q) in the case of Japan and Germany.

The results of the FMOLS and ARDL models showed that the corporate ESG disclosure had a significantly positive impact on corporate financial performance (ROA, ROE and Tobin's Q) in the long run; these results proved to be consistent with (Borghei et al., 2018; Delmas et al., 2011; Konar & Cohen, 2001; Lang & Lundholm, 1993; Pereira-Moliner et al., 2015). The results indicated that with good corporate ESG disclosure, would be benefial for corporate financial performance in both mature and emerging markets. The results also supported the stakeholder theory in that with good corporate environmental information disclosure, firms will benefit and be more able to attract customers and increase corporate reputation and furthermore, increase corporate financial performance. It supported the theory of environmental accounting that firms would benefit from the environmental conservation activities.

From the result of the FMOLS and ARDL analyses of these three countries, the CSR strategy negatively impacted on corporate financial performance (ROA, ROE and Tobin's Q) in the long term. The results were consistent with previous studies (Cañón-de-Francia & Garcés-Ayerbe, 2009; Wagner, 2005) in that CSR strategies increased costs and reduced financial performance, but it proved to be opposite when compared with other previous research (Al-Tuwaijri et al., 2004; Villarón-Peramato et al., 2018). The CSR strategy corresponded to the environmental conservation cost aspect of the environmental accounting system.

Secondly, this study examined the short-term relationship between corporate environmental performance and corporate financial performance as well as the moderating effect of firm size on the relationship between environmental performance and financial performance. The result showed that emissions per sale negatively impacted financial performance (ROA, ROE and Tobin's Q), both in the samples from China and Japan in the short run. This meant that carbon emissions reduction positively influenced financial performance (ROA, ROE and Tobin's Q) in China. The result was consistent with (Córdova et al., 2018; Fernández-Cuesta et al., 2019; Y. He et al., 2017; Y. S. Liu et al., 2017; Rokhmawati et al., 2017; Valls Martínez et al., 2019) in that firms with low carbon emissions indicated that a firm with a high productivity and reduction of fossil fuel energy consumption, it was beneficial to reduce the cost that would then bring immediate financial benefits.

The result of both a fixed and random effect result showed that ESG disclosure and CSR strategy negatively impacted financial performance (ROA, ROE and Tobin's Q) in short run in China (Clarkson et al., 2008; Y. He et al., 2013). However, there was a positive relationship between ESG disclosure and CSR strategy with regard to financial performance (ROA and Tobin's Q) in Japan in the short run. This meant that in a mature market with strict rules, environmental performance would more likely bring financial benefit in a short time. But this did not apply to the German market, where the environmental performance of German companies could not have any impact on short-term financial performance.

After that, the moderate variable firm size was included into the relationship between environmental performance and financial performance. The results showed that there was a weakening moderating effect of firm size on the negative relationship between ESG disclosure and financial performance (ROA and Tobin's Q) in China, and a weakening moderating effect of firm size on the positive relationship between ESG disclosure and financial performance (ROA and Tobin's Q) in Japan. There was although, a strengthening moderating effect on the positive relationship between emissions reduction and financial performance (ROE and Tobin's Q) in Japan. Firm size did not produce any moderating effect on the relationship between environmental performance and financial performance in Germany.

Thirdly, this study investigated the difference in the CEP–CFP relationship between high emissions per sale industries (electricity, energy, Steel and other metals, construction, Oil and gas, chemical, transportation, food and manufacturing) and low emissions per sale industries (service, retail, electronic communication, pharmaceutical, high technology, financial services, equipment and health) by using the FMOLS and ARDL models. The results showed that firms with high emissions per sales, emissions per sale, and ESG disclosure positively linked with corporate financial performance (ROA, ROE and Tobin's Q) in the long run. However, CSR strategy had a negative influence on financial performance (ROA, ROE and Tobin's Q) in the long run, and the result is supported by Lucas & Noordewier (2016) and Rokhmawati et al. (2017).

With the low emissions per sales industries, the result showed that ESG information disclosure positively impacted financial performance and that CSR strategy negatively impacted corporate financial performance in the long run. Emissions per sale had a positive impact on financial performance (ROE and Tobin's Q) and was similar to the high emissions per sale industries. The emissions per sale did however, negatively impact accounting-based financial performance ROA, and the result was consistent with Gallego-Álvarez et al. (2015). The difference in the emissions per sale influence on accounting-based financial performance ROA was that the low emissions per sale industry usually provided products or services without fossil fuel consumption. The sales from the high emissions per sale industries were more reliant on the products in which production processes with high fossil energy consumption were required. There was not too much that had to be counted as assets that might have included necessities like factory building or other materials in the low emissions per sale industry, so the revenue did not heavily rely on fossil fuel consumption. Moreover, the short-run revealed that the CSR strategy had a positive influence on accounting-based financial performance (ROA and ROE) in high emissions per sale industries in the short run; this meant that with an excellent environmental strategy, energy consumption reduction and material utilisation were improved, which then led to reductions in the cost of products and enhanced financial performance on the balance sheet (Villarón-Peramato et al., 2018; Watson et al., 2004). The CSR strategy function was not obvious in the low emissions per sales industries.

5.4 Discussion on the relationship between top management team and corporate financial performance

This study examined the relationship between top manager team characteristics and corporate financial performance by way of both a fixed and random effect model, and explored the moderating effect of board size on the relationship between top managers' characteristics and corporate financial performance.

The result showed that in the Chinese sample, executive gender diversity positively impacted the corporate financial performance (ROA, ROE and Tobin's Q) and this proved to be consistent with previous research (R. B. Adams & Ferreira, 2009; Darmadi, 2011; Isabel María García-Sánchez et al., 2019). A percentage of independent director negatively impacted financial performance (ROA and Tobin's Q) (Ammari et al., 2016; Cavaco et al., 2017; Uribe-Bohorquez et al., 2018) while the environmental committee negatively impacted the corporate financial performance (ROA, ROE and Tobin's Q).

The results from Japan showed that female director and executive female director did not impact corporate financial performance (Carter et al., 2010; Marimuthu & Kolandaisamy, 2009). The opposite result occurred with China's sample in that high percentage of independent director increased corporate financial performance and these results were consistent with (T. Chen, 2015; J. J. Choi et al., 2007; Cuadrado-Ballesteros et al., 2015; Isabel María García-Sánchez et al., 2017; Schmid & Zimmermann, 2008). The setting with the environmental committee also increased the corporate financial performance (ROA and Tobin's Q).

The result from Germany showed that the high percentage of female director and executive female director positively impacted corporate financial performance (ROA and Tobin's Q); the result was supported by previous research (Campbell & Mínguez-Vera, 2008; Doldor et al., 2012; Low et al., 2015).

Compared with the relationship between top manager team characteristics and corporate financial performance from three samples, we can see that the diversity of board (such as gender diversity, independent diversity and subcommittee diversity) will benefit for financial performance in Japan and Germany, however, the board diversity will decrease financial performance in Chinese firms.

5.5 Summary

The Hypothesis result of the sample from China is shown in Figure 5.1. The empirical result showed that Top managers' characteristics positively impacted corporate environmental performance. More specifically, female director, independent director and the environmental committee were beneficial to reduce carbon emissions, as well as increase environmental disclosure and corporate CSR strategies; as such, the hypothesis H1abcde, H2abc and H3bc were supported in China. The result was consistent with (Kaspereit et al., 2016; L. Liao et al., 2015; Post et al., 2011; Wu, Furuoka, & Lau, 2021) in that the high percentage of female director, the high percentage of independent directors and environmental committee on the board cared more about the corporate environmental performance and increased the non-financial information disclosure.

Compare with Figure 5.1 and Figure 5.2, The short run and long run environmental and financial performance nexus were not uniform in the Chinese firms; it can be observed that emissions reduction proved beneficial for financial performance in the short term, but harmful for financial performance in the long term. ESG disclosure negatively impacted financial performance in the short term (see Figure 5.1) but positively impacted financial performance in the long term (see Figure 5.2) (Pereira-Moliner et al., 2015). CSR strategy exhibited consistent results in both the short term and the long term; furthermore, the results showed that CSR strategy negatively impacted corporate financial performance.

Addedly, this study also examined the impact of top managers on financial performance, the results from Figure 5.1 showed gender diversity did not impact financial performance, so H7abc are not supported; this was consistent with (Y. Liu et al., 2015; Yang et al., 2019), and the high percentage of executive gender diversity negatively impacted corporate financial performance, consequently H1def were not supported. Independent director negatively impacted on ROA and Tobin's Q, so the H8abc was not supported. The environmental and social committee also decreased the accounting-based financial performance and marketing based financial performance, therefore the hypothesis H9abc proved to be completely opposite, which was supported by (Alshetwi, 2017; Cavaco et al., 2017; Uribe-Bohorquez et al., 2018).

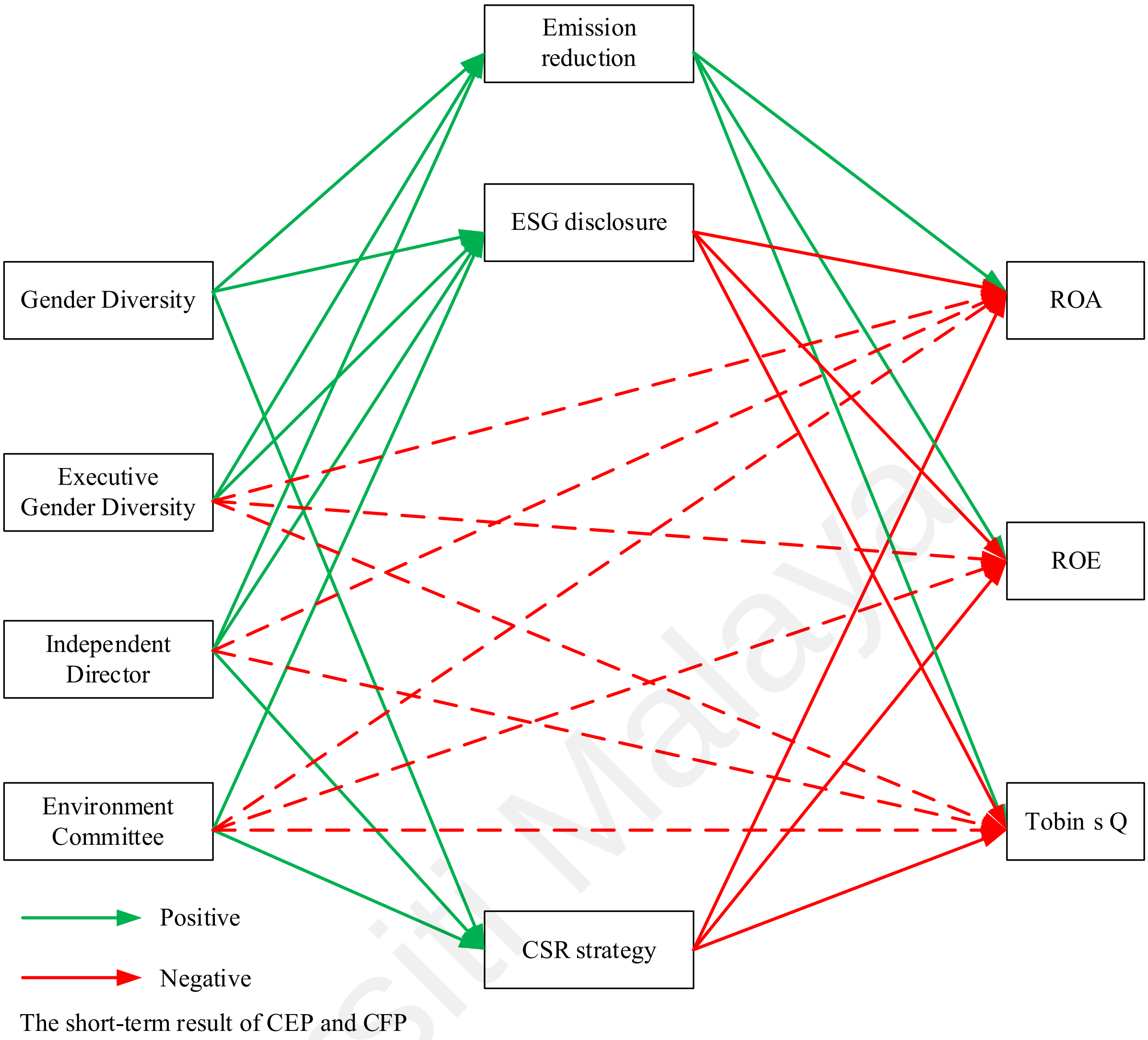

Figure 5. 1 The hypothesis result from China (short-term of CEP and CFP)

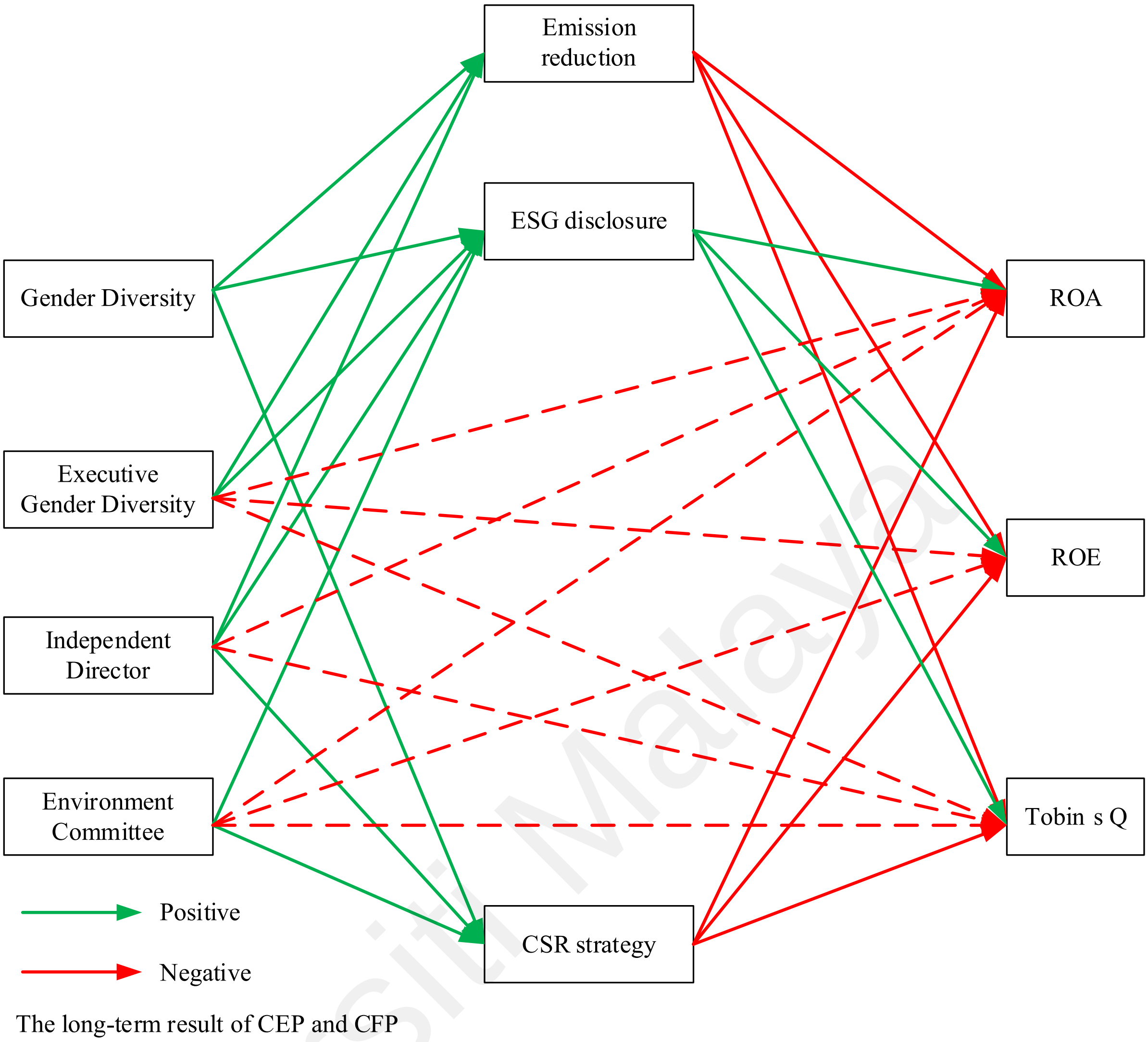

Figure 5. 2 The hypothesis result from China (long-term of CEP and CFP)

The moderate impact of board size on top managers and environmental performance, as well as the top managers and financial performance were also included. The results showed that both female director and executive gender diversity positively impacted environmental performance, board size strengthened the negative relationship between female director on emissions per sale (opposite of emissions reduction) (see Figure 5.3) but weakened the negative relationship between executive female director and emissions per sale (opposite of carbon emissions reduction) (see Figure 5.4) and as such, H1aa were supported. Environment committee positively increased ESG disclosure and CSR strategy; these relationships were weakening by the moderating effect of board size (see Figure 5.5 and 5.6), thus H3bb and H3cc were supported. The moderating regression CEP and CFP showed that firm size weakened the short-term negative relationship between ESG disclosure and financial performance (ROA and Tobin's Q, so that H5aa and H5cc were supported, see Figure 5.7 and 5.8), and board size had a weakening impact on the negative impact of CSR strategy on Tobin's Q in the short run (see Figure 5.9), Hypothesis H6cc was resultantly supported. When board size was included as a moderating variable in the equation between TMT and CFP, there was not any evidence to support the moderating effect of board size on the relationship between top managers' characteristics and financial performance in China.

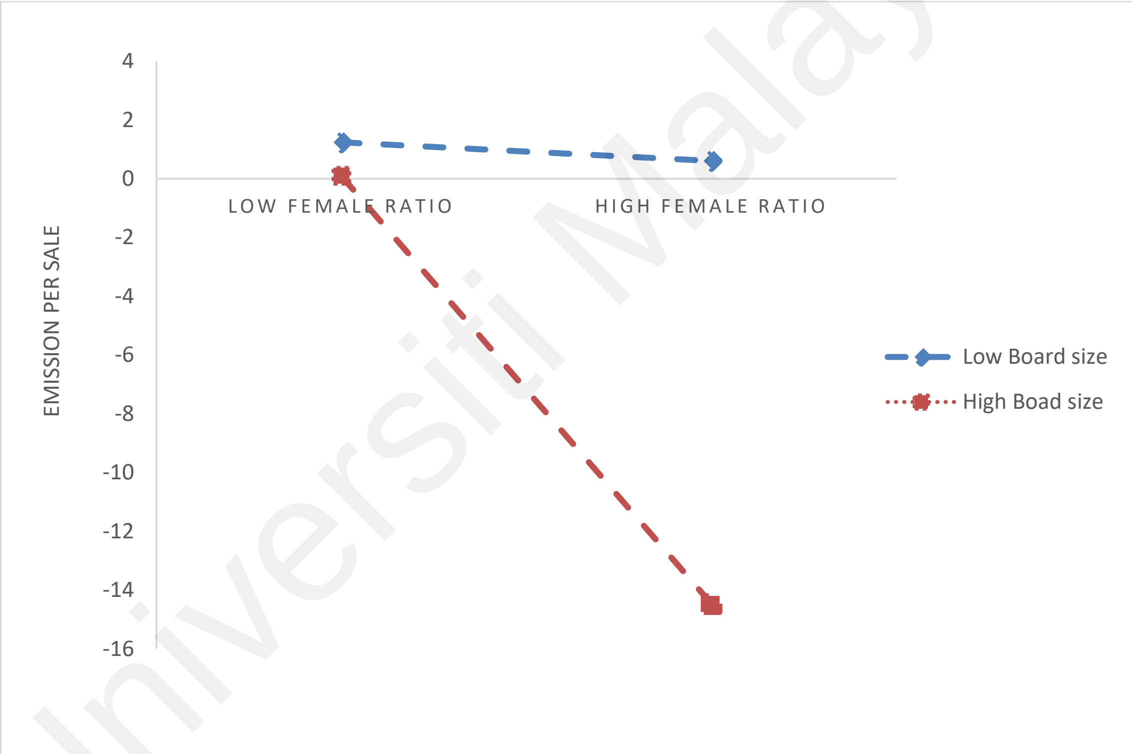

Figure 5. 3 Moderating of Board size on Gender diversity and Emission per sale (China)

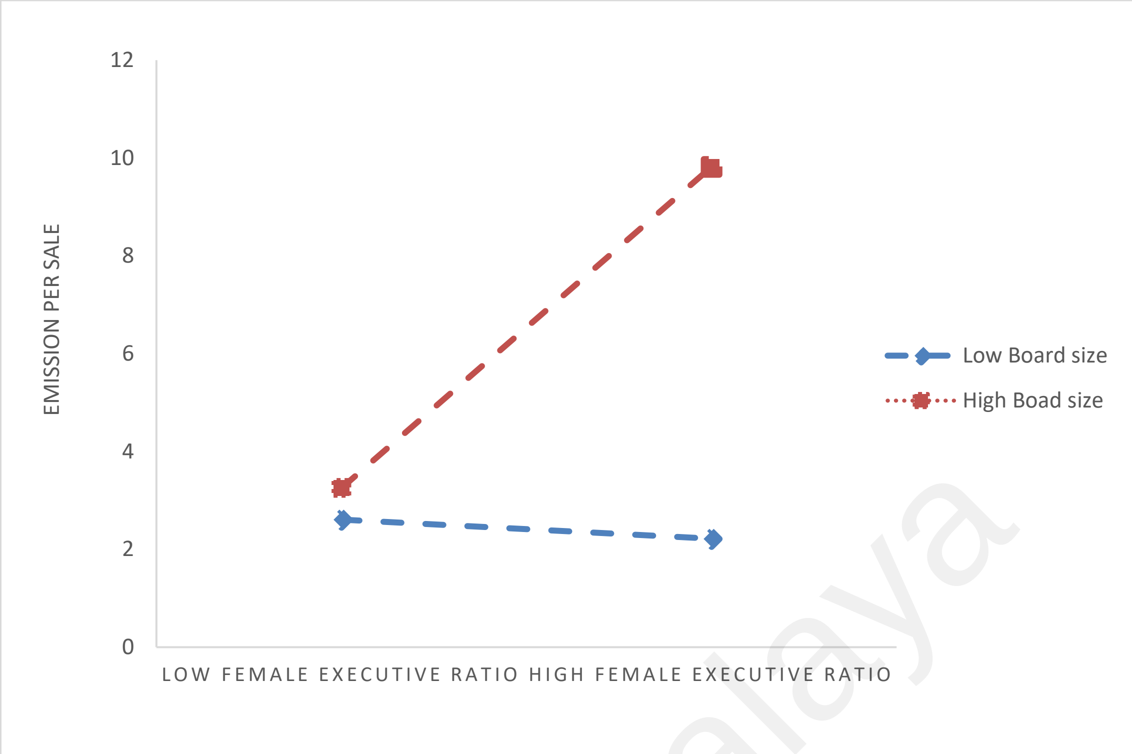

Figure 5. 4 Moderating of Board size on executive Gender diversity and Emission per sale(China)

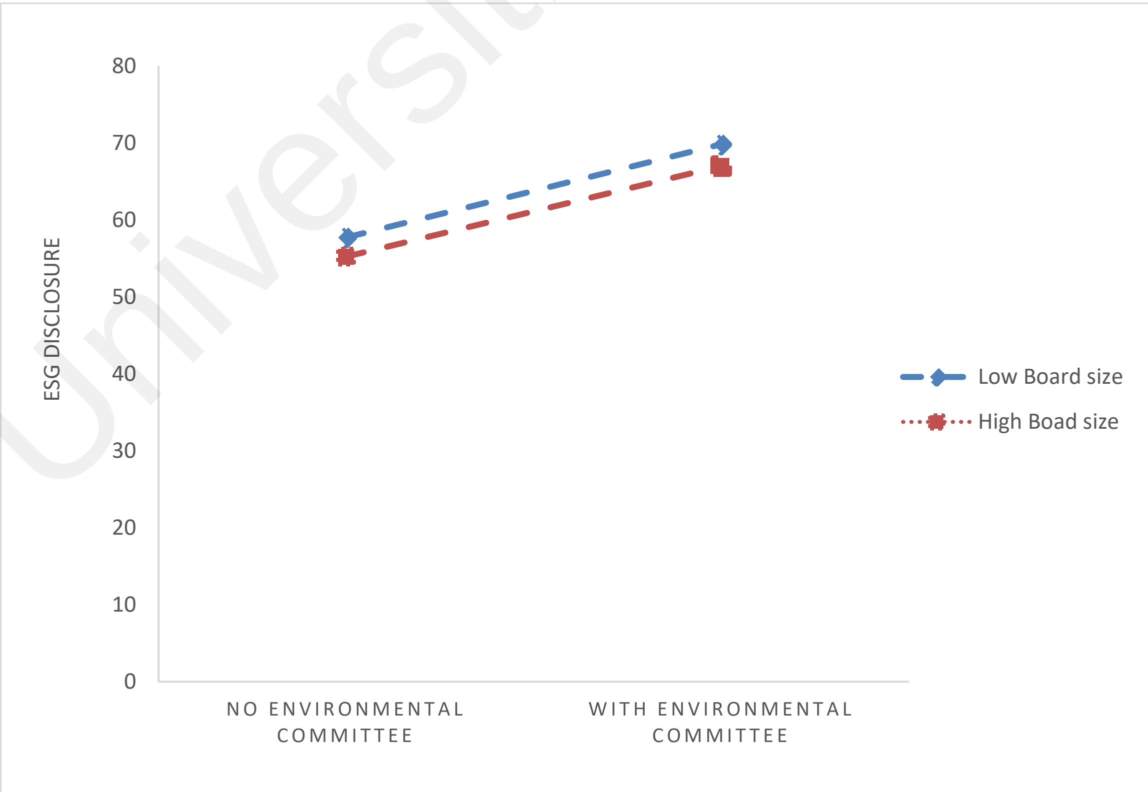

Figure 5. 5 Moderating of Board size on Environmental committee and ESG (China)

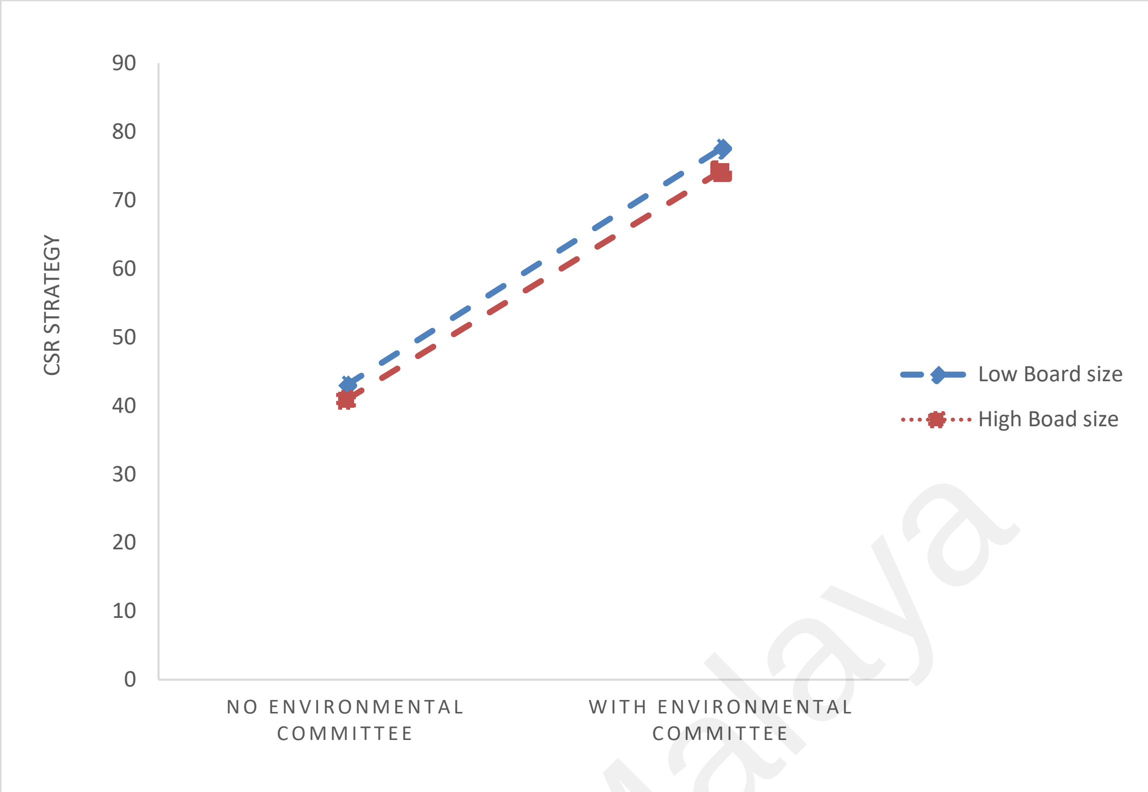

Figure 5. 6 Moderating of Board size on Environmental committee and Strategy (China)

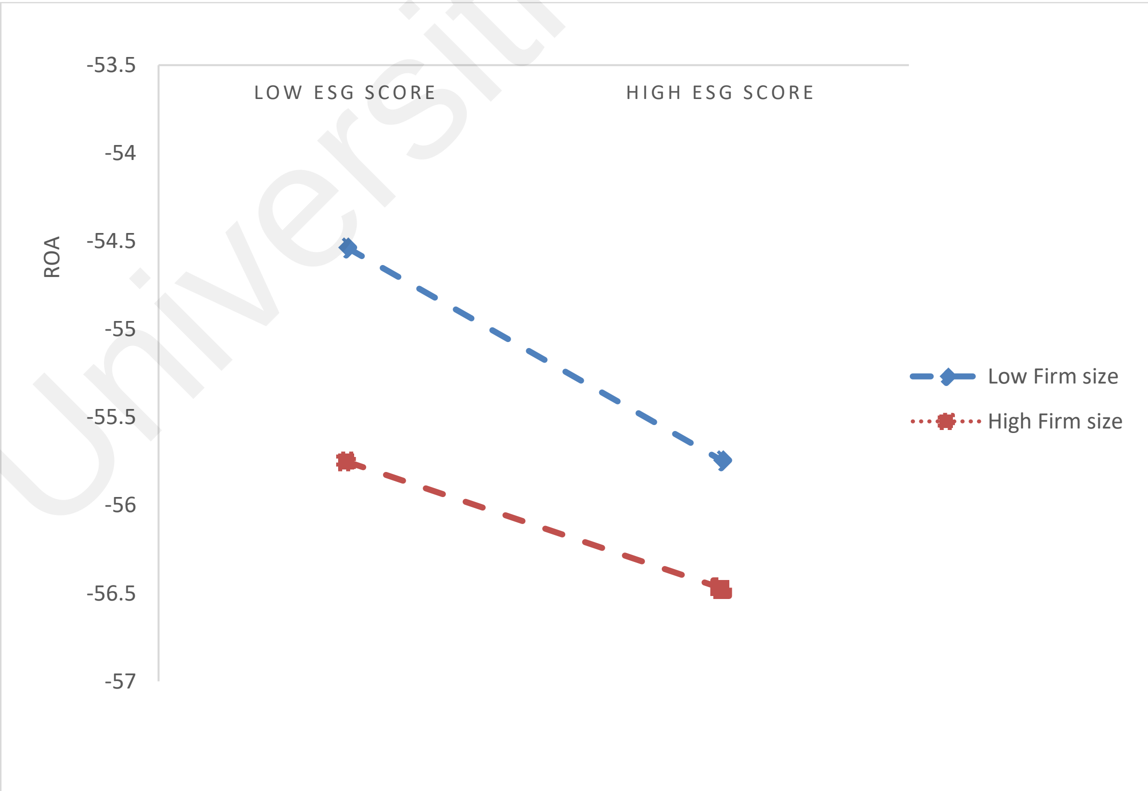

Figure 5. 7 Moderating of Firm size on ESG and ROA(China)

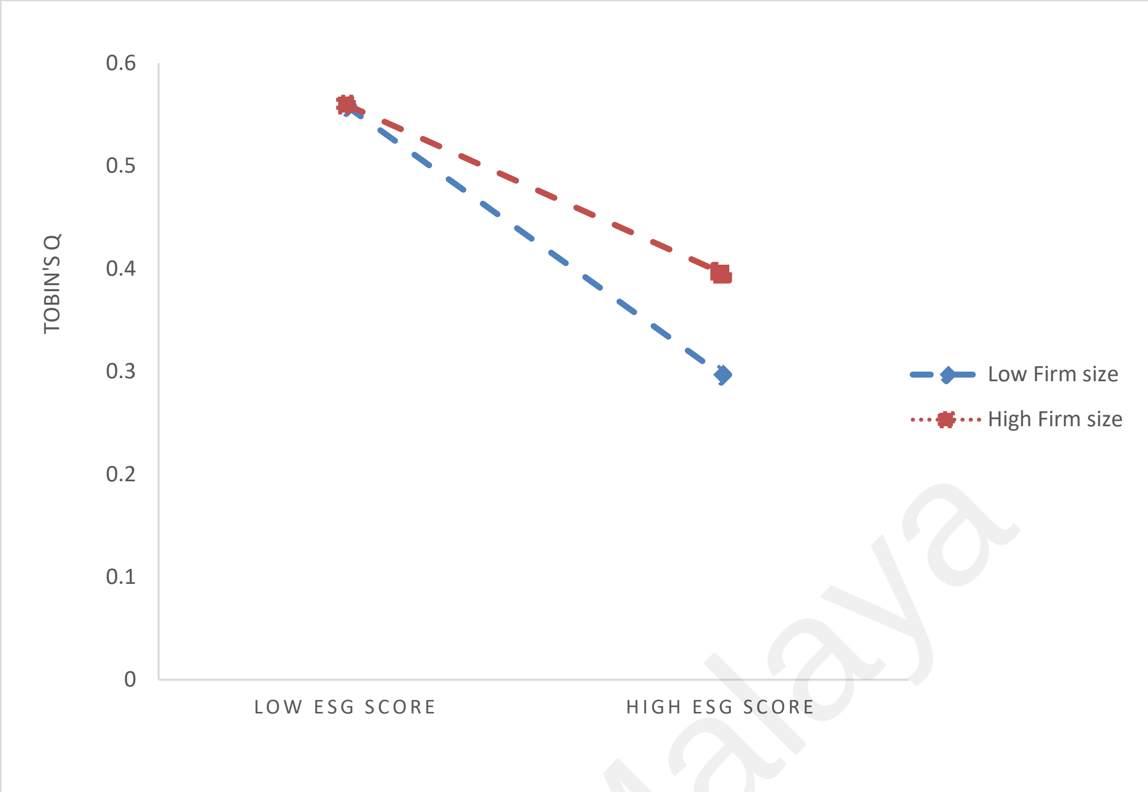

Figure 5. 8 Moderating of Firm size on ESG and Tobin's Q (China)

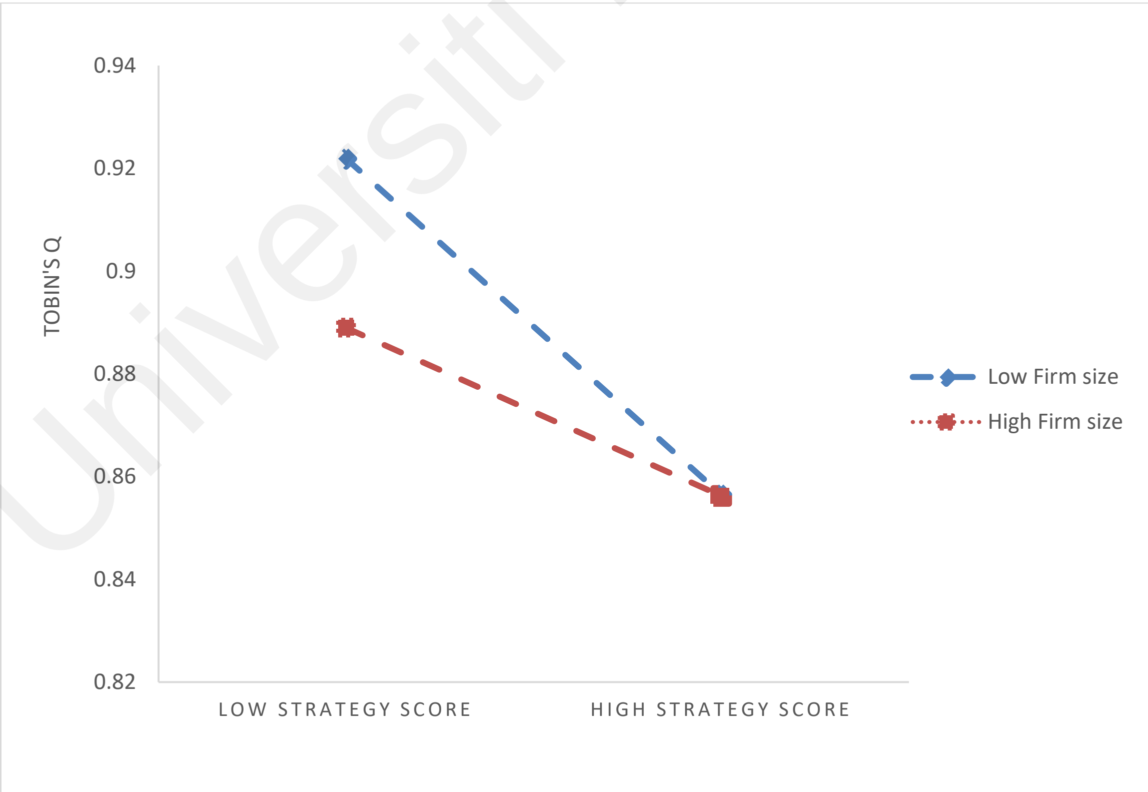

Figure 5. 9 Moderating of Firm size on Strategy and Tobin's Q (China)

From Figure 5.10, the results showed the hypothesis results from the Japanese firms. The result showed that in Japan, firms with a high percentage of female director and independence negatively impacted carbon emissions reduction; this ran counter to the previous research (Buss, 2005; L. Liao et al., 2015) and as a result H1a and H3a were rejected. The environmental committee did not improve the corporate carbon emissions reductions process, so H1c was not supported. The gender diversity, independent director and the establishment of the environmental committee cared more about corporate environmental and social disclosure, and increased the CSR strategies, therefore the hypotheses H2abc and H3abc was supported.

When the CEP–CFP nexus was examined in the short term, it was discovered that environmental performance positively impacted on ROA and Tobin's Q (see Figure 5.10). With an examination of the CEP–CFP nexus in the long term (see Figure 5.11), it was found that carbon emissions reduction was beneficial for increasing ROA and ROE in the long term. Environmental disclosure was beneficial for financial performance (ROA, ROE and Tobin's Q) both in the long term and the short term. The evidence from Japan also showed that corporate financial performance did not benefit from the high CSR strategies over the long term. The difference in the short-term result and long-term result from Japan showed that CSR strategy positively impacted financial performance (ROA and Tobin's Q) in the short term, however, the CSR strategy negatively impacted financial performance over the long term. Moreover, this study examined top managers on financial performance and it was observed that independent directors were beneficial for financial performance, which supported H8abc. The environment committee on the board benefited from increased assistance, and thereby improved ROA and Tobin's Q, which was supported by H9ac.

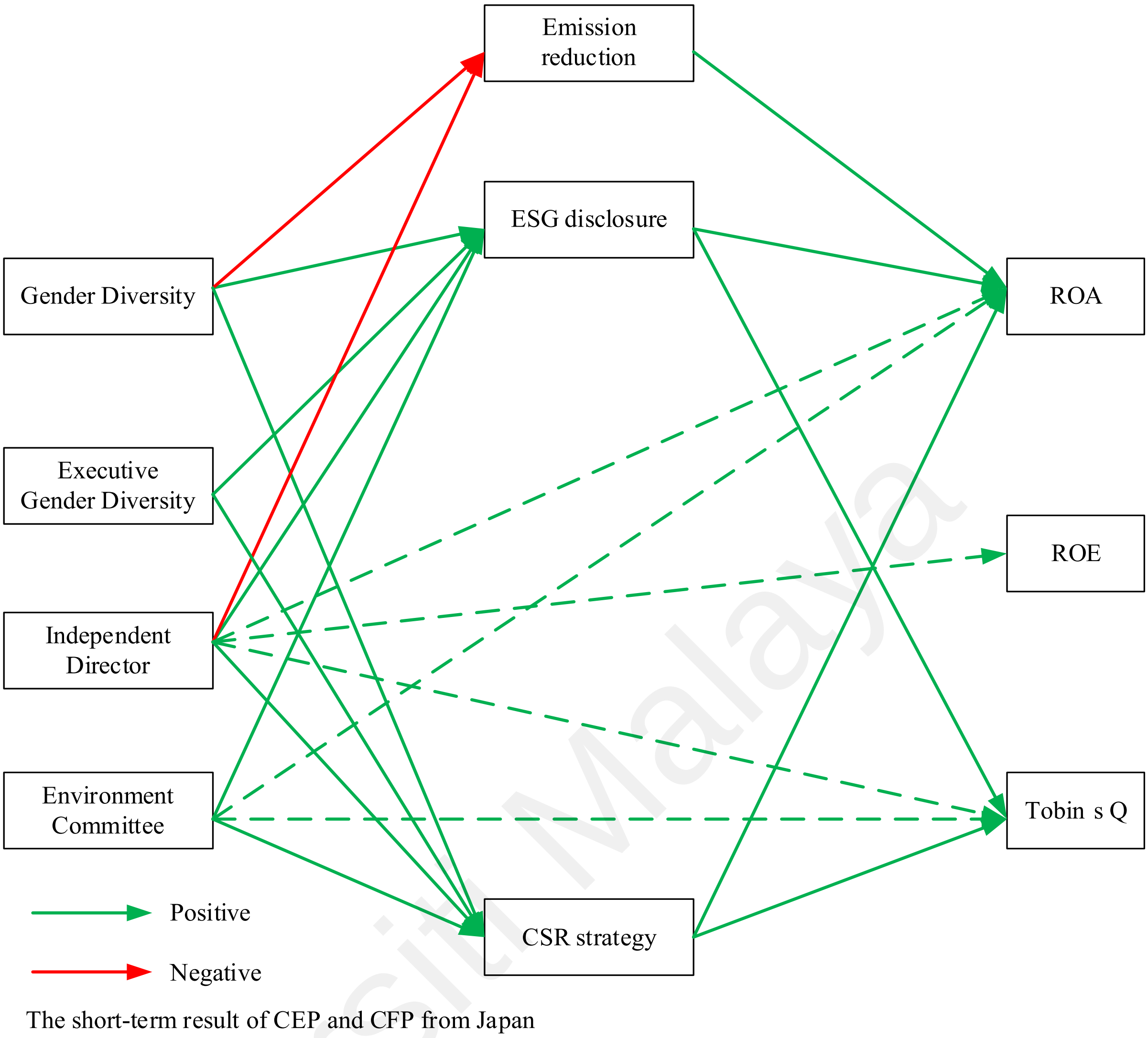

Figure 5. 10 The hypothesis result from Japan (short-term of CEP and CFP)

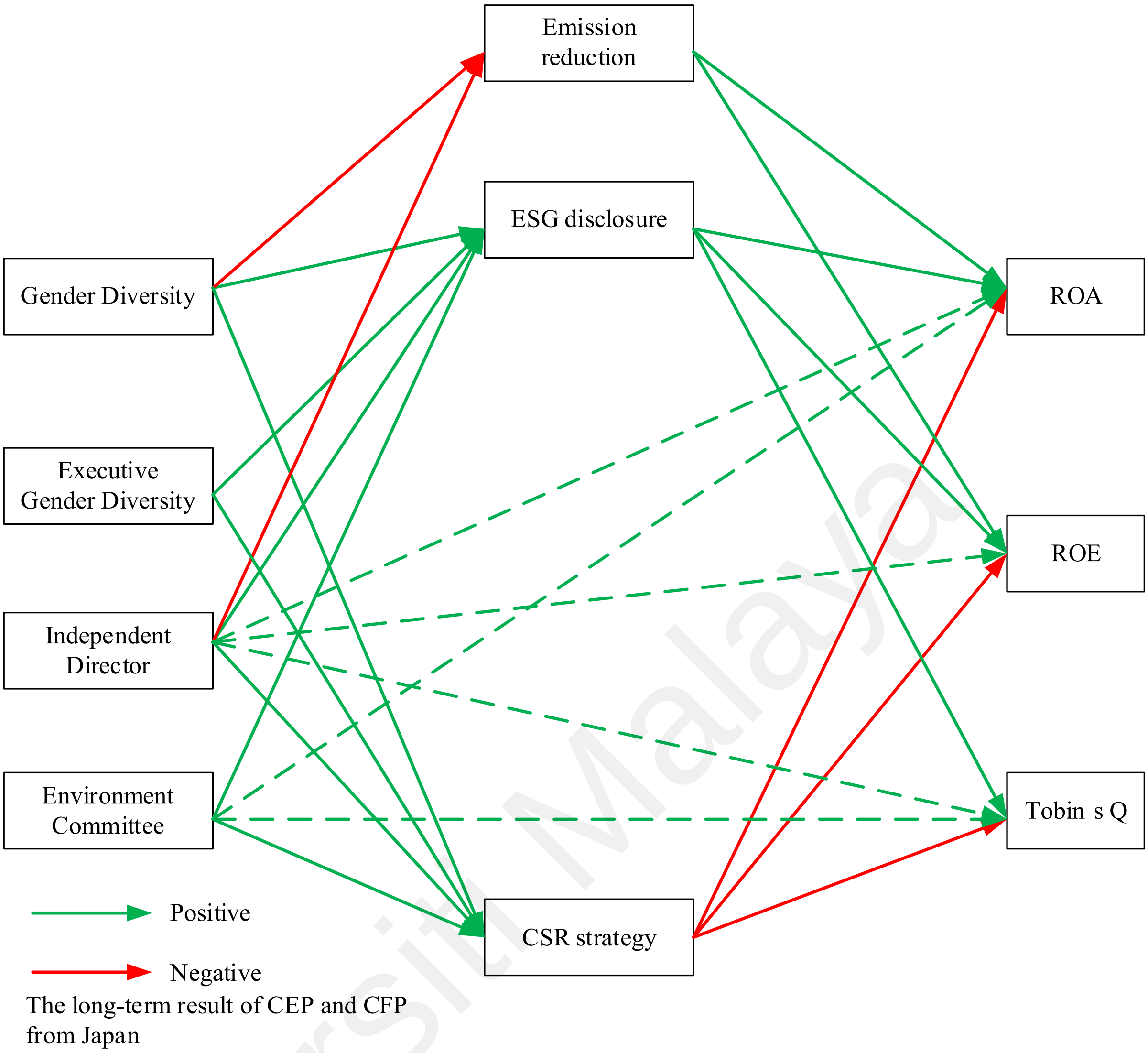

Figure 5. 11 The hypothesis result from Japan (long-term of CEP and CFP)

When the board size and firm size were included as moderating variables here in the research models, the results showed that board size only had a strengthening moderate impact on the positive relationship between independent director and ESG disclosure (see Figure 5.12), so H2bb was supported. The firm size strengthened the relationship between emissions per sale and financial performance (ROE and Tobin's Q) (see Figure 5.13 and 5.14) and as such, H4bb and H4cc were supported. Firm size also had a weakening moderate impact on ESG disclosure and CFP (ROA and Tobin's Q, see Figure 5.15 and 5.16), therefore H5aa and H5cc were supported. When board size was included as a moderating variable in the equation between TMT and CFP, there was not any evidence to support the moderating effect of board size on the relationship between top managers' characteristics and financial performance in Japan.

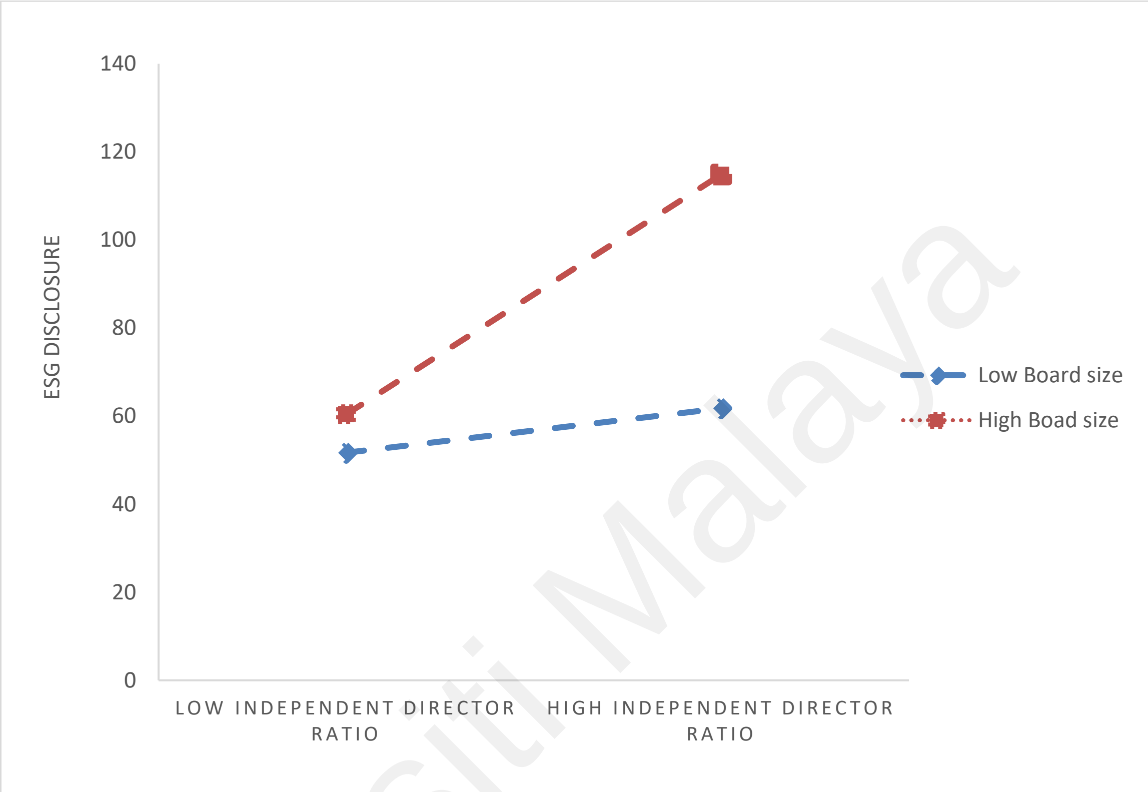

Figure 5. 12 Moderating of Board size on Independent director and ESG (Japan)

Figure 5. 13 Moderating of Firm size on Emission per sale and ROE (Japan)

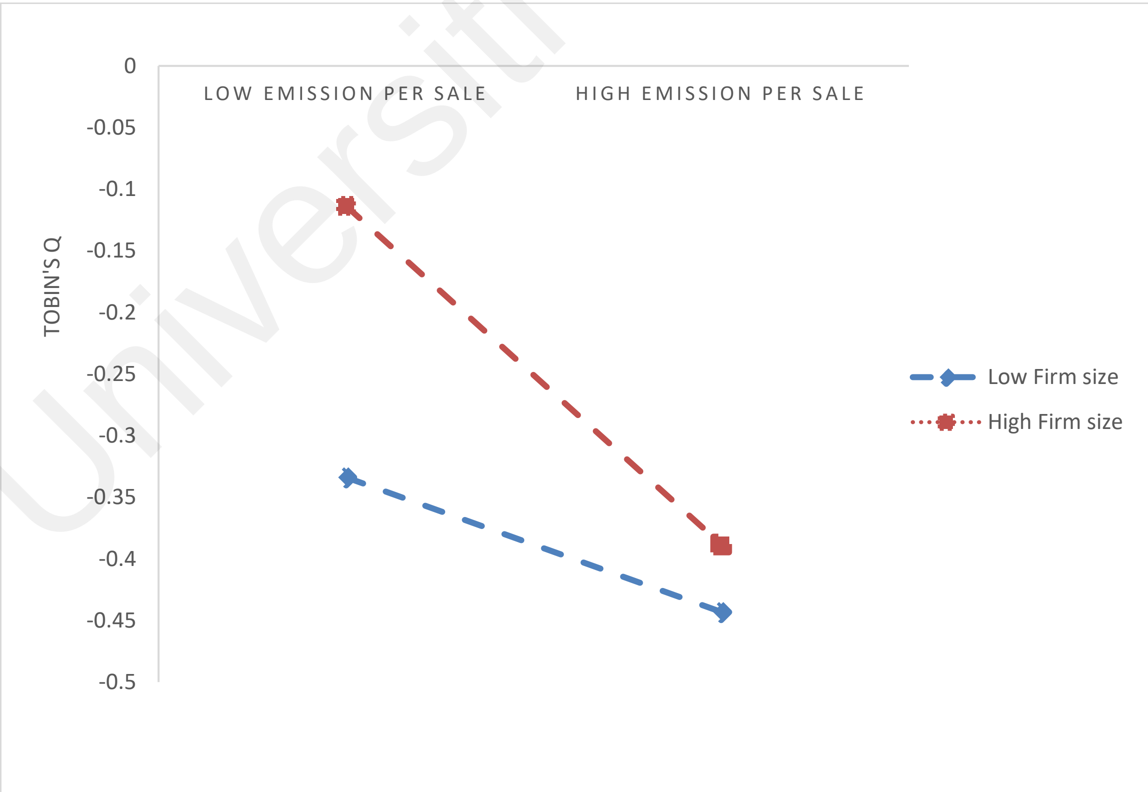

Figure 5. 14 Moderating of Firm size on Emission per sale and Tobin's Q (Japan)

Figure 5. 15 Moderating of Firm size on ESG and ROA (Japan)

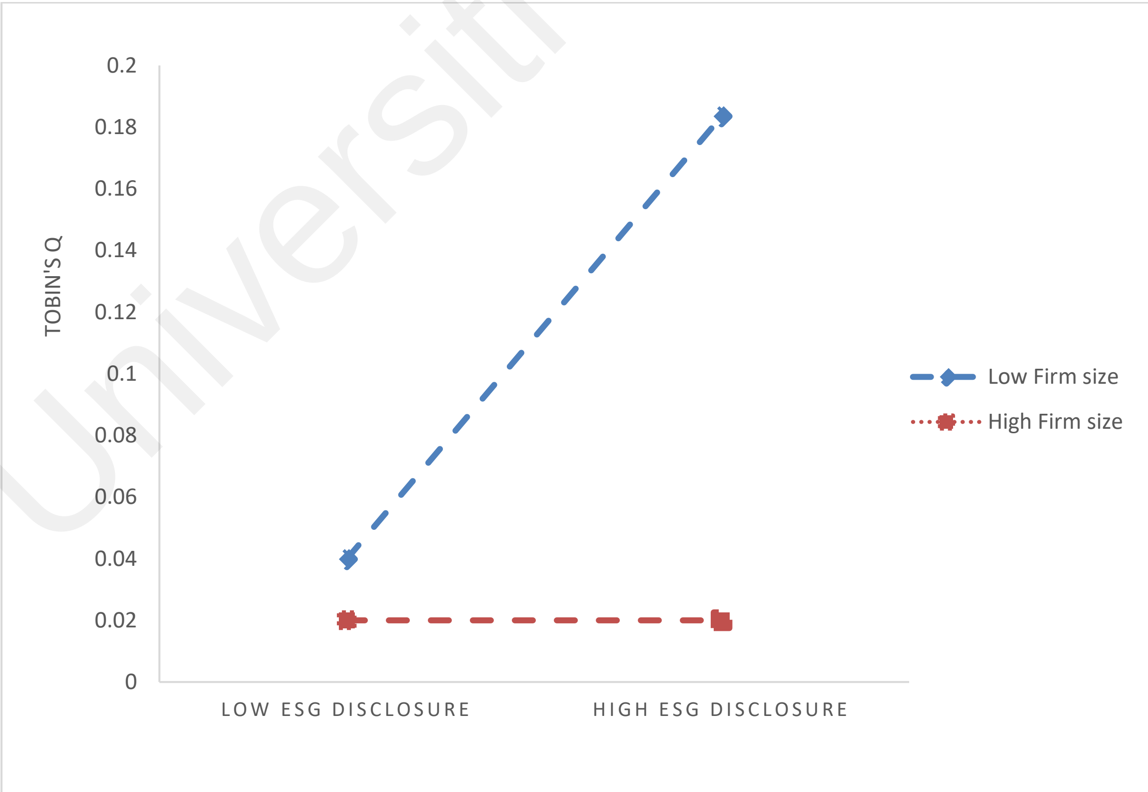

Figure 5. 16 Moderating of Firm size on ESG and Tobin's Q (Japan)

The top management, environmental performance and financial performance nexus from German firms are shown in Figure 5.17. We can see that the female directors and Environment committee do not have an impact on carbon reduction. The high percentage of independent directors on the board of German companies had a negative impact on the carbon emissions reduction. The high percentage of female director, independent director and the environmental committee on the board were more helpful in increasing the ESG disclosure and CSR strategies.

Compared with the short term and the long term results of CEP and CFP in the German samples, the results showed that corporate environmental performance did not impact financial performance in the short term (see Figure 5.17). Carbon emissions reduction was beneficial for ROA and Tobin's Q but not ROE in the long term. ESG disclosure was beneficial for financial performance (ROA, ROE and Tobin's Q) in the long term. Firm CSR performance was negative for ROA and Tobin's Q (see Figure 5.18). This study examined top managers' characteristics concerning financial performance. The results from Figure 5.17 showed that a high percentage of female director and executive female director positively increased ROA and Tobin's Q.

When the board size and firm size were included as moderating variables here in the applied research models, the results showed that board size had a weakening moderate impact on the positive relationship between gender diversity and ESG disclosure (see Figure 5.19), gender diversity and CSR strategy (see Figure 5.20).

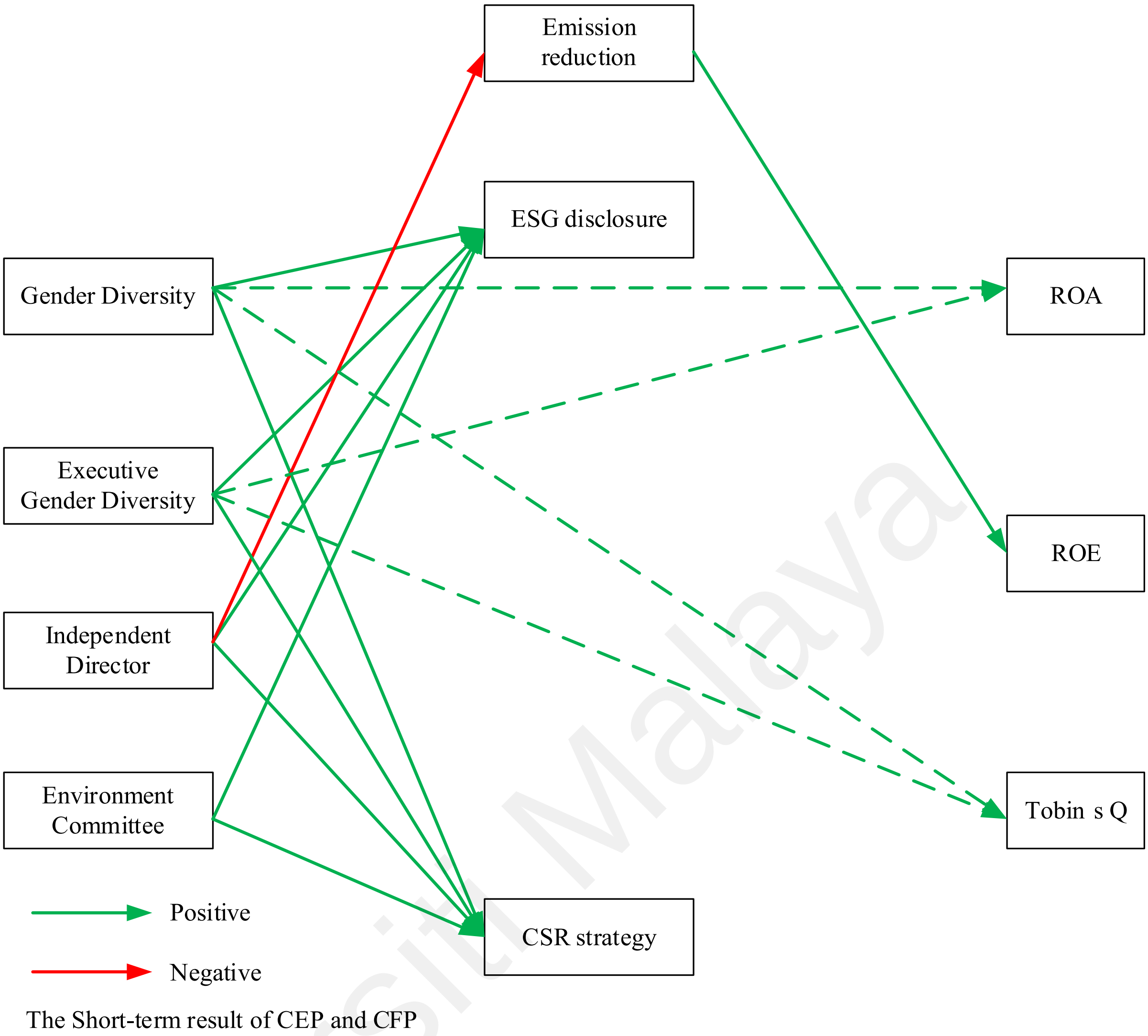

Figure 5. 17 The hypothesis result from Germany (short-term of CEP and CFP)

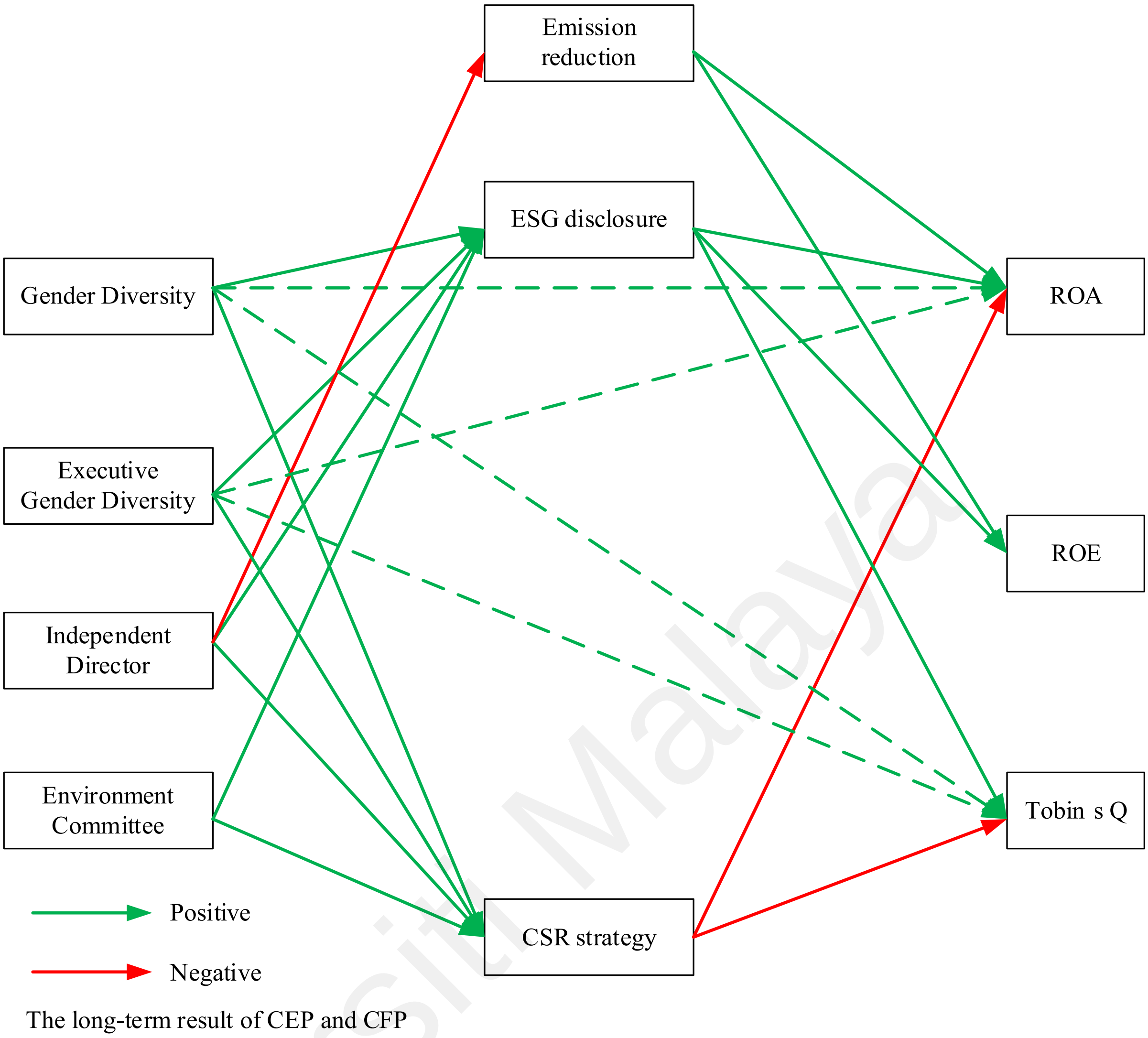

Figure 5. 18 The hypothesis result from Germany (long-term of CEP and CFP)

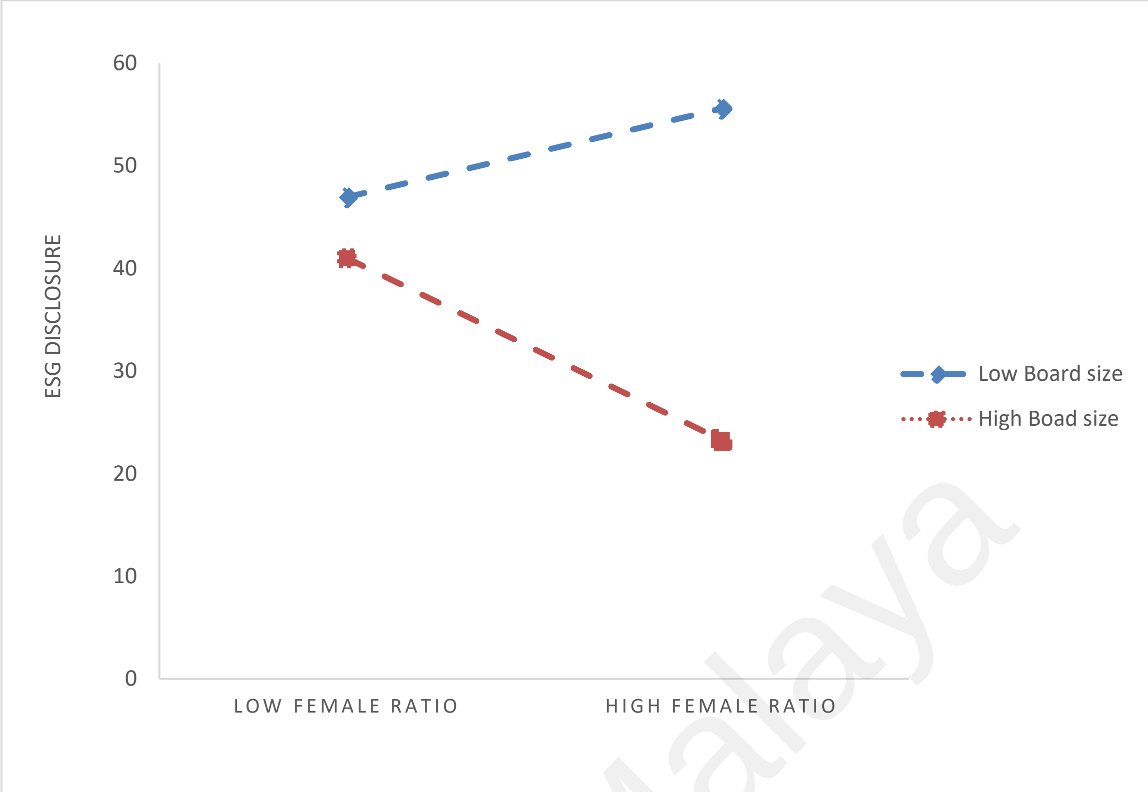

Figure 5. 19 Moderating of Board size on Female director and ESG (Germany)

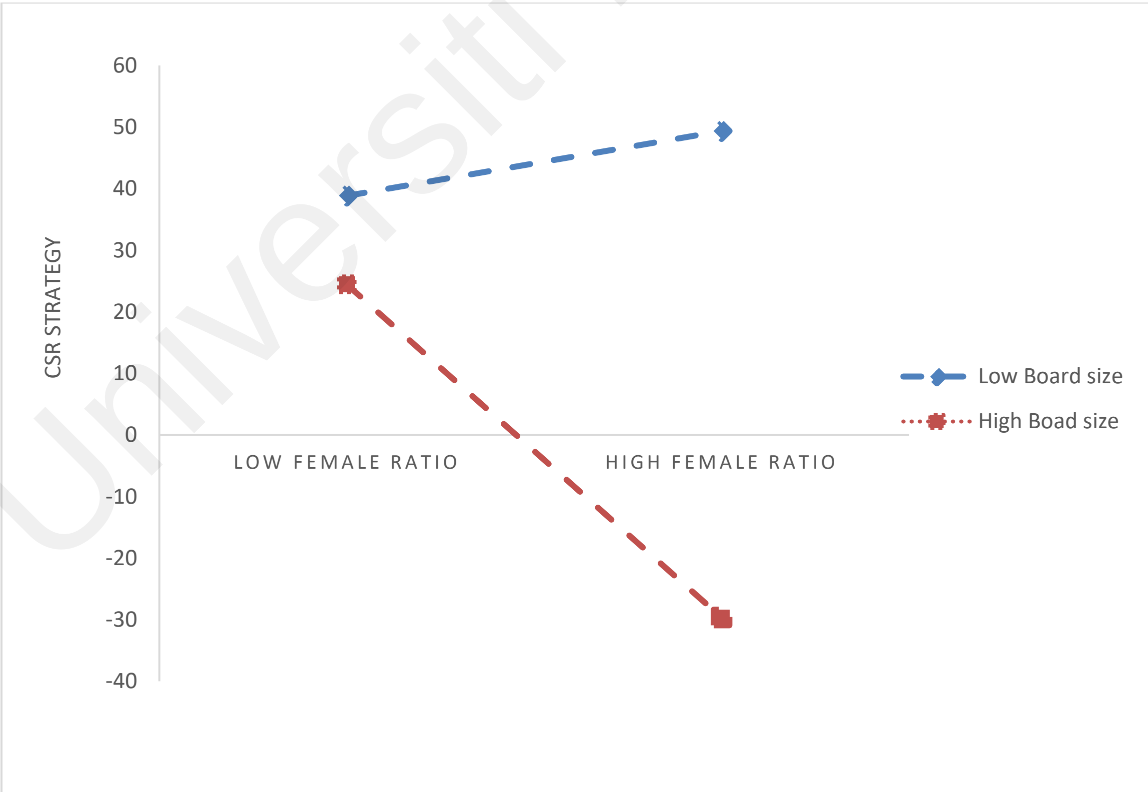

Figure 5. 20 Moderating of Board size on Female director and Strategy (Germany)

CHAPTER 6: CONCLUSION

6.1 Summary of study

As the corporate environmental issues are seriously in recent years and mitigate of climate change is a big goal all over the world, green economy and sustainable development are more and more important in recent years. The study reassessed the corporate top management governance, environmental progress and corporate financial performance of China, Japan and Germany by applying the panel data analysis. Chapter one of this study provided an overview of global environmental problems and the responsibility of the firms with regard to this issue; firms should focus attention on environmental protection and implement new business competition policies. Furthermore, this study outlined the vital, but overlooked research aspects of the problem statement and then formed the research questions and objectives. In this study we selected China, Japan and Germany based on the high GDP, high emissions and stable environmental policies of these three countries. In chapter 2, a comprehensive literature review on TMT characteristics, CEP and CFP, identified the potential research gap. In chapter 3, the economic techniques were introduced to this study, such as the data collection and cleaning, formation of the research model and a consequent detailed explanation. Chapter 4 of this study conducted fixed, random and OLS regression for the nexus between corporate top manager governance and environmental performance. Using economic techniques to examine the CEP and CFP nexus of the three countries under the FMOLS and ARDL models, causality was also employed to verify the results and included an examination of the CEP–CFP relationship of the different industries. This section concluded with an investigation of the nexus of top managers' characteristics and corporate financial performance utilizing both a fixed and random model. Chapter 5 of this study involved a discussion of the empirical results of panel data analysis and a compilation of conclusions.

The descriptive result showed that China's firm's environmental performance (ESG disclosure, CSR strategy and Environmental committee) was lower than the corporations in Japan and Germany. As highly developed countries, Japan and Germany have strict regulations and laws requiring corporations to consider environmental protection in business processes and products. As an emerging market, especially after joining the Paris Agreement (2015), the corporate environmental performance of China (ESG disclosure, CSR strategy and Environmental committee) has increased faster.

With a comparison of the results from China, Japan and Germany, we can see that top manager diversity (more female directors and independent directors and setting environmental committee) has been indicated to be more beneficial for company ESG disclosure and CSR strategies; these results have been supported with the upper echelons theory with the indication that with good managers on a board and working as a team it would be beneficial for environmental performance for disclosure and strategies. Because of the high emissions of Chinese companies, top managers would be better able to focus on outside stakeholders and this will thereby more obviously benefit the corporate emissions process, with the highly mature and advanced carbon reduction market, top managers would then be able to focus on relationships with outside stakeholders and then consequently not give further advantage to emission reductions. The other reason is that due to pressure from economics, firms in China are more reliant on fossil energy consumption and this could work out to be harmful for economics if a strict regulation for carbon emissions reduction becomes mandated.

In a comparison of the results of CEP and CFP relationships between Germany, Japan and China, it is possible to see that with the FMOLS and ARDL analyses of China, Japan, and German samples that the ESG disclosure benefited corporate financial performance (He et al., 2017; Konar & Cohen, 2001; Lang & Lundholm, 1993; Lee & Min, 2015;

Plumlee et al., 2015). The CSR strategy of the firm was harmful for the corporate financial performance (Cañón-de-Francia & Garcés-Ayerbe, 2009; Cordeiro & Sarkis, 1997; Muhammad et al., 2015). The consistent results from the different samples showed that firms will benefit from high financial performance with good environmental and social disclosure and the result will be better to understand that with a high disclosure of non-financial performance, outside stakeholders will be more satisfied and it will be better for firm financial performance. Our results prove that the stakeholder theory plays an important role in the corporate operation and development, and the most important thing is the non-financial information disclosure to outside stakeholders. The different results from these three countries showed that the emissions per sale reduction negatively impacted financial performance in China's companies; however, the emissions per sales reduction positively impacted the accounting based financial performance of firms from Japan and Germany in the long-term. This meant that firms in China were more reliant upon fossil energy consumption and it will be harmful for the economics if there is a strict regulation for carbon emissions reduction.

The result from China, Germany and Japan shows that emission per sale has a different impact on corporate financial performance. German and Japan as developed country have also been under the ruler of social and environmental responsibility for a long time. Firms in these two countries are also under the ETS system. The emission reduction means firms reduce fossil energy consumption and improve energy efficiency. So corporate in Japan and Germany are benefited from this process when minimising carbon emissions. China, as a developing country, without ETS, usually with crude production, and more emission indicate that the more products and more business, so the emission per sale positively impact corporate financial performance. Under the ETS system, it is easier for enterprises to increase carbon emission reduction for long-term benefits, which is also supported by the theoretical support of relevant stakeholders. But in China without the ETS system, companies do not put external stakeholders first but pursue more interests.

The difference in the emissions per sale influence on accounting based financial performance ROA was that the low emissions per sale industry usually provided products or services without fossil fuel consumption. The sales of the high emissions per sale industry were more reliant on the products by which production processes with high fossil energy consumption were required.

It is evident that with a high percentage of female directors and executive gender diversity in Germany, the female directors exhibit a greater role in financial performance and the results showed that female directors positively impacted financial performance in Germany, but this effect did not appear in China and Japan. This mean that with the high gender parity score of Germany, female directors are more functional as a upper echelons to increase corporate financial performance.

6.2 Implications for theory

This research is based on the upper echelons theory and stakeholder theory to check the environmental accounting progress. By examining the top management, environmental and financial performance of 621 firms from different areas, the conceptual model of this study contributes to the literature of top managers, corporate environmental performance and corporate financial performance.

Firstly, we investigated the nexus among the board manager characteristics and environmental performance, which by the predictions of the upper echelons theory (D. C. Hambrick & Mason, 1984; Donald C. Hambrick, 2007). This study argued that top managers on the board with female directors, independent directors, and the CSR committee would be more likely to be influential in improving corporate carbon emissions, information disclosure, and CSR strategies. The overall findings revealed that with gender diversity, Independence of the Board and the formation of an environmental committee on the board all lent to the enhancement of firm environmental and social disclosure and corporate CSR strategies and the findings were consistent with different samples, this study interpreted the findings according to the arguments of the upper echelons theory, in which top managers that work as a team will bring better firm performance. In addition, the stakeholder theory also aided in an explanation of our findings in that with the high pressure of outside stakeholders, the top manager should increase firm social responsibility and disclose more non-financial information. The upper echelons theory was not suitable for the carbon reduction of firms when the company's carbon reduction technology was highly mature; as carbon reduction was no longer the company's main goal. The evidence from the results was compared across the three countries. Germany and Japan have had a high degree of development of carbon reduction over the years. The carbon unit emissions are much lower than in China. Upper echelons performance is more important for carbon reduction in China's firm which has less developed emissions reduction levels, but this function did not appear in Germany and Japan, which have more advanced emissions reduction levels.

Secondly, this study investigated the corporate environmental and financial nexus and the results supported the stakeholder theory that firms with more ESG disclosure will generate more confidence in and more readily befriend outside stakeholders, it is beneficial for firm financial increases. This study investigated the top managers' effect on financial outcome and it was evident that in the context of when a company's carbon emissions reduction technology is immature, the top managers of the company forcibly adapt to the requirements of external stakeholders, which will thereby improve the company's environmental and social performance, but this brings with it sacrifice regarding some economic benefits. But this kind of economic sacrifice won't happen in some regions that have already achieved high levels of carbon reduction.

6.3 Implication for methodology

This study employed positivist approach to conduct the research by using the balance firm level data. A descriptive analysis to check data simply to find the different data characteristics of the three countries, correlation statistics and VIF test check the collinearity of the selected samples. Before choosing the suitable model (Fixed effect, Random effect and Ordinary Least Squares) of our equations, we employed the Hausman test to check the most suitable from fixed and random effects. We also included the breusch and pagan lagrangian multiplier (LM) test to check for the random effect model. In addition, this study used a modified Wald test to check heteroscedasticity in our models, and the Wooldridge test to check autocorrelation among variables.

The regression analysis in the corporate environmental and financial performance are usually tested by the short term in previous research. The shortage of short-term results is that, environmental performance function did not quickly appear in the financial outcome, and markets need time to react to companies' environmental policies. This study not only tested the firm environmental and economic nexus by fixed and random effect in the short term, we also included a Fully Modified Ordinary Least Squares (FMOLS) and a Regression and Autoregressive Distributed Lag (ARDL) to investigate the long-term nexus between environmental and financial performance. Before conducting the FMOLS and ARDL analyses, this study used a unit root test to check the stationary of our variable, a cointegration test to check the long-term relations among variables, and a Causality Test in the end to check the causality of variables.

In addition, the moderation and interaction variables were include in our models to check the moderating effect of board size of top managers and firm size of environmental performance. In this study we used the Centralized Processing Solution to avoid multicollinearity in interaction terms. During the process of the empirical test, this method proved to be useful in reducing the VIF value.

6.4 Implication for policy

Although the study is based on firm-level data, it also has benefits for national policymakers. Under the global carbon emissions reduction trend, every country has the responsibility and obligation to reduce carbon emissions. Industrial production is the primary source of carbon emissions. On the road to carbon emissions reduction, the country will formulate relevant laws to encourage enterprises to take the lead in implementing carbon emissions reduction. The priority of enterprises is to achieve profitability and development. Under such circumstances, how to effectively guide enterprises to reduce carbon emissions on their own is an issue that policymakers need to consider.

Based on the econometric results, the possibility of different causality in different countries has been proven. And with the different results from the different industries, it is reasonable to conclude that the policy-makers should care about the different areas and industries, as there are different critical aspects attributed to the different industries. The result showed the long-term impact of environmental performance on financial performance and the effect does not appear to be particularly fast as the results were indicated to be different in the short run and the long run, so in this case policy-makers should consider the factor that corporate CSR performance is not a phenomenon of instant returns. It will become a function in firms over a long process. The high emissions per sale industries are more sensitive regarding this policy. With the strict requirement of carbon reduction policies, firms that decrease carbon emissions reduce product output, which is economically harmful to the firm. The policy should encourage and help high emissions industries to improve the carbon reduction technologies. Advance technologies to improve the issues of carbon while simultaneously tackling the company's overall carbon emissions reduction could potentially also make the company's environmental performance and financial performance tend to have a positive relationship.

The female director, independent director and environmental committee are important for corporate environmental and social performance as they are more likely to increase corporate CSR strategies. Policymakers can improve the firm-level social and environmental performance by increasing the ratio of female directors, independent directors, and establishment of an environmental committee. However, governments should also consider the situation and economics when focusing on corporate environmental protection, especially in emerging markets, such as with reference to our result from China and how it showed that board diversity is beneficial for corporate environmental performance, yet at the same time, it can sacrifice financial performance.

The result of this study is also beneficial for firms, and some suggestions can be given to the company. The company's board characteristics of directors and management will impact the company's environmental decision-making and the company's social responsibility image. In the era of the green economy, enterprises should adjust their environmental policies according to national laws. Practical and positive environmental response policies will improve the company's image and bring positive financial effects.

The company's accounting system has not yet mandated that carbon emissions rights are reflected on the balance sheet as an asset item. As time goes on, global warming and carbon reduction voices have increased. However, carbon emissions rights have some attributes of assets. Perhaps in the future, carbon emissions rights will be an asset of the company and will be reflected on a company's balance sheet. Carbon emissions reduction will also be essential for enterprises to improve their advantages in future competition.

There are two parts that belong to environmental accounting (see Figure 2.3); one involves the environmental conversation cost, the other relates to the economic benefit from the environmental conversation activities. A firm should balance both of these to make an effective sustainable development system.

6.5 Limitations of study

In this study we ran the short-term and long-term regression on environmental performance and corporate financial performance, but we could not find a suitable method to test the long-term relationship between top managers' characteristics and environmental performance or the long-term relationship between top managers' characteristics and financial performance. This is because when we included the percentage of female directors as a variables in the FMOLS and ARDL models, there were errors for our model in the software and although we verified that our data included a significant number of zeros inside firms without any female directors. Hence, we ran both the fixed and random effect instead of the FMOLS and ARDL model.

In this study, we excluded missing data firms from our sample. In this way, the startups of recent years were no longer within our scope. This study only collected data from listed firms and companies that are more subject to social and government supervision. It cannot comprehensively reflect the environmental performance of all companies. Because of this, the study used short-panel data and only used a one year-period lag for the analysis. So, the long-term result also cannot reflect the long-term result beyond one year.

In conclusion, we selected the sample of the three countries, which make us care more about the comparison of these three samples in our study. However, the method of this study was not advanced and some new ideas of methods to test our data was not available for this study.

6.6 Future research

In future research, I will try to solve the methodological problem which I cannot test in the long-term relationship between top managers' characteristics and environmental performance, as well as the long-term relationship between top managers' characteristics and financial performance.

Future research could delve further into startup firms. Many high-tech companies have been established in recent years; they make a significant contribution to GDP but have not been included in our sample. A future study will expand the sample to both listed and private firms.

The other point I want to mention here is that from the result of this study, we can see that the results are different when different measurements are used; so, in the future we can make a more detailed division amongst each link of corporate environmental protection in order to analyze the roles and proportions of a company's finances.

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