Abstract

Supply Chain Structure, Nature of Financing, and the Determinants and Consequences of Supply Chain Disclosure – A Resource-Based View

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Abstract

Supply chain disruptions, such as the Covid-19 pandemic, have exposed the growing risks faced by supply chains. This is emphasised by the increasing globalisation and liberalisation of the global economy. Such complexities and uncertainties have heightened the need for transparency to mitigate the growing supply chain risks. The purpose of this thesis is to identify the structure of supply chains and examine the effects on important areas of risk. This includes examining the nature of supply chain financing and the nature, reasons, and effects of supply chain disclosures by companies to mitigate such a risk.

Firstly, motivated by the liquidity problems faced by supply chains because of recent disruptions, the thesis investigates the effect of supply chain dimensions on the capital structure of companies. Secondly, motivated by the lack of visibility and transparency in supply chains and emphasised by the effects of the Covid-19 pandemic, it examines the effect of supply chain structure on supply chain disclosures of companies (SCD). Thirdly, the thesis examines whether SCD reduces information asymmetry in capital markets by measuring its effects on the cost of equity and cost of debt.

Based on an exploratory sequential design methodology, interviews were first conducted with industry leaders to understand the dynamics and dimensions of the supply chain. These interviews, along with previous literature, were used to identify the supply chain dimensions. Four dimensions were identified. These were: (i) customer base, (ii) operating portfolio, (iii) environmental and (iv) social.

Secondly, archival data were used to examine the above stated objectives on a sample of companies listed on the United Kingdom (UK) FTSE All-Share index. The sample was limited to companies operating in the manufacturing, retail and primary industries because these industries have supply chain structures with identifiable supply chain dimensions. In

total, the sample has 80 companies with available data for a four-year period surrounding the Covid-19 years (2018 – 2022, with 320 firm-year observations).

The thesis uses the resource-based view (RBV) to identify and explain the dimensions of the supply chain, focussing on the four dimensions. The findings of the first part of the thesis revealed that the customer base dimension (measured via domestic sales) was positively and significantly associated with capital structure (book leverage). This finding suggests that a more domestic-oriented customer base will reduce the structural complexity of the supply chain and have a lower level of risk as opposed to those of global supply chains, and as a result be more favourable towards debt financing. Additional tests were performed to examine moderation effects of other variables and alternate measures of capital structure. The findings revealed some positive association with short-term debt financing. The inclination towards debt financing and short-term debt financing for supply chains could be explained by the nature of activities involved. Most of the supply chain activities are of an ongoing operational nature which is likely to be financed by debt financing arrangements rather than equity. Overall, the findings show that among the four supply chain dimensions the nature of the customer base is most likely to affect the financing of the supply chain.

The second part of the thesis examined the effects of the supply chain dimensions on the extent of SCD. The findings show an increase in SCD from pre-Covid levels and that there has been greater emphasis on messages communicating the operational supply chain information in the post-Covid years. The main findings show that customer base and social dimensions have a negative and significant relationship with SCD. The former relationship is due to a more localised customer base, resulting in the reduced complexity of supply chain operations and consequentially less SCD. A reason for the latter could be that social dimensions are enhanced through long-term collaborations with suppliers and SCD can threaten these collaborations through the disclosure of socially sensitive information. On the other hand, environmental dimensions had a positive and significant effect on SCD. This is

likely because of the increased public attention on climate-related issues and a growing trend towards regulatory requirements being imposed by policy makers.

The third part of the thesis examined the effect of SCD on the cost of equity and cost of debt. A non-significant, positive relationship was found against the cost of equity. This is likely due to the lack of relevant disclosures such as supply chain KPIs in current corporate reporting. In comparison, a significantly negative association was found with the cost of debt. This is because supply chain operations are predominantly financed with short-term debt financing, and debt providers would gain more certainty about corporate activities with higher SCD. Additional tests were conducted on the effect of supply chain messages and the effects of Covid on the cost of equity and cost of debt. The findings remained unchanged.

This thesis contributes to the nascent literature on supply chain accounting, especially in light of disruptions caused by the major supply chain disrupter, Covid-19. More specifically, the thesis constructs a framework identifying the dimensions of the supply chain and examining the effects of four of these dimensions on supply chain financing and SCD. It further constructs a comprehensive SCD index and operationalises the index by measuring the extent of SCD in annual reports. The thesis also examines the effects of SCD on the costs of financing. It creates an awareness among shareholders, managers and creditors of the importance of communicating companies' supply chain information. It also provides implications for companies to further communicate disclosures on their supply chain. Given that the scope of the current study was limited to examining annual reports, future research could investigate the dissemination of SCD through the more active communication channels to understand the dynamic nature of SCD. For better generalisation of the results across countries, studies should also investigate SCD in cross-country settings.

Keywords: Supply chain management; supply chain structure; supply chain disclosure; disclosure index; resource-based view; business model reporting;

Table of Contents

List of Figures

List of Tables

Research Output

The following research outputs have been published in academic journals and presented at conferences and have been peer reviewed.

Publications:

Velayutham, A., Rahman, A. R., Narayan, A., Wang, M. (2021). Pandemic turned into pandemonium: the effect on supply chains and the role of accounting information, *Accounting, Auditing and Accountability Journal* 34(6)

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Velayutham, A., Rahman, A., Narayan, A. Wang, B. *The role of supply chain information in business model disclosures – through a resource-based view*. Accounting & Finance Workshop 2023 (Online)

Velayutham, A., Rahman, A., Narayan, A. Wang, B. *Transitioning towards circular business models – the role of supply chains and accounting.* New Zealand Management Accounting (NZMA) Conference 2022.

Velayutham, A., Rahman, A., Narayan, A. Wang, B. *Transitioning towards circular business models – the role of supply chains and accounting.* European Research Seminar (ERS) Conference 2022 (Online)

Velayutham, A., Rahman, A., Narayan, A. Wang, B. *The role of supply chain information in business model disclosures – through a resource-based view*. British Accounting and Finance Association (BAFA) Annual Conference 2022 (Online)

Velayutham, A., Rahman, A., Narayan, A., Wang, M. *Pandemic turned into pandemonium: the effect on supply chains and the role of accounting information.* Auckland Regional Accounting Conference 2020.

List of Abbreviations

BM	- Business Model
Covid-19	- Coronavirus 2019
CRM	- Customer Relationship Management
CSCM	- Circular Supply Chain Management
ERP	- Enterprise Resource Planning
FPH	- Fisher and Paykel Healthcare
FSC	- Financial Supply Chain
FTSE	- Financial Times Stock Exchange
FY	- Financial Year
GFC	- Global Financial Crisis
GSCM	- Green Supply Chain Management
IT	- Information Technology
KPI	- Key Performance Indicator
NPD	- New Product Development
NGO	- Non Governmental Organisation
PAT	- Principal Agent Theory
R&D	- Research and Development
RBV	- Resource-Based View
S&OP	- Sales and Operations Planning
SEC	- Securities Exchange Commission
SCD	- Supply Chain Disclosure
SCF	- Supply Chain Finance
SCM	- Supply Chain Management
SCOR	- Supply Chain Operations Reference
SSCM	- Sustainable Supply Chain Management
TA	- Thematic Analysis
TCE	- Transaction Cost Economics
UK	- United Kingdom
US	- United States
VIF	- Variance Inflation Factor

Attestation of Authorship

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgments), nor used artificial intelligence tools or generative artificial intelligence tools (unless it is clearly stated, and referenced, along with the purpose of use), nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning.

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Chapter One: Introduction

1.1 Introduction

The focus of this thesis is to investigate the extent of supply chain disclosure (SCD) in company annual reports and the determinants and consequences of such disclosure. This thesis is motivated by recent disruptions to company supply chains, most notably the coronavirus (Covid-19) pandemic, which has resulted in liquidity problems, as well as visibility and transparency concerns in supply chains (Dai et al., 2020). This poses serious concerns given that supply chains are important in sustaining a company's competitive advantage (Sharifi et al., 2006). Prior to outlining the focus of the thesis, this chapter provides a background to the supply chain environment, defining the concepts of supply chain and supply chain management (SCM). This section briefly discusses the evolution of the supply chain, which leads to the focus of the thesis and identifies the research questions to be explored. Subsequently, this chapter summarises the main findings of the research questions. Finally, it discusses the scope of the research and provides an outline of the remainder of the thesis.

1.2 Aim of the study

In investigating the extent of SCD in company annual reports and the determinants and consequences of such disclosure, I divide this thesis into three research questions. Firstly, as motivated by the liquidity problems faced by supply chains, the thesis investigates the effect of supply chain structure on the capital structure of the company. Secondly, the thesis examines the effect of supply chain structural determinants on the communication of supply chain structure through SCD. This is motivated by the lack of visibility and transparency in

supply chains and emphasised by the effects of the coronavirus (Covid) pandemic. The final research question is motivated by whether the communication of supply chain structure through SCD is transparent in informing company risks. It investigates the effect of SCD on information asymmetry, through the effect on the cost of equity and cost of debt. These three research questions form three separate but interlinked studies in this thesis.

In conducting the three separate but interlinked studies, I first review the structure of the supply chain. This is to identify the resources of the supply chain that provide the firm a competitive advantage. In doing so, I use the resource-based view (RBV) theory. In identifying these resources, the thesis outlines that the structure of the supply chain comprises multiple flows and processes (Lockamy & McCormack, 2004; Pfohl & Gomm, 2009). From this foundation, the resources identified will henceforth be referred to as supply chain dimensions. From the identification of these dimensions, four of these dimensions are used to measure the structure of the supply chain; (i) customer base, (ii) operating portfolio, (iii) environmental dimensions and (iv) social dimensions.

These four dimensions of the supply chain are subsequently examined against the capital structure of the firm, thereby reflecting on the first research question. In the second research question, these same four supply chain dimensions are examined against SCD. SCD reflects the multiple flows, processes and dimensions of supply chain structure identified previously and is measured via the development of an SCD index. In this way, SCD represents the communication of supply chain structure. Following this, the study examines the effect of SCD and the communication of supply chain structure on information asymmetry. This is done by examining the effect of such disclosure on the risk premium required by shareholders and creditors, and consequentially the effect on the cost of equity and cost of debt.

1.3 Background

This subsection provides an overview of the supply chain and the evolution of the supply chain in the last few decades. In investigating the structure of the supply chain and the dimensions within, the supply chain can be defined as a network of organisations and entities involved in the upstream and downstream activities that create value for the customer (Mentzer et al., 2001). As such, a simplified supply chain includes (i) an upstream supplier, (ii) the focal company (henceforth referred to as the firm/company) and (iii) a downstream customer. These parties are involved in upstream activities (e.g. sourcing of raw materials, production of products) and downstream activities (e.g. distribution of products) to the final customer.

This network of organisations and the activities involved are increasingly being recognised as an integral part of company operations and activities to create value (Sharifi et al., 2006). As a result, this has seen the management of this network of organisations and the activities they engage in grow in importance. This can be encapsulated through the definition of SCM. SCM can be defined as the planning and management of all activities within procurement, production, logistics and distribution along with the collaboration and coordination of these activities with upstream and downstream entities (Council of Supply Chain Management Council of Supply Chain Management Professionals, 2021).

Tan (2001) tracks the evolution of SCM throughout the decades from the 1950s to the 21st century. They note that the traditional concept of SCM displayed characteristics of mass production and in-house production while holding huge investments in work-in-process inventory. The 21st century saw the liberalisation of the global economy and this resulted in increased international competition (Free & Hecimovic, 2020). While this opened up companies to global markets and customers, companies also faced pressures, including product customisation and shorter lead times (Sharifi et al., 2006). To cope with the pressures

from an increasingly liberalised global economy, supply chains have tended to adopt outsourcing practices and lean practices (Christopher, 2012). This resulted in companies forming cooperative and strategic relationships with suppliers, outsourcing partners and customers (Sharifi et al., 2006). Alongside these changes, environmental and sustainability issues within the supply chain have also gained more media attention. This has resulted in companies being held accountable for such issues within their supply chains (Birkey et al., 2018; Srivastava, 2007).

More recently, the effects of the Global Financial Crisis (GFC) in 2008 and the Covid pandemic in 2019 have further affected companies' supply chains. Liebl et al. (2016) noted that the GFC affected the ability of downstream customers to pay their suppliers which subsequently resulted in the bankruptcy of suppliers. Literature has also shown that the emergence of the Covid-19 pandemic affected businesses and their supply chains at the firm, national and international levels. Dai et al. (2020) noted that the pandemic exposed a lack of transparency and planning in supply chains. Baker McKenzie (2020) further mentioned that the pandemic highlighted the lack of diversification in sourcing strategies and the importance of risk management. At the operational level, Mickle and Kubota (2020) noted analysts' and investors' concerns over Apple's over-reliance on Foxconn. In sum, the global expansion of supply chains in the 21st century and the effects of the GFC and the Covid pandemic have resulted in changes to the structure of the supply chain. This has in turn shed light on the changes in the dimensions of the supply chain.

Outlining the structure of the supply chain, Pfohl and Gomm (2009) emphasised that the supply chain comprises various flows through these supply chain activities. These include the (i) flow of materials, (ii) flow of information and (iii) flow of financing. The primary flow within the supply chain, flow of materials, can be further divided into different processes, as outlined in the supply chain operations reference (SCOR) framework. The SCOR 4.0 as

proposed by Lockamy and McCormack (2004) divides these processes into (i) plan, (ii) source, (iii) make and (iv) deliver. This has since been updated to SCOR 12.0 which additionally includes the processes of (v) return and (vi) enable (White, 2021). Within these processes there are further dimensions that will be explained later. Alongside the flow of materials are the flow of information and flow of financing, which respectively comprise the transfer of information and finances between entities of the supply chain. These three flows give a basic understanding of the structure of the supply chain and will be elaborated on in the following chapters. However, it is sufficient to problematise and motivate the three research questions in the following subsection.

1.4 Problematisation of research questions

In the following subsection, I outline the rationale behind investigating the three research questions briefly outlined above.

As mentioned previously, the supply chain has undergone significant changes since the start of the 21st century, with the effects of globalisation, the GFC and the Covid pandemic. This has changed the structure of the supply chain and highlighted the importance of different dimensions within it. Further to this, the GFC and the Covid pandemic have exposed liquidity problems in supply chains (Mefford, 2009). Liebl et al. (2016) noted this by illustrating the bankruptcy of suppliers due to late payment from the downstream supply chain during the GFC. This is a problem for supply chains moving forward as the increasing frequency and magnitude of supply chain disruptions will cause further liquidity problems (Velayutham et al., 2021) and heighten the importance of efficiently utilising supply chain resources.

Such liquidity problems have seen the rise and growing importance of supply chain financing (SCF) (Mefford, 2009). It will also increase the importance of aligning physical supply chain resources with financial resources and matching cash inflows with cash

outflows (Silvestro & Lustrato, 2014). Thus, matching the structural dimensions of the supply chain with external financing resources — debt and equity financing, as well as internal financing — is of increasing importance. In light of this, I investigate the effect of the above-mentioned supply chain dimensions: (i) customer base, (ii) operating portfolio, (iii) environmental dimensions and (iv) social dimensions, against capital structure (measured via book leverage). The first research question is as follows.

RQ 1: *What is the effect of the dimensions of supply chain structure on the capital structure (book leverage) of the company?*

In addition to the growing liquidity problems faced by supply chains, Dai et al. (2020) also note that the Covid pandemic has exposed a lack of transparency within supply chains. With the growing importance of supply chains to company success and the increasing frequency and magnitude of supply chain disruptions, Moss Adams (2020b) raise the importance of disclosing supply chain information in going concern disclosures. Further to this, Deegan and Islam (2010), Bateman and Bonanni (2019) and Bayne et al. (2022) mention that there are growing calls from shareholders to disclose supply chain information, including social and sustainability practices.

However, Arvidsson (2011) and Bayne and Wee (2019) note that there is a lack of KPIs pertaining to the supply chain. This is a problem as, while there are growing calls for SCD, current practice suggests that there is a lack of disclosure relating to the communication of supply chain structural dimensions. This study helps address this problem by investigating how the dimensions of (i) customer base, (ii) operating portfolio, (iii) environmental dimensions and (iv) social dimensions affect the communication of supply chain dimensions via SCD. Given this, the second research question is as follows.

RQ2: *What is the effect of the dimensions of supply chain structure on the extent of supply chain disclosure (SCD) communicated by the company.*

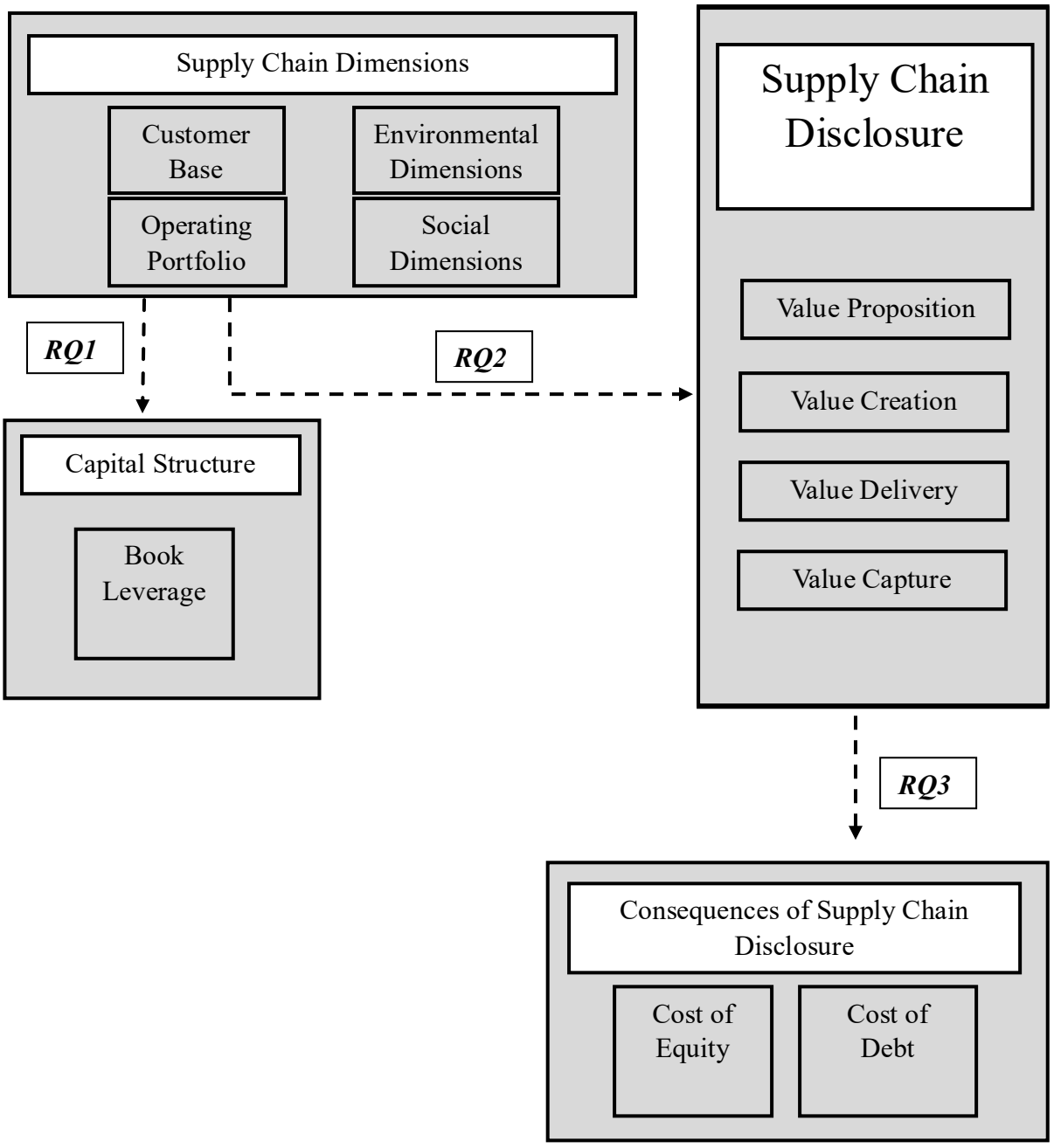
Moving onto the third and final question, the supply chain, as an integral component of company success, is important to both shareholders and debtholders. This is outlined by Bayne et al. (2022) who previously mentioned that there have been calls for greater SCD from shareholders. Adding to this, Hendricks and Singhal (2005b, 2008) noted that supply chain disruptions have negative effects on stock price performance and shareholder value. In the context of debtholders, Bradley and Roberts (2015) note that the supply chain is important to company value creation and consequently important in evaluating the company's ability to repay.

Previous research has mentioned that shareholders and debtholders see the supply chain as an important part of company success, however, do they value the communication of supply chain dimensions via SCD. In addressing this question, this study examines whether the communication of supply chain structure through SCD influences information asymmetry through the cost of equity and cost of debt, respectively. Hence, I investigate the following.

RQ3: *What is the effect of supply chain disclosures (SCD) of the company on the cost of equity and cost of debt?*

This subsection addresses the motivation, and problematises the three research questions through the central theme of the dimensions of supply chain structure. Given this, *Figure 1-1* summarises the three research questions.

Figure 1-1: *Summary of Research Questions*



1.5 Summary of main research findings

This subsection addresses the findings of the three research questions comprising this thesis. Using the RBV, an in-depth review of the structure of the supply chain was conducted. An examination of previous literature found that the structure of the supply chain comprised the flow of materials, flow of information and flow of financing (Pfohl & Gomm, 2009). The flow of materials can be further divided into the processes of (i) plan, (ii) source, (iii) make and (iv) deliver (Lockamy & McCormack, 2004). From this, four dimensions of (i) customer base, (ii) operating portfolio, (iii) environmental dimensions and (iv) social dimensions were used to proxy for the structure of the supply chain.

The first research question examined the effect of the four supply chain dimensions on capital structure. In doing so, I measured capital structure via the proportion of debt financing to total assets, also known as book leverage. The main findings found a positive and significant relationship between customer base and book leverage. Reasoning from this, a more domestic-oriented customer base will reduce the structural complexity of the supply chain, and as a result be more favourable towards debt financing. Additionally, a more domestic-oriented customer base will localise the downstream supply chain, thereby reducing the vulnerabilities of the supply chain to global disruptions. This will reduce the uncertainty in the supply chain and favour debt financing. However, the remaining three dimensions of supply chain structure — (i) operating portfolio, (ii) environmental dimensions and (iii) social dimensions — were found to be not significant with book leverage.

Additional tests were conducted. This included the interaction of (i) environmental dimensions and (ii) social dimensions with (a) customer base and (b) operating portfolio against book leverage. Further to this, I investigated the moderating effects of the flow of financing. This included the interaction of (i) asset turnover, (ii) inventory turnover and (iii) cash conversion cycle (CCC) with (a) customer base and (b) operating portfolio against book

leverage. In all, the findings showed some significance to the moderating relationships. Overall, the moderation tests showed that environmental and social dimensions as well as the flow of financing need to be integrated with the dimensions reflecting the flow of materials. This integration enhances the efficient and effective use of supply chain resources and promotes the dynamisms within the supply chain. I also employed an alternative dependent variable of capital structure — short-term financing — measuring the proportion of short-term financing to total assets. The findings of the four supply chain dimensions on short-term financing showed that only customer base and environmental dimensions had significant effects.

The second question examined the effect of the same four supply chain dimensions, mentioned above, on the extent of SCD in company annual reports. Overall, the findings noted a significantly negative relationship between (i) customer base and (ii) social dimensions against SCD. Further to this, a significantly positive relationship was found between environmental dimensions and SCD. However, no relationship was found between operating portfolio and SCD. The negative relationship between customer base and SCD is likely owing to the reduced structural complexity of a more localised customer base (Cahan et al., 2005). This will reduce the costs associated with monitoring the operations and dimensions of the supply chain. This will lead to less information asymmetry between stakeholders and the company, reducing the need to communicate the operations and dimensions of the supply chain. Secondly, Egels-Zandén et al. (2015) and Andersen and Skjoett-Larsen (2009) provide a reason for the negative relationship between social dimensions and SCD. They note that enhancing social responsibility in supply chains requires long-term collaborations with suppliers. However, disclosing supply chain practices (including supplier practices) threatens such collaborations with suppliers. Hence, to safeguard such collaborations and enhance social responsibility, companies will disclose

fewer supply chain practices. Explaining the significant positive relationship between environmental dimensions and SCD, I note that the integration of environmental dimensions in the supply chain can lead to increased structural complexity of the supply chain (Macchion et al., 2020). This leads to increased monitoring costs and greater information asymmetry. As such, there will be an increased need to communicate the operations and dimensions of the supply chain via SCD.

The third research question subsequently examined the effect of communicating the operations and dimensions of the supply chain via SCD on the cost of equity and cost of debt. This was tested to see if the external communication of supply chain dimensions, through SCD, is informative of supply chain and company risks, thereby reducing information asymmetry. The findings revealed that the relationship between SCD and the cost of equity is statistically and economically not significant. In line with previous studies, the lack of disclosure around meaningful supply chain KPIs and disconnection with future outlook may be the reason for this (Bayne et al., 2022; Bayne & Wee, 2019). In regard to the cost of debt, the results show a significant negative relationship between it and SCD. This negative relationship was due to the communication of supply chain operations that was disclosed voluntarily. More specifically this was owing to the communication of value creation operations in the supply chain. An explanation for this is that the operations of the supply chain are predominantly financed with SCF and short-term debt financing (Banerjee et al., 2004). As such, the SCD will provide creditors with useful information on supply chain operations. Further to this, value creation in the supply chain is likely to be informative to creditors in setting appropriate debt covenants (Bradley & Roberts, 2015; Campello & Gao, 2017). In support of this, economic significance for this negative relationship was also found.

1.6 Scope of the study

This subsection outlines the scope and the boundaries of the study. According to Croom et al. (2000) SCM is multidisciplinary and intersects with many other disciplines. These include strategic management, logistics, marketing, information systems, finance and accounting among others. In the area of accounting, supply chain research has mainly been studied in management accounting, namely costing and performance measurement (Free, 2007, 2008; Joyce, 2006; Ramos, 2004). However, this research is at the intersection of the supply chain and financial accounting disciplines, specifically at the disclosure of supply chain information. In addition to this, this study is narrowed in several ways.

Firstly, there are many theories that can explain the structure of the supply chain and its dimensions such as the RBV, transaction cost economics (TCE), the principal-agent theory (PAT) and the network theory (or relational view) (Halldorsson et al., 2007). These respective theories have different focus points in the context of the supply chain which will be explained further in the next chapter. However, the study uses the RBV to explain how the supply chain creates value and how this value needs to be communicated and disclosed to external shareholders.

Secondly, Ivanov et al. (2019) note that there are different types of supply chains, that can affect the structure and dimensions of the supply chain. These include (i) manufacturing supply chains, (ii) service supply chains, (iii) e-commerce supply chains and (iv) digital supply chains. Manufacturing supply chains and service supply chains produce goods and services for the final customers. On the other hand, e-commerce and digital supply chains are supply chains that have come about owing to the change in the external environment, towards e-commerce and digital trends, respectively. Examples of these supply chains are Amazon and Adidas Speedfactory, respectively (Ivanov et al., 2019). Owing to the myriad differences among these four types of supply chains, it would be too complex to control for such

differences. Hence, I limit the scope of the current study to manufacturing supply chains who produce goods and products for final customers. The operations, processes, and activities within manufacturing supply chains are easier to identify with the processes of plan, source, make, and deliver (Lockamy & McCormack, 2004).

Moreover, in examining the effect of supply chain structural dimensions on the extent of SCD, the study focusses on disclosures limited to company annual reports. Dissemination of supply chain information occurs across multiple sources, including company websites, company documents (e.g. conflict mineral disclosure statements, human slavery reports), company filings, sustainability reports, annual reports and through the media. Marshall et al. (2016) and Doorey (2011) note that Patagonia and Nike disclose much of their supply chain information on their respective company websites. Additionally, sustainability reports are also a main source of information, specifically for environmental and social information regarding the supply chain (Bayne et al., 2022) . The media is also used as a source to communicate supply chain information, albeit from an external source outside the boundaries of the company (Deegan & Islam, 2010, 2014). The current research is limited to investigating the extent of SCD in annual reports because companies' annual reports are frequently the primary source of information for shareholders and debt providers. They also provide an overall, bigger picture of the operations and financial performance of the company (Healy & Palepu, 2001).

1.7 Outline of the study

The remainder of this thesis will be structured as follows. *Chapter Two* will review the main theories used in the SCM literature and look specifically into the RBV, which this study will focus on. The chapter will also link the RBV to the corporate reporting of business

models, which will be used in explaining the communication of supply chain resources through SCD.

Chapter Three outlines the research methodology used in this study. The research methodology used is an exploratory sequential design, comprising interviews and the collection of archival data. This methodology is informed by the use of the RBV theory. An exploratory sequential design is used to understand and investigate the dimensions of the supply chain. The use of interviews, along with previous literature on the dimensions of the supply chain, informs the development of the supply chain framework and SCD index.

Chapter Four outlines the findings of the interviews and together with previous literature, is used to develop the supply chain framework. The supply chain framework is used as a foundation to identify the four dimensions of the supply chain: (i) customer base, (ii) operating portfolio, (iii) environmental dimensions and (iv) social dimensions.

The three subsequent chapters (*Chapters Five, Six and Seven*) examine the three research questions mentioned above. *Chapter Five* examines the relationship between the four supply chain dimensions and capital structure. *Chapter Six* outlines the second research question investigating the effect of the four supply chain dimensions on SCD. In doing so the chapter constructs the SCD index, based on the supply chain framework previously outlined. *Chapter Seven* logically flows on from this and examines the consequences of SCD on the cost of equity and cost of debt.

In conclusion, *Chapter Eight* provides a succinct summary in linking the three research questions together. Further to this, the chapter outlines the contributions and limitations of the study. Lastly, it provides an overview for areas of future research. *Figure 1-2* provides a summary of the thesis structure with the outline of chapters, research questions, hypotheses, and main findings.

Figure 1-2: *Thesis Structure*

Chapter Two: Theoretical Framework: Resource-Based View

Chapter Three: Research Methodology

Chapter Four: Supply Chain Framework

Supply Chain Flows	***Supply Chain Processes***	***Supply Chain Dimensions***
Flow of Materials	*Supply Chain Strategy, Sourcing and Procurement, Production, Logistics and Distribution, Environmental Practices, Social Practices*	*Customer Base, Operating Portfolio Environmental Dimensions, Social Dimensions (Explanatory Variables)*
Flow of Information	*Information Technology, Information Sharing*	
Flow of Financing	*Supply Chain Finance, Working Capital Asset Utilisation*	*Asset Turnover, Inventory Turnover, Cash Conversion Cycle (Moderating Variables)*

Chapter Five: Supply Chain Structure and The Nature of Financing

Hypotheses	***Research Design***	***Key Findings***
H1 $_{A(Alternate)}$***:*** *Positive Relationship between customer base and book leverage*	*FTSE All-Share Index (80 companies)*	*Significantly positive relationship between customer base and book leverage*
	Period: 2018 - 2021	
H1 $_{B(Null)}$***:*** *No relationship between operating portfolio and book leverage*	*Observations: 320*	*No relationship between operating portfolio, environmental*

H1 $_{C(Null)}$***:*** *No relationship between environmental dimensions of the supply chain and book leverage* ***H1*** $_{D(Null)}$***:*** *No relationship between social dimensions of the supply chain and book leverage*	*Dep Var: Book Leverage* *Indep Var: Customer base, Operating. portfolio, Environmental dimensions Social Dimensions*	*dimensions and social dimension with book leverage*

Chapter Six: Determinants of Supply Chain Disclosure

Research Question 1	***Research Design***	***Key Findings***
H2 $_{A(Alternate)}$***:*** *Negative relationship between customer base and supply chain disclosure* ***H2*** $_{B(Null)}$***:*** *No relationship between operating portfolios and supply chain disclosure* ***H2*** $_{C(Alternate)}$***:*** *Positive relationship between environmental dimensions of the supply chain and supply chain disclosure* ***H2*** $_{D(Null)}$***:*** *No relationship between social dimensions of the supply chain and supply chain disclosure base*	*FTSE All-Share Index (80 companies)* *Period 2018 & 2021* *Observations: 160* *Dep Var: Supply Chain Disclosures* *Indep Var: Customer base, Operating portfolio, Environmental dimension, Social dimensions*	*Negative relationship between (i) customer base and (ii) social dimensions on supply chain disclosure* *Positive relationship between environmental dimensions and supply chain disclosure* *No relationship between operating portfolio and supply chain disclosure*

Chapter Seven: Consequences of Supply Chain Disclosure

Research Question 1	***Research Design***	***Key Findings***
H4: *Negative relationship between supply chain disclosure and cost of equity*	*FTSE All-Share Index (80 companies)*	*No effect of supply chain disclosure on the cost of equity*
H5: *Negative relationship between supply chain disclosure and cost of debt*	*Period: 2018 & 2021*	*Negative relationship between supply chain disclosure and the cost of debt*
	Observation: 160	
	Dep Var: Cost of Equity & Cost of Debt	
	Indep Var: Supply Chain Disclosure	

Chapter Eight: Conclusion

Chapter Two: Theoretical Framework

2.1Introduction

The second chapter introduces the RBV theory used in this research. This thesis is based on the identification of supply chain dimensions used to create a competitive advantage. Using the RBV theory, I identify these dimensions, and they are subsequently used as the basis for the three research questions being investigated. The first research question involves the effect of four of these dimensions against capital structure. The second question involves the effect of these four dimensions against the external disclosure of supply chain dimensions, referred to as SCD. The third question involves the communication of SCD and the effect on the cost of equity and cost of debt. Given the focus on supply chain dimensions in all three research questions, this chapter reviews the literature on RBV. Subsequently, in explaining the communication of supply chain resources through SCD, I integrate the RBV theory with the corporate reporting of the business model (BM). BM reporting provides context to the communication of supply chain dimensions through SCD. This culminates in the development of a theoretical framework combining the RBV and the corporate reporting of BMs.

2.2Supply chain management

The supply chain is a network of organisations involved in upstream and downstream activities that create economic value. Halldorsson et al. (2007, pp. 286) similarly defined SCM as the "management of a network of interconnected businesses". This network of activities, both upstream and downstream, is structured differently for different organisations. Given this, the dimensions of the supply chain are different. Numerous theories can be used to explain these different supply chain structures and dimensions. They include the (i) PAT,

in the context of SCM, (ii) TCE, (iii) network perspective, which is also referred to as the relational view and (iv) RBV. All these theories, including others not mentioned here, have been used in previous SCM literature (Corbett et al., 2004; Halldorsson et al., 2007; Ketokivi & Mahoney, 2020). The first three theories mentioned look at the supply chain from a network perspective or from the perspective of dyadic relationships. On the other hand, the latter theory, RBV, emphasises the individual dimensions of the supply chain. In the context of the three research questions, the RBV helps identify the important supply chain dimensions that create value and a competitive advantage for the company. Consequently, it highlights the dimensions of the supply chain that should be communicated through SCD. Given this, the following subsection reviews the theoretical underpinnings of the RBV, the elements of the theory and its application to SCM.

2.2.1 Resource based view (RBV)

The RBV became popularised through the works of Wernerfelt in 1984, Barney in 1986 and the symposium of the Journal of Management in 1991 (Lockett et al., 2009). The underlying notion of the RBV is to answer the question of why firms differ in their performance and focusses on the internal differentiators of the firm. In answering why individual firms differ in their performance, Lockett et al. (2009) noted that the RBV focusses on 'resources' within firms' as the unit of analysis to achieving a sustained competitive advantage. In this study, these resources used by the firm to develop/sustain a competitive advantage will be interchangeably referred to as dimensions of the supply chain.

Chahal et al. (2020) characterise such resources that give rise to competitive advantages as being (i) valuable, (ii) rare, (iii) inimitable and (iv) non-substitutable. These characteristics are abbreviated in many studies as VRIN. However, Hitt et al. (2016) and Chahal et al. (2020) note the focus of the RBV on being resource-driven is very vague and

has no clear boundaries. Lockett et al. (2009) note such resources (dimensions) can be categorised as static dimensions and dynamic dimensions. This overlaps with the dynamic capabilities theory. Further to this, resources can be categorised as tangible and intangible (and knowledge) dimensions. This overlaps with the knowledge-based view. In this way, the RBV may be considered an overarching theory of 'resources', covering the dynamic capabilities theory and knowledge-based view. This can be seen as a disadvantage towards the focus of the theory, but also advantageous in that the RBV can be applied to different disciplines.

Barney et al. (2001) and Hitt et al. (2016) state that the theory of the RBV stemmed from strategic management literature but has subsequently been applied to different disciplines including literature in human resource management, marketing, corporate governance and economics. For example, in the economics literature, the RBV has been used to explain diversification (or market entry) and corporate refocussing (or market exit) (Lockett & Thompson, 2001). In recent years, Hitt et al. (2016) acknowledge the growing literature of the RBV in operations management (OM) and SCM research. This includes research in operations strategy, performance management in the supply chain and product or service innovation.

As Hitt et al. (2016) noted, the ultimate goal of SCM is to create value for the customer. This requires the integration of supply chain dimensions within the flow of materials, flow of information and flow of financing. This is where the RBV can be applied in using the 'resources' available to the company to create customer value. Drilling deeper, Rungtusanatham et al. (2003) note that the RBV provides an explanation as to why and with whom companies form supply chain relationships. These relationships open up access to resources of not only the company but also complementary resources/dimensions of its suppliers, outsourcing partners, distribution partners and customers. In this way, the RBV

helps identify such resources in the supply chain as can be accessed by the company to create value and sustain a competitive advantage. Thus, it helps in answering the three research questions of the thesis.

From this, Lockett et al. (2009) summarise the three elements of the RBV: (i) resource functionality, (ii) resource recombinations and (iii) resource creation. Applying the element of resource functionality, a company can take advantage of internal company dimensions they have developed previously to respond to future opportunities and challenges. This can be in the form of technologies (tangible dimensions) or technical knowledge dimensions (intangible or knowledge-based resources) (Hitt et al., 2016). This is exemplified through Fisher and Paykel Healthcare's (FPH) superior learning and actionable research and development (R&D) into respiratory care. This allowed the company to take advantage of the increase in demand for respiratory ventilators at the beginning of the Covid-19 pandemic (Fisher and Paykel Fisher and Paykel Healthcare, 2020). In the context of this thesis, such supply chain dimensions should be communicated to allow stakeholders to understand the resources

The second element, resource recombinations, is the leveraging of internal company dimensions alongside supply chain dimensions belonging to suppliers, customers, and distribution partners. This is exemplified through Fonterra's collaboration with Unifi to recycle plastic bottles to manufacture polyester clothing (FarmSource, 2021). To elaborate, Fonterra has access to plastic bottles that can be recycled and manufacturing equipment, while Unifi has technical expertise in textile manufacturing. In this way, the combination of resources from Fonterra and Unifi have been leveraged to develop dynamic capabilities.

The third element of the RBV, resource creation, can be applied in the supply chain context through the undertaking of supply chain activities such as new product development (NPD) in developing new resources. For example, engagement in NPD activities can help

develop new supply chain dimensions such as supply chain learning (Zhu et al., 2018). Moreover, the adoption of circular economic activities can help companies research into, develop and acquire new virgin resources. This can be leveraged to take advantage of emerging opportunities in the circular supply chain (Farooque et al., 2019). Thus, dimensions that have been developed by firms previously can be used to efficiently perform supply chain activities (resource functionality). Similarly, supply chain activities can help in developing new supply chain dimensions (resource creation).

Hitt et al. (2016) noted the applications of the RBV in operations management and SCM research and the three elements of the RBV. In the context of the current thesis, the three elements of the RBV show that supply chain dimensions encompass resources that facilitate the operations of the supply chain and the company (resource functionality). Similarly, supply chain dimensions encompass capabilities that are the combination of multiple resources (resource recombinations). Further to this, supply chain dimensions encompass resources created through the undertaking of supply chain operations (resource creation).

Following on from this, Chahal et al. (2020) conducted a meta-analysis of empirical research that tested the RBV in operations management research. The study identified three main supply chain dimensions from research done between 2007 and 2020. These are flexibility, supply chain integration, and organisational capability which were regressed against measures of business, competitive, operational and financial performance. In summary, the study noted positive relationships between these supply chain dimensions and the four measures of performance, which were supported by the majority of previous studies (Chahal et al., 2020).

In addition to adopting the RBV in many of the above-mentioned disciplines including operations management and SCM, the RBV has also been applied to accounting,

including corporate governance and sustainability reporting (Barney et al., 2001; Farooq et al., 2018). In the corporate governance literature, Barney et al. (2001) note that corporate governance can be a source of competitive advantage. This is based on the skills and experience of the board of directors and their monitoring of management. In the discipline of sustainability reporting, Farooq et al. (2018) combine the theories of the RBV and legitimacy theory in explaining the variation in the quality of sustainability disclosure. Farooq et al. (2018) used the RBV to explain the sustainability competencies of the organisation in determining the quality of sustainability reports. However, in this study I use the RBV to investigate the dimensions of the supply chain.

In using the RBV to investigate the dimensions of the supply chain, Pfohl and Gomm (2009), Lockamy and McCormack (2004) and White (2021) note that SCM comprises (i) the flow of materials, (ii) the flow of information and (iii) the flow of financing. Lockamy and McCormack (2004) and White (2021) further note that the flow of materials comprises the following processes, of which this thesis focusses on the first four;

- Plan
- Source
- Make
- Deliver
- Return
- Enable

In applying the RBV, the supply chain structure can be categorised into the above three supply chain flows and the four supply chain processes within the flow of materials. These flows and processes are illustrated in *Figure 2-1*.

2.3Supply chain disclosure (SCD)

After reviewing the literature on RBV and its use in identifying the dimensions of the supply chain, I investigate the communication of supply chain dimensions through SCD in the context of the corporate reporting of business models. Given this, I link the RBV theory to the corporate reporting of business models.

Previous studies in the disclosure literature have explained such disclosure in the context of agency theory, signalling theory, legitimacy theory and institutional theory to name a few (Alberti-Alhtaybat et al., 2012; Cahan et al., 2005; Shehata, 2013). These theories have also been used in examining SCD. Bateman and Bonanni (2019) note that Patagonia, in disclosing its supply chain resources pertaining to the sourcing of raw materials and manufacturing of products, uses signalling theory. This is done through providing information on its suppliers' operations, raw materials, clothing mills and factories. In this context, Patagonia is using SCD to signal the increased transparency of its supply chain to investors.

In another example, Deegan and Islam (2010) supplemented the use of legitimacy theory with media efficacy theory to investigate how negative media attention created change in the disclosure of supplier information by Nike and H&M. Deegan and Islam (2014) similarly used the influences of non-governmental organisations (NGOs) and news media to influence accountability of supply chains. Additionally, in the context of institutional theory, Doorey (2011) noted that Nike's disclosure of its suppliers in April 2005 prompted industry competitors, such as Levi's, Puma, Adidas, and Reebok to follow suit and disclose supplier information.

Despite the use of signalling theory, legitimacy theory and institutional theory in explaining the communication of supply chain dimensions through SCD, the current thesis uses none of these. This is because the above-mentioned theories focus on why SCD is

disclosed, and not on the communication of supply chain dimensions through SCD. On the other hand, the BM communicates how supply chain dimensions create a competitive advantage through the supply chain. Given this, the RBV, which identifies the dimensions of the supply chain, is supplemented with the corporate reporting of business models to communicate the value of supply chain dimensions through SCD.

2.3.1 Corporate reporting of business models

Recent studies have called for increased accounting for supply chains (Beattie & Smith, 2013; Burritt & Schaltegger, 2014). Together with concerns that annual reports are becoming lengthier and more complicated, Beattie and Smith (2013) call for the corporate reporting of BMs. In this way, they note that the corporate reporting of BMs will communicate how the company converts resources and capabilities into economic value. Similarly, Shafer et al. (2005, pp. 202) view the BM as "creating and capturing value within a value network". Integral to the concept of the BM and the conversion of resources and capabilities into economic value is the RBV theory (DaSilva & Trkman, 2014). The study notes that the BM addresses the competencies that underlie a firm's competitive advantage and that this is consistent with the RBV that the firm is seen as a bundle of resources and capabilities. As such, the corporate reporting of BMs is helpful in linking the RBV lens of SCM and accounting disclosure.

Expanding on this, Lewandowski (2016) organises the dimensions of the BM into a business model canvas which incorporates key partners, key activities, key resources, value propositions, customer relationships, customer segments, distribution channels, revenue streams and cost structure. Shafer et al. (2005), in their business models' definition above, highlight strategic choices, and the creation and capture of value as important elements.

Combining these, Norris et al. (2021) outline that the BM comprises (i) value proposition, (ii) value creation, (iii) value delivery and (iv) value capture as in *Figure 2-1*.

Nielsen and Roslender (2015) outline the four elements from value proposition to value capture. Value proposition places a key emphasis on what customers place value on and how the company intends to go about finding a solution to meet customers' needs. Expanding on this, the study notes that value proposition aligns the components of the infrastructure such as organisational resources and competencies, with downstream customers. In supplementing the RBV with the corporate reporting of business models, the element of value proposition is reflective of the plan (supply chain strategy) processes of supply chain structure.

Moving to the second element, Norris et al. (2021) and Haslam et al. (2015) define value creation as the processes and dimensions that are used to meet customers' needs. Ellinger et al. (2012) further mention that value creation manifests through revenue growth, cost reduction, working capital efficiency and fixed capital efficiency. Hence, in supplementing the RBV with the corporate reporting of business models, the element of value creation is reflective of the source (sourcing and procurement) and make (production) processes of supply chain structure.

Thirdly, value delivery constitutes activities in the downstream supply chain and in getting the product/service to the customer. It is about getting the product/service to the customer at the right place and at the right time, at the lowest possible cost (Li et al., 2006). Given this, in supplementing the RBV with the corporate reporting of business models, the element of value delivery is reflective of the delivery (logistics and distribution) processes of supply chain structure.

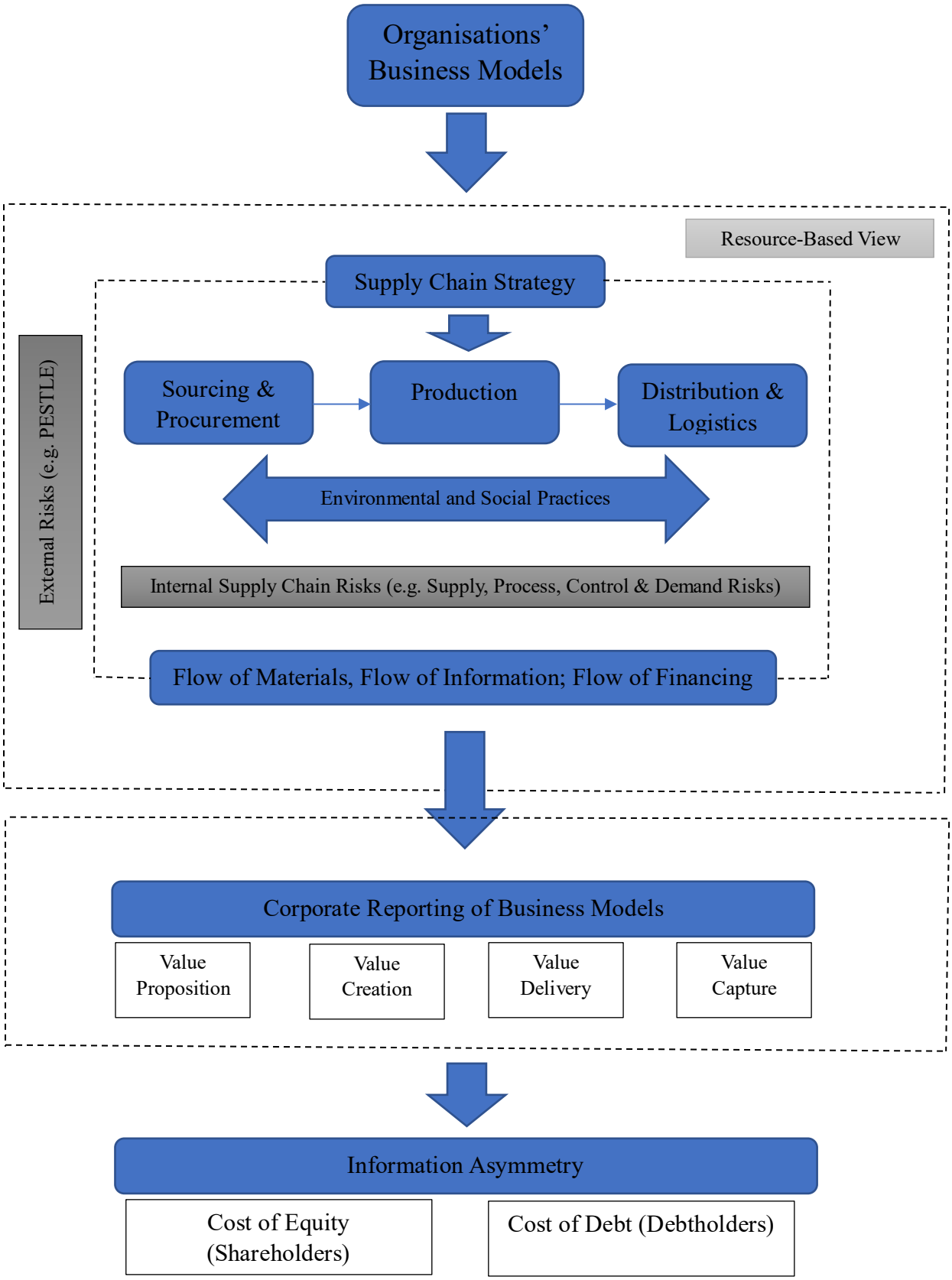
Lastly, Nielsen and Roslender (2015) note that value capture is the realisation of revenue as a result of the process of value creation and value delivery. This, in combination

with the management of supply chain and company risk factors along with firm performance, can assist in developing/sustaining competitive advantages (Christopher et al., 2011; Giannakis & Papadopoulos, 2016). Hence, in supplementing the RBV with the corporate reporting of business models, the element of value capture is reflective of the integration of the (i) flow of materials, (ii) flow of information and (iii) flow of financing within the supply chain. Overall, the supplementation of the RBV, and the resources of the supply chain, with the corporate reporting of business models, results in the following

- Plan (Supply Chain Strategy) → Value Proposition
- Source (Sourcing and Procurement) → Value Creation
- Make (Production) → Value Creation
- Deliver (Logistics and Distribution) → Value Delivery
- Flow of Materials, Information and Financing → Value Capture

In this way, the integration of the RBV with the corporate reporting of business models helps to explain the communication of supply chain dimensions. This is illustrated in *Figure 2-1*.

Figure 2-1: *Theoretical Framework – Resource-Based View and BM reporting*



2.4Conclusion

This chapter outlines the theoretical framework used in identifying the dimensions of the supply chain and the subsequent communication of these supply chain dimensions via SCD. The first half of the chapter reviews the RBV and explains how the dimensions of the supply chain are to be identified. More specifically, I use the three elements of the RBV — (i) resource functionality, (ii) resource recombination and (iii) resource creation — to explain this. These three elements provide a guide to how and why supply chain dimensions facilitate supply chain and company operations. In this way, the RBV is used to explain why supply chain dimensions help develop a competitive advantage and, consequently, helps in identifying important dimensions of the supply chain. Subsequently, I supplement the RBV with the corporate reporting of business models. BM reporting communicates how supply chain dimensions create a competitive advantage. In this way BM reporting is an extension of the RBV in explaining how supply chain dimensions are communicated. Thus, developing a theoretical framework combining RBV and the corporate reporting of business models helps in explaining SCD.

Chapter Three: Methodology

3.1Introduction:

This chapter outlines the research methodology used in this thesis. In using the RBV theory to identify the dimensions of supply chain structure and to address the three research questions, I use an exploratory sequential design methodology. In discussing the research methodology, I first address the ontology, epistemology and paradigm underpinning this study and how it facilitates the use of an exploratory sequential design. This methodology involves exploratory interviews and the collection of archival data.

3.2Ontology, epistemology and paradigm

This section briefly explains the ontological and epistemological perspective, as well as the research paradigm that the study fits into. Firstly, ontology is explained as the beliefs that underpin research and can be categorised as objective or subjective research (Sekaran & Bougie, 2016). Objective research is based on observations underpinned by facts and results and the assumption that there is only one reality, This is as opposed to subjective research which is based around the perspectives of different stakeholder groups and multiple realities (Creswell & Creswell, 2018; Rehman & Alharthi, 2016).

This is complemented by the epistemology of the research which discusses the nature of knowledge and how this knowledge is measured, interpreted and examined (Rehman & Alharthi, 2016). To explain this further, an objective ontology which is based on facts and results, is accompanied by a realist epistemology. Operationalising such research is conducted by using quantitative methods. On the other hand, a subjective ontology, which focusses on the perspective of multiple stakeholder groups and can be referred to as multiple realities is accompanied by a relativist epistemology (Collis & Hussey, 2014).

I subsequently apply the ontology and epistemology to the current study. As shown in *Figure 3*-1, the study assumes that there is only one truth and that there is a relationship/no relationship between supply chain dimensions and SCD. This fits into an objectivist ontological perspective. *Figure 3-1* goes on to show that an objective ontology aligns with a realist epistemology. This is because the relationship between supply chain dimensions and SCD can be measured, interpreted, and examined using quantitative methods. As a consequence, *Figure 3-1* illustrates that an objective ontological perspective and a realist epistemology are used in this thesis.

The ontological and epistemological perspective of this research subsequently determines the most suitable research paradigm of the study. Mackenzie and Knipe (2006) define the term "paradigm" as a collection of assumptions, concepts and propositions that dictate thinking and research. Creswell and Creswell (2018) list the types of paradigms, with the two main paradigms being those of (i) positivism and (ii) interpretivism. An objective ontology and realist epistemology reflect a positivist paradigm, whereas a subjective ontology and a relativist epistemology reflect an interpretivist paradigm.

Given that the study is based upon an objective ontology and a realist epistemology, the study uses a positivist worldview/paradigm, which is further divided into a (i) positivist paradigm and (ii) post-positivist paradigm. Illustrated in *Figure 3-1*, I use a post-positivist paradigm which, as Panhwar et al. (2017) note, is used to explore a phenomenon. Fox (2008) introduce the concept of realist post-positivism. While it shares similarities with positivism in that it is based on empiricism, a realist post-positivist approach considers and acknowledges the context and setting of the research. As such, realist post-positivism is used to explore the dynamics of the supply chain.

Following this, Creswell and Clark (2011) note that post-positivist research focusses on questions that are deterministic and addresses a cause-and-effect relationship. Further to

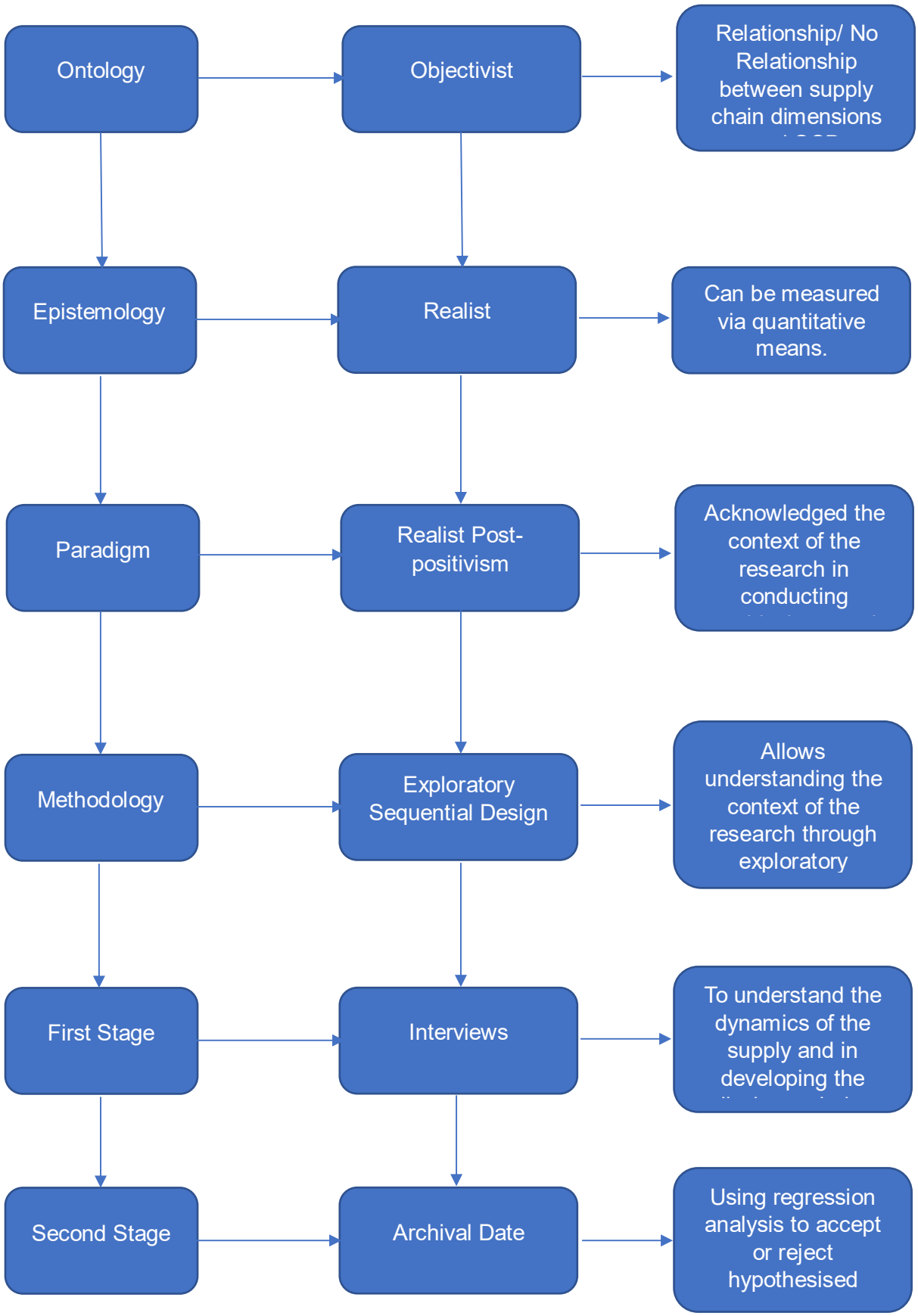
this, post-positivism dictates that research questions can be observed and measured through an empirical lens. Hence, Fox (2008), Panhwar et al. (2017) and Creswell and Creswell (2018) provide evidence that the study fits into a post-positivist worldview. The use of a realist post-positivist paradigm in this thesis is illustrated in *Figure 3-1*

3.3Research methodology: exploratory sequential design

Following the use of an objective ontology, a realist epistemology and a post-positivist paradigm. the thesis employs an exploratory sequential methodology. *Figure 3-1* shows that an exploratory sequential methodology allows the researcher to understand the context of the research. In this way, the chosen methodology aligns with a realist post-positivist paradigm. On the other end, an exploratory sequential methodology allows the researcher to understand the context of the research by initially conducting qualitative interviews prior to the collection of archival data.

Creswell and Creswell (2018) explain that an exploratory sequential design is done sequentially and begins with conducting qualitative interviews. As illustrated in *Figure 3-1,* this allows understanding of the dynamics of the supply chain, specifically the structure of the supply chain. It also helps understand the effects of the Covid-19 pandemic and other supply chain disruptions on the structure of the supply chain. The use of interviews to explore the resources/dimensions of the supply chain is also supported by the theoretical framework of the RBV. For example, applying the RBV, Coates and McDermott (2002) explored the development of new resources and capabilities within an organisation. To accomplish this, they conducted multiple interviews. In addition to conducting interviews to examine the dimensions of the supply chain, I also used interviews to support the development of the SCD index. As in previous studies such as Hossain et al. (1995), interviews are used to provide practical rigor to the construction of the disclosure index, and in this case the SCD index.

Figure 3-1: *Design Methodology*



Following the administering of interviews, the second stage comprises the collection of archival data. This is illustrated in *Figure 3-1.* This is as opposed to a typical exploratory sequential methodology which consists of a survey. This is similar to Chahal et al. (2020) who, based on the RBV, performed empirical research to investigate the effect of supply chain dimensions on firm performance. Subsequently, the current study conducts a quantitative regression analysis to examine the effect of supply chain dimensions on capital structure and on SCD, as well as examining the consequences of SCD .

Based on the post-positivist paradigm and the exploratory sequential methodology, I use qualitative interviews and archival data. Firstly, in conducting the interviews, I will outline the (i) preparation of interview questions and choice of interview sample, (ii) process of acquiring interviewees for participation in the study and (iii) analysis of such interviews. This is discussed in *Section 3.3.1*. The second stage comprising the collection of archival data outlines the quantitative sample used across all the three research questions.

3.3.1 Initial phase: interviews

A. Interview Sample & Interview Questions

The initial phase of the research comprised online interviews. Mahama and Khalifa (2017) note that interviews can be either quantitative or qualitative. They note that, whereas quantitative interviews are used to develop a more in-depth understanding of participants' interpretation along a predesigned research instrument, the purpose of qualitative interviews is to gather data on interviewees' knowledge and experiences to help make sense of objects, events, and work practices. The latter is more suited towards the exploratory nature of interviews and aligns with the post-positivist paradigm of understanding the context of the research. Hence, this study uses qualitative interviews to understand the structure and

dimensions of the supply chain, as well as gather insights into the development of the disclosure index.

In outlining the selection of interviewees, interviews were conducted with New Zealand companies and limited to manufacturing organisations and companies in primary industries. The scope of the interview sample is summarised in *Figure 3*-2. Within this interview scope, interview participants primarily comprised supply chain managers because of their roles and responsibilities in designing the structure of supply chain. Furthermore, these participants have knowledge of the important supply chain dimensions and resources that companies need to consider in developing a competitive advantage. In addition, other interviewee participants included marketing managers, sustainability managers, logistics managers and finance managers. The selection criteria is summarised in *Figure 3-2* below.

- Firstly, marketing managers were interviewed due to the importance of marketing in the downstream supply chain and in communicating information to the upstream supply chain (Juttner et al., 2007; Rexhausen et al., 2012). As such, marketing managers will provide insights into the dimensions related to the flow of information and distribution and logistics processes of the supply chain.
- Secondly, sustainability managers were interviewed due to the growing importance of sustainability in organisations and in their supply chains. In the recent past, the adoption of sustainability practices and circular economic practices throughout the supply chain has come to the forefront of companies' sustainability agendas, with the growing awareness on sustainable supply chain management (SSCM) and circular supply chain management (CSCM) (Burritt & Schaltegger, 2014; Farooque et al., 2019). Thus, it is important to consider the environmental and social dimensions in the supply chain in developing a competitive advantage.

- Thirdly, logistics managers were interviewed. While these managers are external to the company's supply chain, logistics and distribution play a vital role in the flow of materials and information through the supply chain. This has been evident through the effects of the Covid-19 pandemic and the Suez Canal disruptions. Hence, insights from these interviewees will assist in understanding the dimensions of logistical activities in connecting the supply chain.
- Lastly, finance managers were interviewed. In contrast to supply chain managers who will provide insights into the operational processes of the supply chain, finance managers will allow for reflections on the financial processes of the supply chain. These interviewees will be able to shed light on the dimensions related to the flow of financing within the supply chain.

Overall, interviewing supply chain managers as well as personnel who interact with supply chain operations in the above-mentioned roles will provide a more comprehensive picture of the dimensions of the supply chain. Moreover, interviewing a variety of participants will lead to the development of a disclosure index that is reflective of practice. *Table 3-1* shows that eight interviews were conducted. This is alongside details of the type of industry which the companies belong to and the positions of the interviewees.

Table 3-1: *Interview Participants*

	Job Positions of Interviewees					
	Supply Chain	Marketing	Sustainability	Logistics	Finance	Total:
Manufacturing	2	1	1		1	5
Retail	1					1
Primary Industries	1					1
Transportation				1		1
Total:	4	1	1	1	1	8

After narrowing the sample of interview participants, the next phase comprised formulating and tailoring the interview questions to the target participants. As outlined in *Figure 3-2*, the format of interview questions was semi-structured. This was in order to focus the questions towards addressing the study's research objectives but also allow for flexibility in answers to explore alternative patterns and themes that were not observed in previous literature. The interview was divided into four sections. The first section addressed background and demographic questions relating to the participants' role in their companies' supply chain, and the overall structure of the supply chain. The second section sought to investigate the internal and external factors affecting supply chain structure and how this influenced the dimensions of the supply chain. The third section probed into the internal informational environment and external supply chain disclosures. The last section comprised questions on the effect of the Covid-19 pandemic on the organisations' supply chain and the future changes in their roles/responsibilities with regard to the supply chain.

B. Interview Process:

After the interview questions were prepared, email invitations were sent to participants (mentioned above) of the selected scope of companies in New Zealand. Supply chain managers were initially interviewed to explore and understand the processes and dimensions of the supply chain. From this starting point, other participants (e.g. marketing managers, sustainability managers, etc.) were identified. This would assist the researcher in getting alternative perspectives on the supply chain and receiving more in-depth answers to specific questions.

Potential interview participants were initially identified through LinkedIn, and a search of their current position and previous work experience narrowed the participants to be interviewed. While this process was used throughout the interview process, a snowballing

technique was also used. Snowball sampling is when initial interview participants contact other potential interview participants, on behalf of the researcher (Mahama & Khalifa, 2017). In the context of this study, snowball sampling was used to get people in different positions within the same organisation and get people from different organisations.

The interviews took approximately one hour each and were conducted using online Microsoft Teams. Expanding on this, video communication technologies such as Microsoft Teams have a function to automatically transcribe verbal communications between the interviewer and interviewee, which helped in conducting verbatim transcription afterwards. The advantage of using online video technologies was the convenience it provided to interviewees with busy schedules. This was a prominent issue as interviewees were in senior positions and were short of time. However, as de Villiers, Farooq and Molinari (2021) explain, the disadvantage of using such technologies is the limitation of developing a rapport with interview participants, which is easier when conducting face-to-face interviews. Another disadvantage of conducting online interviews was the inaccessibility to interviewees' work environments. This is an important limitation because observing the work performed in the supply chain would have provided richer data than verbal communications about the interviewee's supply chain and the dimensions of the supply chain. Physical interviews were, however, not conducted due to visitors not being allowed on-site at companies' premises because of the risk of Covid-19 transmission.

C. Analysis of Interviews

After the online interviews had been conducted, verbatim transcription took place using the rough transcribed recordings from Microsoft Teams. The transcription recording was listed as an outcome of conducting the interviews in *Figure 3-2*. The first part of the analysis constituted highlighting important information that provided insights into the (i)

processes and dimensions of the supply chain and (ii) factors influencing the extent of disclosure, and important disclosure items in developing the disclosure index. This is summarised in *Figure 3-2* in stating the purpose behind conducting analyses of interviews. Subsequently, this was used to develop emerging themes garnered from the interviews using thematic analysis (TA). According to Terry et al. (2017), TA is a qualitative method for identifying themes. They note that TA is used to bridge the gap between qualitative analysis and quantitative methods through providing qualitative techniques to use within a post-positivist paradigm. Hence, the use of TA aligns with the post-positivist paradigm and exploratory sequential design methodology.

As mentioned previously, TA is used for the identification of themes within qualitative data. This identification of themes using TA can be either deductive or inductive. Deductive themes are themes determined by theory and/or previous literature, whereas inductive themes are data-driven and are not preconceived (Fereday & Muir-Cochrane, 2006; Terry et al., 2017). In the current analysis of interviews, I use a combination of deductive and inductive coding. In part, the interview questions guided the organisation of themes. This is illustrated through the categorisation of questions into seeking (i) the structural dimensions of the supply chain, (ii) the external disclosure of supply chain information and (iii) the effects of the Covid-19 pandemic. Hence, deductive themes are used. However, the broadly structured interview questions offered flexibility to explore new insights into the processes and dimensions of the supply chain. Hence, inductive coding is also used to identify new themes not observed in previous literature. The use of deductive and inductive coding is also important in the current context because of the effects of the pandemic on supply chains. This has affected supply chains in new ways, which is unlikely to have been highlighted in previous literature. The use of thematic analysis, and deductive and inductive codes are mentioned as procedures in analysing the interview data in *Figure 3-2*

Figure 3-2: *Exploratory Sequential Design*

Purpose:

- Explore and understand the dynamics of the supply chain
- Develop disclosure index

Procedures:

- Semi-structured interviews
- New Zealand Companies
- Manufacturing/ Primary Industries
- Interviewees comprised supply chain managers, sustainability managers, marketing managers, finance managers and logistics managers.

Outcomes:

- Interview transcripts

Purpose:

- Investigate important dimensions of the supply chain
- Development of the disclosure index.

Procedures:

- Thematic Analysis
- Deductive and Inductive Codes

Outcomes:

- Interview Transcripts

Purpose:

- Perform regression analyses to accept or reject hypothesised Relationships

Procedures:

- OLS Regression
- Moderating Analyses

Outcomes:

- Descriptive statistics
- Bivariate correlations
- Independent Samples T-Test
- Multivariate regression

3.3.2 Archival data

The second phase of the exploratory sequential methodology, which typically comprises a survey, is conducted through the collection of archival data. After conducting exploratory interviews to understand the important dimensions of the supply chain, I collected archival data to examine the effect of these dimensions on (i) capital structure and (ii) SCD, as well as the consequences of SCD. As noted in *Figure 3.2,* the purpose of collecting archival data is to perform regression analyses in addressing the three research questions. In examining these relationships, *Figure 3-2* notes that the study carries out ordinary least squares (OLS) regressions and moderating analyses.

The first step in collecting archival data is to determine the quantitative samples to be used. The choice of a single-country analysis or a cross-country sample defines this study. The benefits of a cross-country sample would be a larger sample size and scope for more insightful findings. However, a cross-country analysis is problematic due to the number of unexplained country-level variables that can affect the dimension of the supply chain as well as SCD. Hence, controlling for the number of variables, some of which could be hidden, would be impractical. This would affect the validity of the results due to endogeneity concerns. As such, a single-country analysis was decided upon.

The choice of single-country analysis was between a sample of United States (US) companies or United Kingdom (UK) companies. An argument could also be made for companies listed on the New Zealand stock exchange, NZX, as the above-mentioned interviews were conducted with managers of New Zealand-based companies. However, the exploratory sequential design methodology strongly suggests that different samples be used for the qualitative and quantitative phases (Creswell & Creswell, 2018). Moreover, a large sample size restricted the study to considering US companies or UK companies only. There are a number of reasons why a US sample was considered inappropriate. Firstly, US

companies, unless listed on overseas indices, are not required to prepare full annual reports, and are only required to prepare reports in line with the Security Exchange Commission (SEC). The majority of such company reports mainly report on mandatory information, much of which does not disclose much supply chain information. Thus, using a US sample would generate very low disclosure scores against the SCD index. This would reflect in poor validity of such findings, meaning a final sample based on a single-country analysis and comprising UK companies was decided upon.

However, an interview sample of New Zealand companies, followed by archival data and empirical analysis of UK companies may be problematic. This is because interview findings based off New Zealand companies are used in understanding the structure of the supply chain and in the constructing of the disclosure index, which are subsequently used in the empirical analysis of UK companies. Country differences in how supply chains are structured[1], along with differences in how New Zealand responded to the Covid-19 pandemic[2] may result in mismatches in the interview themes identified and applicability to UK companies. Despite this concern, interview questions on the (i) structure of the supply chain, (ii) importance of internal visibility and external transparency and (iii) effect of the Covid-19 pandemic were sufficiently broad. This allowed interview findings based on New Zealand companies to be generalisable to the UK setting. This will be supported by the interview themes identified in the following chapter.

Hence, a sample of companies listed on the FTSE All-Share index is used. Below, I outline and justify the exclusion criteria in coming to the number of companies sampled. This sample is common across all three research questions and as such the sample is outlined below. However, it is noted that the number of observations, the variables employed, and the

[1] New Zealand companies are geographically further away from suppliers and customers (Skilling, 2022) as compared to other countries. This is evidenced by a reduced presence of shipping giant, Maersk in New Zealand (Fox, 2023)

[2] New Zealand companies were subjected to more severe lockdowns and border controls (Frost, 2021)

empirical model regressed are different for each research question. In this way, they will be discussed in *Chapter Five*, *Chapter Six* and *Chapter Seven,* respectively.

Data and Sample:

This study is based on a sample of companies listed on the United Kingdom (UK) FTSE All-Share Index, The total number of companies listed on the index, as of 2021, was 576 companies across 11 industries. These industries are listed as per the industry classification benchmark (ICB). From this total population, the following exclusion criteria were applied to obtain a final sample of 80 companies.

Firstly, companies not in manufacturing, retail or primary industries were excluded. In reasoning this, Ivanov et al. (2019) list four types of broad supply chains: manufacturing supply chains, service supply chains, e-commerce supply chains and digital supply chains. These supply chains all have different supply chain structures and processes. As mentioned in the scope of the study, in *Chapter One*, this study only focusses on manufacturing and retail supply chains, due to the similarities in their supply chain structures and processes. This scope is applied when developing the supply chain framework and SCD index. Therefore, only manufacturing and retail-related industries were sampled. This eliminated companies in the following industries: Telecommunications (ICB 15), Financials (ICB 30), Real Estate (ICB 35) and Utilities (ICB 65). This reduced the sample size by 316 companies. In addition, companies in the Oil and Gas Industry were also eliminated because they do not conform to manufacturing/retail supply chains. This further reduced the sample size by 12 companies.

Secondly, the study excluded companies in the remaining industries that engaged in service-related activities such as entertainment and media (within consumer discretionary) and construction (within industrials). Further to this, companies that have business models

based on buying companies, improving them and subsequently selling those companies (e.g. Meggitt Plc) were excluded. This further reduced the sample size by 111 companies.

The third step involved excluding companies with missing variables. The list of exclusions was inclusive of companies that did not have a 2018 annual report due to not being listed on the index (e.g. Dr Martens and Moonpig Group). Companies that had missing data on the supply chain dimensions examined or on the variables controlled for were also excluded. This further reduced the sample size by 57 companies. The above-mentioned exclusions are illustrated in *Table 3-2* in coming to the final sample size of 80 companies across five industries. These five industries included (i) healthcare, (ii) consumer discretionary, (iii) consumer staples, (iv) industries and (v) basic materials.

Table 3-2: *Sample Size*

FTSE All-Share Index:		#
Total Companies:		576
Less: Exclusions		
1. Non-Manufacturing/ Retail/ Primary Industries	316	
2. Oil & Gas Industry	12	
3. Service Companies within Manufacturing/Retail	111	
4. Missing Data	57	
Final Sample Size		80

3.4Conclusion

This chapter comprises an initial interview sample, followed by the collection of archival data. In summary, the interviews serve a dual role. Firstly, they allow exploration and understanding of the processes and dimensions of the supply chain. Secondly, they provide insights into supply chain information important to be disclosed and the factors that affect such disclosure. These exploratory findings are used to develop the supply chain framework

and SCD index, which will be discussed in the following chapter (*Chapter Four*). This is followed by the quantitative phase and the collection of archival data. This is used to perform regression analyses to examine the effect of supply chain dimensions on capital structure and SCD, as well as the consequences of SCD on information asymmetry. These research questions are investigated in *Chapter Five*, *Chapter Six* and *Chapter Seven*, respectively.

Chapter Four: Supply Chain Framework

4.1 Introduction

This chapter outlines the supply chain framework to be used in this thesis and provides a foundation to understanding the three research questions. The supply chain framework, which is based on the structure of the supply chain, is developed using previous literature and interview findings. Given this, the chapter is divided into eight subsections. The second subsection outlines the structure of the supply chain, specifically the flows and processes. This provides a basis for the interview findings. The third subsection reports the interview findings using thematic analysis. Subsequently, I use the RBV theory to identify the dimensions of the supply chain, which are defined as the resources and features that provide a firm with a competitive advantage. This is discussed in the fourth and fifth subsections. The fourth subsection identifies the supply chain dimensions within the flow of materials and the fifth subsection identifies the dimensions within the flow of information and flow of financing. The sixth subsection discusses the integration of the three flows, the processes and dimensions that comprise the structure of the supply chain. Following this, the seventh subsection discusses the supply chain structure in the context of the Covid pandemic. Lastly, the eight subsection provides a conclusion.

4.2 Supply chain structure; flows and processes

Pfohl and Gomm (2009) explain that SCM compromises the (i) flow of materials, (ii) flow of information and (iii) flow of financing. The flow of materials is characterised by the movement of raw materials from suppliers to the company (upstream supply chain) and movement of finished goods to end consumers (downstream supply chain). Facilitating this movement of goods is the flow of information and flow of financing. The flow of information

comprises information and knowledge that is transferred between different organisations in the supply chain (Baihaqi & Sohal, 2013). The flow of financing is the transfer of financial resources between these same organisations (Gomm, 2010).

Diving deeper, Lockamy and McCormack (2004), Baihaqi and Sohal (2013) and Silvestro and Lustrato (2014) provide insights into the supply chain processes within the three flows. Starting with the flow of materials, Lockamy and McCormack (2004) explain that the flow of materials can be categorised into (i) plan, (ii) source, (iii) make, and (iv) deliver. This is termed as SCOR 4.0. These four processes will henceforth be referred to as (i) supply chain strategy, (ii) sourcing and procurement, (iii) production and (iv) logistics and distribution. White (2021) expanded on these four processes to also include the processes of (v) return and (vi) enable. The addition of these two processes updated the concept as SCOR 12.0. While I acknowledge that there is a revised version, this study is based on SCOR 4.0 and the processes of (i) supply chain strategy, (ii) sourcing and procurement, (iii) production and (iv) logistics and distribution.

White (2021) explains that supply chain strategy involves the determining of resources and requirements to align with business goals. Secondly, the sourcing and procurement process is defined as the sourcing of goods and services to meet demand. Based on Lockamy and McCormack (2004) and White (2021), this process includes purchasing and supply of materials (procurement) and collaboration with suppliers. Explaining the third process, White (2021) notes that the production process involves the manufacturing of finished goods to make them ready for the market. The fourth process dealing with logistics and distribution is reflective of the delivery of finished goods to the customer.

Moving onto the supply chain processes within the flow of information, Baihaqi and Sohal (2013) outline these as (i) information technology and (ii) information sharing. The former refers to the technology used to transfer information between members of the supply

chain, while the latter refers to the quantity and quality of information being shared (Baihaqi & Sohal, 2013). Information technology and information sharing aids in the upstream and downstream flow of materials. In addition to this, the flow of financing can also be divided into (i) the management of the financial supply chain (FSC) and (ii) SCF (Gomm, 2010; Silvestro & Lustrato, 2014). The former is explained as running parallel to the physical flow of materials, and addresses the financial transactions that facilitate the flow of materials (Silvestro & Lustrato, 2014). The latter refers to the financing of working capital of the overall supply chain and the individual members of the supply chain through internal financing arrangements within the supply chain (Gomm, 2010). Concluding this, a summary of the supply chain flows and processes was illustrated previously in *Figure 1-2*.

4.3 Interview findings

The structure of the supply chain comprises the three supply chain flows, and the supply chain processes within each of these flows were discussed previously. This is subsequently used to formulate the interview questions. Firstly, in exploring the flow of materials through the supply chain, questions were asked on the strategy of the supply chain. This included questions on the internal and external factors that affect the supply chain strategy. In addition, key performance indicators (KPIs) used to measure the performance of the supply chain against the strategy were also interrogated. Following this, and as illustrated in *Table 4-1*, themes were developed on the internal and external factors influencing supply chain strategy, and on the KPIs frequently measured by firms. This provided insights into the dimensions of supply chain strategy. The semi-structured nature of the interviews also provided flexibility and offered insights into the dimensions within the material flows of the supply chain, including within the (i) sourcing and procurement process, (ii) production process, and the (iii) distributions and logistics process.

Secondly, understanding the flow of information and the processes of information technology and information sharing through the supply chain allowed for questions on the (i) role of information in facilitating the flow of materials and (ii) tools used to enhance the internal visibility and the internal information environment. These questions teased out dimensions on the different technologies used in facilitating the material flow such as enterprise resource planning (ERP) and customer relationship management (CRM) systems. Further to this, the findings provided insights into the types of information shared along the upstream and downstream supply chains. These themes are outlined in *Table 4-1*. In addition to questions posed on the flow of materials, questions were also asked on the role of financing in facilitating the flow of materials. Interview responses provided insights into the importance of aligning the FSC with the physical supply chain, the dimensions of SCF, and the tools used by firms to manage the working capital of the supply chain. In doing so, *Table 4-1* outlines the dimensions within the FSC and SCF.

Overall, this allowed an exploration into the structure and processes of the supply chain, as well as insights into the dimensions within. The following discussion (detailed below) brings to light the dimensions of the supply chain within the flow of materials, flow of information and flow of financing. An understanding of the dimensions within these three supply chain flows subsequently led to a discussion on the recent effects of the Covid-19 pandemic. This allowed an understanding of the co-workings of the three supply chain flows and the effects of the pandemic on the supply chain dimensions. This thereby provided a more holistic picture of the supply chain in the context of supply chain disruptions. In addition to understanding the integration of the three supply chain flows, insights into the structure, processes and dimensions of the supply chain also aided the investigation of the important supply chain information that should be externally disclosed. The themes teased

out from questions on the effects of the Covid-19 pandemic and the factors influencing the disclosure of supply chain information is laid out in *Table 4.1*

Briefly explaining *Table 4-1*, the themes analysed from the above interview questions are listed, followed by a description of the theme. These thematic findings are subsequently used to reinforce the previous literature on the structure, processes and dimensions of the supply chain. As such, *Table 4-1* links these thematic finding to previous literature in cases where the interview findings provide support to previous literature. The last column of *Table 4-1* indicates the section of *Chapter Four* to which the discussion of the interview findings applies.

4.4 Flow of materials

The combination of previous literature on the structure of the supply chain — flows and processes — and the interview findings provides insights into the dimensions of the supply chain. Khan and Pillania (2008) point to the hierarchy of (i) strategic dimensions, (ii) tactical dimensions and (iii) operational dimensions. In this section, I focus on the strategic dimension of supply chain strategy and the tactical dimensions of (i) sourcing and procurement, (ii) production and (iii) logistics and distribution. Within each of these strategic and tactical dimensions, I dive deeper into reviewing the operational dimensions. Alongside these dimensions, I also outline the supporting dimensions within the flow of information and flow of financing, and the subsequent integration of all these dimensions.

Table 4-1: *Thematic Analysis of Interview Findings*

Global Theme: Understanding the Supply Chain and the Supply Chain Disclosure Environment			
Organising Theme 1: Changes in the Supply Chain		Links to Previous Studies	Discussion of Theme:
Efficiency, Agility & Responsiveness:	Balancing leanness (efficiency) and agility (flexibility) in the supply chain in getting the product to the customer as quickly as possible	(Towill & Christopher, 2002)	Supply Chain Strategy (*Section 4.4.1*)
Greater social and environmental impacts	The company is responsible for the environmental and social impacts of their wider supply chain.	(Farooque et al., 2019; Green et al., 2012)	Sourcing and Procurement (*Section 4.4.2*) Hypothesis Development - Justification in the inclusion of the environmental dimension as an explanatory variable (*Section 5.2.2*)
Optimisation of Costs	The optimisation of costs and flow of financial resources is of increasing importance in adding value through the supply chain.	(Pfohl & Gomm, 2009)	Flow of financing (*Section 4.5.2*)
Resilience	The need to develop resiliency in the supply chain is increasingly vital to respond to the demand variability resulting from supply chain disruptions	(Tang, 2006)	Supply chain integration (*Section 4.6*)

Organising Theme 2: Structure of the Supply Chain			
Internal Company influences:	Internal company dynamics such as (i) sustainability strategy, (ii) product life cycle and (iii) speed-to-market affect how the supply chain is structured	(Ivanov et al., 2019; Lamming et al., 2000; Norris et al., 2021)	Supply chain strategy (*Section 4.4.1*)
Internal supply chain Factors	Internal supply chain dynamics such as (i) raw material manufacturing and (ii) freight logistics affect how the supply chain is structured		Supply chain strategy (*Section 4.4.1*)
External Factors	External factors such as the (i) scalability of operations and (ii) geographic position of where the country operates in affects how the company and its supply chain is structured		Supply chain strategy (*Section 4.4.1*)
Organising Theme 3: Key Performance Indicators			
Safety and Wellbeing	Near miss reporting; lost time injury	(Arvidsson, 2011; Bayne et al., 2022; Bayne & Wee, 2019)	Dependent Variable – Construction of the disclosure index (*Section 6.3.4 B*)
Service	Delivery In Full and On Time (DIFOT) Shelf availability; Inbound and Outbound case fill;		
Quality	Pick Accuracy		
Efficiency	Vehicle Utilisation		
Product Innovation	Supporting innovation and "R&D type projects"		
Environmental	Carbon emissions; Waste to landfill		

Working Capital	Stock cover levels; aging/ obsolete stock		
Financial	Internal reporting (e.g. labour and vehicle costs) and External reporting (e.g. gross profit)		
Ease of Communication	Ease of communication with suppliers		
Organising Theme 4: Information Sharing			
Flow of Information	The flow of information across the supply chain is bidirectional between (i) suppliers and the company and vice-versa,(ii) customers and the company and vice-versa, and (iii) in collaboration with external partners.	(Baihaqi & Sohal, 2013; Yigitbasioglu, 2010)	Flow of information (*Section 4.5.1*)
Organising Theme 5: Financing			
Flow of Financing	The flow of financing involves (i) aligning financial flows with the downstream flow of materials and information, (ii) optimising cost structure, (iii) opportunity costs and (iv) supply chain financing	(Gomm, 2010; Hofmann, 2005; Silvestro & Lustrato, 2014)	Flow of financing (*Section 4.5.2*)
Organising Theme 6: Internal Visibility			
Tools to enhance internal visibility	Tools used to enhance internal visibility of the supply chain include (i) supplier code of conduct requirements, (ii) supplier certifications, (iii) meetings with	(Awaysheh & Klassen, 2010; Choi et al., 2020; Montecchi et al., 2021)	Supply chain transparency - Internal visibility (*Section 6.2.1 A*)

	key suppliers, (iv) supplier audits and self-assessments, (v) supply chain mapping and (vi) information systems		
Organising Theme 7: Supply Chain Disclosure (SCD) Index			
Collaborations/ Partnerships	Collaborations and partnerships with suppliers, customers and external organisations are important in activities such as new product development and incorporating circular practices in the supply chain	(Kaipainen et al., 2022; Koufteros et al., 2007)	Dependent Variable – Construction of the disclosure index (*Section 6.3.4 B*)
Social Disclosures	Social, environmental and circular economy disclosures are increasingly considered value-relevant disclosures given the growing importance in the supply chain.	(Awaysheh & Klassen, 2010)	
Environmental & Circular Economy Disclosures		(Green et al., 2012; Tiscini et al., 2022; Vitolla et al., 2023)	
Organising Theme 8: Factors affecting the extent of SCD			
Confidential & Proprietary Information	The supply chain is a competitive advantage tool, hence operational supply chain information is of confidential or proprietary nature.	(Ellis et al., 2012)	Discussion of Findings (*Section 6.5*)
Materiality & Value-Relevance	Supply chain information is disclosed provided it affect investors decision-making		

Legitimacy	Social and environmental supply chain information is disclosed in response to legitimacy threats and to counteract mediatised information.	(Deegan & Islam, 2010, 2014)	
Organising Theme 9: Effects of the Covid-19 pandemic			
Labour Shortages	Labour shortages in the form of (i) employees needing to isolate and maintain social distancing, (ii) employees who were scared of returning to work and (iii) loss of international students and travellers who were casual/part-time employees		Example: Covid-19 Pandemic (*Section 4.7*)
Order and Lead-Time Delays	There were delays in the order lead time from suppliers and to customers as well as delays in manufacturing orders		
Shipping & Logistics	Delays in the arrival of cargo ships, combined with limited volume space and rapidly increasing prices, and prioritisation of U.S-China shipping routes		
Country Regulations	Global supply chains were also affected by national government regulations on essential services and lockdowns		
Scaling of Production	While many of the companies suffered from reduced demand, some companies faced increased		

	demand which required the scaling of production to meet this increased demand		
Organising Theme 10: Lessons Learnt from the Pandemic			
Sourcing Strategies	The pandemic exposed the need to diversify sourcing and procurement in regard to number of suppliers and geography of suppliers	(Blome & Henke, 2009; Golini & Kalchschmidt, 2011)	Example: Covid-19 Pandemic (*Section 4.7*)
Building Cadence	Building production cadence into the system to in response to demand variability and unforeseen events		
Organising Theme 11: Changes in the Next 3 years			
Resilience	Developing resilience in the supply chain to (i) manage freight and raw materials and (ii) respond to future climate-related supply chain disruptions	(Tang, 2006)	Supply chain integration (*Section 4.6*)
Digitalisation vs. Cyber Security Risks	Balancing the digitalisation and automation of supply chain processes against the growing risks of cyber security threats and the potential effects of the supply chain and the company.	(Ben-Daya et al., 2019; Pandey et al., 2020)	
Involvement of Finance in Supply Chain Operations	Finance managers need to understand and involve themselves in supply chain operations to be effective in optimising costs		Flow of financing (*Section 4.5.2*)

4.4.1 Supply chain strategy

The supply chain structure, as noted by Lockamy and McCormack (2004), begins at the strategic level and with the development of the supply chain strategy (strategic dimension). This is guided by the proposition of value, in which Haslam et al. (2015) note that it is how a firm makes money. Nielsen and Roslender (2015) mention that an important part of a successful value proposition is factoring in what customers place value on. To elaborate, Nielsen and Roslender (2015) note that the proposition of value aligns the infrastructure of the supply chain with downstream customer interactions. Expanding on the infrastructure of the supply chain, it includes the organisational structure, strategies, resources, competencies, supply chain network and value configurations. As such, numerous dimensions are considered including operations strategy, supply chain capabilities and appropriate performance indicators (Bayne et al., 2022; Ivanov et al., 2019; Towill & Christopher, 2002).

In discussing the strategy of the supply chain, it comprises (i) the operations strategy and (ii) the capabilities used to carry out the operations strategy (Ivanov et al., 2019; Towill & Christopher, 2002). In noting this, the operations strategy is either (i) a lean operations strategy or (ii) an agile operations strategy (Towill & Christopher, 2002). This is noted in *Figure 4-1*. Purvis et al. (2014) also explain that a firm's supply chain strategy can adopt characteristics of both lean and agile operations strategies, which they term a "leagile" operations strategy. The operations strategy subsequently guides the capabilities used to operationalise either a lean or an agile operations strategy. Ivanov et al. (2019) list these capabilities as (i) cost-leadership, (ii) quality, (iii) innovation, (iv) flexibility and (v) responsiveness. *Figure 4-1* illustrates the inclusion of these capabilities as supply chain dimensions. For example, a lean operations strategy primarily adopts a cost-leadership approach, whereas an agile operations strategy primarily focusses on flexibility. However,

different capabilities can be and frequently are used in tandem (Kristal et al., 2010). The operations strategy and the capabilities form the foundation of a company's supply chain strategy.

However, bearing that in mind, the supply chain strategy is not decided upon in a vacuum and is based upon different factors. Firstly, the strategy of the supply chain is determined by getting the product to the customer as quickly as possible. Stressing the importance of this, interviewee #2 noted:

> *We design our supply chain around what we're trying to achieve and basically the design there is around, OK, how do we get a product into a customer's hands when and how they need it, OK. And then you work backwards from that what capabilities, what functions do you need.*

This quote suggests that the strategy of the supply chain is based on the objective of getting the product to the customer as quickly as possible and combined with meeting customer needs. This plays a major role in the choice of operations strategy and capabilities. Secondly, however, the strategy of the supply chain is also a product of its environment, which consists of various dimensions, including (i) internal dimensions, (ii) upstream supply chain dimensions, (iii) downstream supply chain dimensions and (iv) external market dimensions.

I first address the internal dimensions of the firm. This includes the (i) company strategy, (ii) sustainability strateg(ies) and (iii) product offerings. Referring to their sustainability strategy Interviewee #4 stated: *"As part of our latest sort of iteration of strategy we're looking to obviously continue to maximise value through the core, but also monetise and I guess progress and monetise the sustainability journey."*

This shows that a company's sustainability strategy is an important part in guiding the strategic dimensions of the supply chain and of a company's value proposition in creating value for customers. Further to this, a company's sustainability strategy has become an important vehicle towards the integration of sustainability development goals (SDGs) into company and supply chain operations (Pohlmann et al., 2020). As such, the progress towards SDGs is also another dimension of the supply chain. *Figure 4-1* illustrates both of these dimensions. The dimensions of sustainability strategy and SDG have been examined in Green et al. (2012), who combined these two dimensions in a proxy for green supply chain management (GSCM) and the commitment and support from the company.

Lamming et al. (2000) list further internal dimensions. They note that the product offerings by the company also influence the strategic dimensions of the supply chain, and as such are considered to be another dimension of supply chain strategy (*Figure 4-1*). They note that companies that sell functional (innovative) products are more likely to employ a lean (agile) supply chain structure which subsequently impacts the value proposition strategies of the company. Interviewee #7 provided support for this by mentioning:

> *There are different shelf lives; like some products they can last for like maybe two years and some products they can last for 20 years on the shelf. So, um, I guess the supply chain needs to cater for that and is also speed-to-market as well.*

The interrelationship between product offerings and supply chain strategy can be illustrated through Zara's supply chain. Aftab et al. (2018) note that fashion company, Zara, structures its supply chain differently for its basic (functional) and fashion (innovative) product lines. The study notes that, for its fashion product line, the company uses an agile supply chain structure, focussing on quality, flexibility, speed, and innovation to differing

extents. This is as opposed to its basic product line which employs a lean supply chain structure and focusses predominantly on cost efficiency (Aftab et al., 2018). However, in noting this, there are many other dimensions to the structuring of company supply chains.

Apart from internal dimensions of the firm affecting the supply chain strategy, strategy is also influenced by upstream and downstream dimensions of the supply chain. Interviewee #2 noted that the manufacturing of raw materials from upstream suppliers and the movement of freight logistics by downstream distributors determine the strategic dimensions of the supply chain. To put this into context, Interviewee #2 briefly noted the effects of raw material manufacturing and freight logistics, during the Covid-19 pandemic.

> *There's two kind of disruptors at the moment . . . One is the raw material manufacturing of, of component tree that comes from suppliers and the other one is the freight logistics distribution network that is controlled by freight forwarders.*

Given this, relationships with upstream suppliers (in raw material manufacturing) and downstream logistics partners (in freight logistics) are important dimensions influencing strategic dimensions of the supply chain. These dimensions are summarised in *Figure 4-1* and such relationships can be summed up through the overall business model (Norris et al., 2021).

Furthermore, external market and competitive dimensions also have to be considered in the supply chain strategy and in developing a competitive advantage (Nielsen & Roslender, 2015). This is referred to as external dimensions of the industry in which the firm operates. This constitutes noting the competition within the industry and leveraging future opportunities and challenges therein. These two dimensions, within the external dimensions, are noted in *Figure 4-1*. For instance, AstraZeneca's 2018 annual report notes that a growing elderly population across the world has expanded the market for healthcare products

(AstraZeneca, 2018). In addition, the Covid-19 pandemic has created a demand for vaccinations and PPE equipment, which has brought about opportunities and challenges for Fisher and Paykel Healthcare (Fisher and Paykel Fisher and Paykel Healthcare, 2020). Thus, an overview of the external market environment — opportunities, challenges and industry competition — are important dimensions in influencing the strategic dimensions of the supply chain. Dai et al. (2020) note that being able to adapt to these opportunities and challenges by leveraging is fundamental to ensuring that the strategy of the supply chain is resilient to disruptions such as that of the pandemic.

Furthermore, Interviewee #6 also alludes to the geography of the country the company operates in as playing a big part in the strategy of the supply chain. Interviewee #6 mentions that New Zealand having a small population and large geography limits the scalability of supply chain operations. They further note:

> *New Zealand's position on the planet has an impact in terms of both imports and exports and the length of time it takes to get product here from those product categories that are not grown in New Zealand. And so that, I think, raises challenges in terms of operational efficiency and cost.*

Thus, the geography in which the company operates in is a dimension influencing the supply chain strategy.

However, in linking supply chain strategy to the company's value proposition, there need to be control mechanisms in place to align the supply chain strategy with the value propositions (Burritt & Schaltegger, 2014). These controls are frequently in the form of performance dimensions, and specifically key performance indicators (KPIs), which, in addition to aligning strategy to value propositions, communicate the success of the firm in

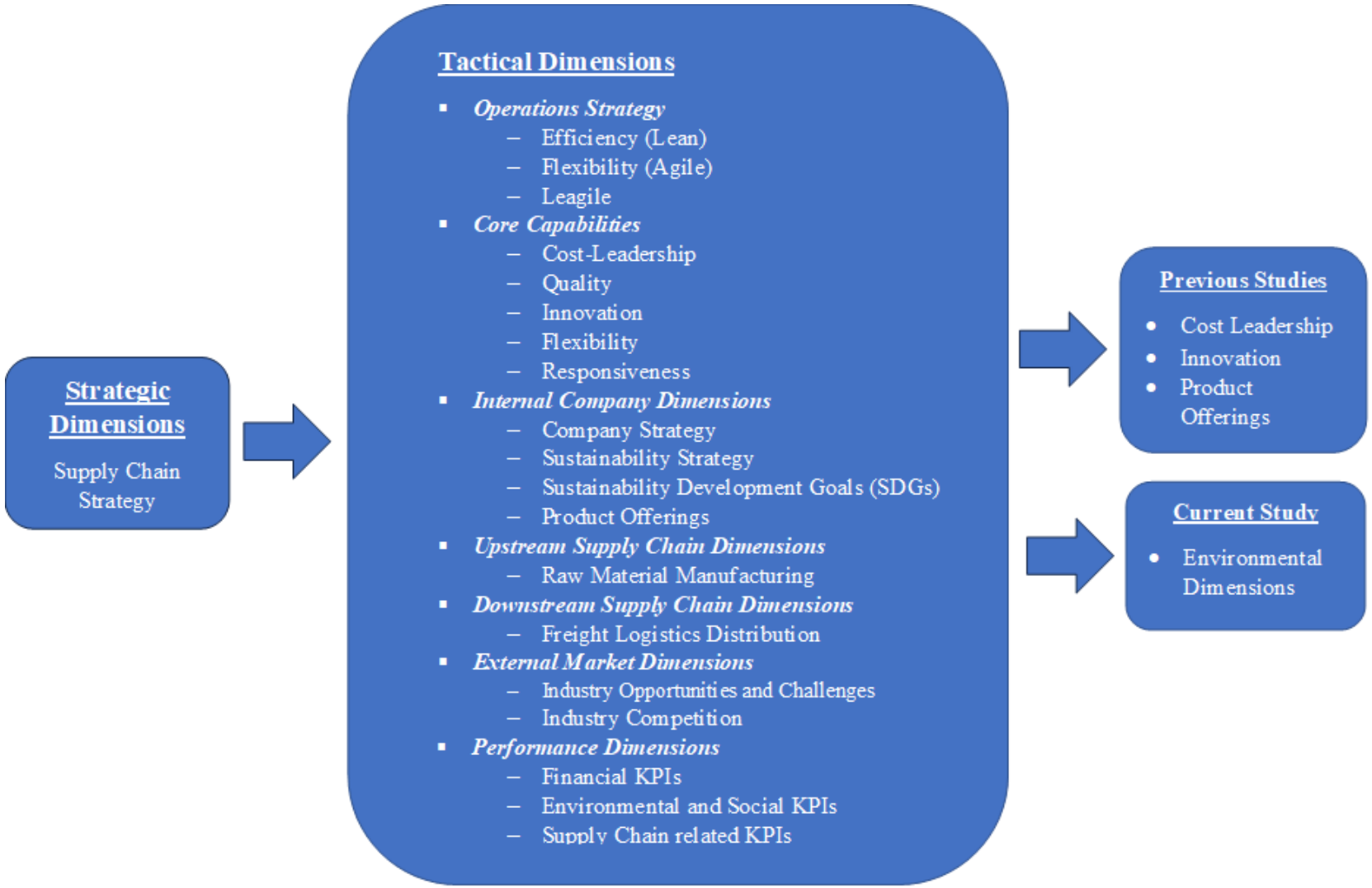
achieving its supply chain strategy (Bayne & Wee, 2019). Interview findings note that such KPIs in the context of the supply chain include financial KPIs (e.g. gross profit margin), environmental and social KPIs (e.g. waste to landfill), and supply chain-related KPIs (e.g. product innovation). This is reflected in *Table 4-1.*

Research in previous studies has examined different dimensions. Scholars have studied the effect of operational dimensions such as (i) cost leadership, (ii) innovation, (iii) green supply chain management and (iv) product offerings against firm performance and capital structure (DeCampos et al., 2022; Green et al., 2012; Lu & Shang, 2017; O'Brien, 2003). I will link the dimensions influencing supply chain strategy, listed in *Figure 4-1,* to the current research in subsequent chapters. In the current thesis, dimensions such as green supply chain management and sustainability strategies are used as proxies for supply chain structure. This is through the composite measure of environmental dimensions.

In summary, this subsection discussed the formulation of supply chain strategy, comprising (i) operations strategy and (ii) core capabilities. This is influenced by the objective of getting the product to the customer as quickly as possible. On the other hand, the internal and external environments also affect the strategy of the supply chain. These environmental factors can be characterised into several dimensions including (i) internal company dimensions, (ii) upstream supply chain dimensions, (iii) downstream supply chain dimensions and (iii) external market dimensions. These dimensions and the subdimensions are summarised in *Figure 4-1*. From this discussion, I have identified such dimensions that have been discussed in previous studies and which are used in the current thesis.

The supply chain strategy (strategic dimension) informs the tactical dimensions of the supply chain, characterised through the processes of (i) sourcing and procurement, (ii) production and (iii) logistics and distribution. These tactical dimensions are discussed below.

Figure 4-1: *Supply Chain Strategy (Flow of Materials) – Dimensions*



4.4.2 Sourcing and procurement

The sourcing and procurement process is reflective of how value is created in the supply chain (Norris et al., 2021). Ivanov et al. (2019) define procurement as the purchase of goods and services from third parties and in-house providers. A factor analysis performed by Lockamy and McCormack (2004) found that the (i) purchasing and supply of materials (supply base) and (ii) strategic supplier collaboration are important overarching dimensions within the sourcing and procurement process. Further to this, Green et al. (2012) and Awaysheh and Klassen (2010) note that (iii) environmental dimensions and (iv) social dimensions are also important. The four dimensions mentioned, and the subdimensions within these will be discussed below.

The efficient supply and purchasing of materials can be looked at as the management of the company's supply base (Blome & Henke, 2009). Expanding on this, the management of a company's supply base affects the complexity of the upstream supply chain and can be subdivided into further dimensions, as summarised in *Figure 4-2*. This includes dimensions such as (i) single sourcing versus multiple sourcing and (ii) local sourcing versus global sourcing (Blome & Henke, 2009; Golini & Kalchschmidt, 2011).

Blome and Henke (2009) outline the importance of single versus multiple sourcing within a company's supply base. They note that a single sourcing strategy makes it easier for the company to form closer collaborations with suppliers but increases the likelihood of disruptions to the supply of materials. On the other hand, multiple sourcing strategies reduce the likelihood of supply disruptions and provide more cost competition to the sourcing of materials. However, multiple sourcing adds to the structural complexities of the supply base and the upstream supply chain (Lu & Shang, 2017). The consequences of a single or dual sourcing strategy, as opposed to a multiple sourcing strategy can be illustrated through Apple's supply chain in the context of the Covid-19 pandemic. Wu (2021) reports that

Apple's dual sourcing strategy of mobile chip components from Broadcom Inc. and Texas Instruments suffered delays in the production and supply of these components, amid the Covid-19 pandemic. This consequently impacted the release to the market of Apple products, which adversely affected shareholder value.

Secondly, Golini and Kalchschmidt (2011) and Ivanov et al. (2019) outline the importance of local versus global sourcing. On the one hand, local sourcing allows for greater flexibility and responsiveness in supply chain operations (Ivanov et al., 2019). Such benefits are illustrated through Zara's supply chain (Aftab et al., 2018). Moreover, local sourcing reduces the vulnerability of the supply chain to global risks (Mefford, 2009). On the other hand, Golini and Kalchschmidt (2011) find that global sourcing helps reduce costs through accessibility to more suppliers. However, the downside is companies have to invest more in inventories and maintain more inventory on hand to counter longer lead times. In addition, global sourcing exposes the upstream supply chain to greater globalised risks and uncertainties (Free & Hecimovic, 2020). This tension between local sourcing and global sourcing can be encapsulated by the shift towards regionalisation and localisation given the effects of the pandemic on global supply chains (Free & Hecimovic, 2020). Providing a further example of Apple, Mickle and Kubota (2020) noted analysts' and investors' concerns over Apple's over-reliance on Taiwanese companies, amid escalating US-China trade tensions. This was made worse by the Covid-19 pandemic, which created multiple delays in the production process. In consequence, this resulted in cutbacks of up to 10 million units of the new iPhone 13 which caused Apple's shares to drop .

In combination, interviewees noted the importance of diversifying a company's supply base, both regarding the number and geography of a company's suppliers. This has especially been the case after the initial effects of the Covid-19 pandemic. In noting the geographical spread of the supply base, Interviewee #1 made this statement in the context of his company

and attributed it to the lessons learnt from the disruptions of the pandemic: *"So maybe have a supplier in Malaysia and the supply in the US so just don't have both suppliers in the same country you know."*

Interviewee #1 also added the importance of having more than a single supplier of the same component and geographically spreading this supply from different countries:*"Whilst we do get a lot of sewing activity done in Vietnam what it certainly made us realise was you wouldn't want just scrap all the sewing in the New Zealand factory either."*

Overall, the management of a company's supply base, according to the number of suppliers and the geographic spread of those suppliers, is a valuable resource. This is especially the case after the effects of the pandemic on supply disruptions. However, such resources are unlikely to be rare, inimitable and non-substitutable as many competitors will have multiple suppliers from multiple countries. Thus, a company's supply base alone is unlikely to be a valuable resource contributing to competitive advantages in itself. Hence, developing strategic collaborations with a smaller set of the supplier base may provide unique resources that provide a competitive advantage.

This leads me to the second dimension, strategic supplier collaboration as outlined by Lockamy and McCormack (2004). Strategic supplier collaboration is important in new product development (NPD) and the maintaining of a competitive advantage (Perks, 2000). This is further summarised in *Figure 4*-2. In explaining this, Perks (2000) notes that interfirm collaboration with suppliers, as opposed to intrafirm collaboration, can secure access to new resources as well as share costs and risks associated with product development. A great example of this is Honda's strategic collaboration with Rover in penetrating the European automotive market and in developing new products alongside the European-based company (Perks, 2000). This collaboration benefitted both companies with Honda acclimatising to the European automotive market more quickly, than compared to having no alliance. On the

other side, Rover benefited from Honda's established systems and processes. This allowed for greater innovation and financial performance (Corsten & Felde, 2005; Luzzini et al., 2015). Hoegl and Wagner (2005) and Zhang et al. (2017) further noted that supplier collaboration is associated with greater adherence to the development schedule of new products, the minimisation of development and product costs, and improved speed in bringing new products to market. All these benefits can contribute to NPD being a source of competitive advantage.

Overall, strategic collaboration with a few suppliers can provide access to relational resources from collaborating with industry leaders (Fonterra, 2023), as well as complementary resources from suppliers such as knowledge resources, which may be rare, inimitable and non-substitutable. However, while joint, strategic collaborations would allow the company a sustained competitive advantage for a period of time, this advantage would diminish as external collaborations started becoming a commonplace (Koufteros et al., 2007).

Contemporaneously, the dimensions of a company's supply base — (i) single versus. multiple sourcing and (ii) local versus. global sourcing — and strategic collaboration in NPD is insufficient to sustain a competitive advantage. The ability to maintain a competitive advantage through sourcing and procurement processes lies in the adoption and integration of environmental and social/ethical practices (Awaysheh & Klassen, 2010; Green et al., 2012). This is emphasised by Interviewee #5 who notes: *"Typically, in an organisation more than 80% of the environmental and social impacts of an organisation might be encountered in the supply chain of a company."*

This is supported by Green Jr et al. (2012) and Geng et al. (2017), who note that environmental dimensions such as (i) environmental certification (ii) green procurement and (iii) the eco-design of products (*Figure 4-2*) influence environmental practices and have positive effects on environmental and economic performance. The importance of such

environmental dimensions in economic performance and competitive advantage is reflected in *Figure 4-2*. Firstly, as noted by Gualandris et al. (2014), environmental certification is important in improving environmental performance and shifting toward green products and processes. This subsequently helps in implementing green procurement and eco-design of production. Green et al. (2012) define green procurement as the collaboration and cooperation with suppliers for the purposes of discovering environmentally-friendly materials. Eco-design is the collaboration with suppliers to design products that minimise the use of materials and energy in production, and which can be reused and recycled after consumer use (Green et al., 2012). Hence, as Interviewee #5 stated, the dimensions of green procurement and eco-design complement each other. Integrating these environmental dimensions to a company's supply base allows the company to find suppliers who use environmentally sustainable materials and collaborate with such suppliers to design new, greener products. In doing so, companies can sustain a competitive advantage. To illustrate this, I recall Interviewee #5 who mentioned:

> *So, one of the things we're doing, which we're only just really starting, is to liaise with suppliers who might be in the space to develop new materials or to provide materials that provide novel healthcare benefits as well as environmental impact reductions.*

Further to this, incorporating social dimensions into managing the company's supply base and in NPD is important in legitimating supply chain activities. Such social dimensions include supplier monitoring through (i) supplier code of conduct requirements and (ii) supplier audits. This will help in legitimating the upstream supply base of the firm through rigorous supplier selection, enforcement and monitoring, thereby indirectly sustaining a competitive advantage over rivals (Awaysheh & Klassen, 2010; Venkatesh et al., 2020). The

identification of these social dimensions is reflected in *Figure 4-2*. Awaysheh and Klassen (2010) also note the growing awareness of human rights issues and labour practices (e.g. modern slavery) in the supply chain. This teases out additional social dimensions of (iii) human rights and (iv) modern slavery and is reflected in *Figure 4-2*. In an environment where stakeholders are more demanding of information about product origins, integrating social dimensions in managing the supply base and in NPD can be a source of competitive advantage.

Overall, the sourcing and procurement process can be divided into several dimensions including (i) the supply base (ii) strategic collaboration with suppliers, (iii) environmental dimensions and (iv) social dimensions, as summarised in *Figure 4*-2. Previous studies have examined some of these dimensions, such as NPD, green procurement, eco-design and code of conduct requirements against supplier performance and firm performance (Carter & Jennings, 2002; Corsten & Felde, 2005; Green et al., 2012; Venkatesh et al., 2020). These dimensions studied in previous research are noted in *Figure 4-2.* In the current thesis, dimensions such as eco-design and human rights are used as proxies for supply chain structure. This is through the composite measures of environmental dimensions and social dimensions, respectively.

4.4.3 Production

The second tactical dimension that the supply chain strategy informs is the production process. The production process, in combination with the sourcing and procurement process, addresses how value is created through the supply chain (Norris et al., 2021). Ivanov et al. (2019) and Sharifi et al. (2006) note that the production process is the activity of making the product.

Figure 4-2: *Sourcing & Procurement process (Flow of Materials) – Dimensions*

The primary activity of the production process is the manufacture of the product. In their study, DeCampos et al. (2022) found that the number of products within their portfolio positively affected firm performance up to an optimal point before firm performance became negatively affected. They also note that the number of products comprising the company's product portfolio affects the complexity of the firm (and the upstream and downstream supply chains). Given this, a company's product portfolio is an important dimension affecting the production process of a company's supply chain and as such is illustrated in *Figure 4-3*.

The manufacturing of such products, within the product portfolio, can either be performed via contracting production to outsourcing partners and/or via in-house production. The former is reflective of outsourcing, which increases the structural complexity of the overall supply chain through having more supply chain partners. The latter also increases the structural complexity of the supply chain through having a greater asset base to support such production. Hence, outsourcing and in-house production are further dimensions that impact on the structural complexity and length of the supply chain and are summarised in *Figure 4-3*.

This decision of whether to outsource the manufacturing of products or manufacture in-house is illustrative of the make-or-buy dilemma of products (Geyskens et al., 2006). This make-or-buy dilemma can be explained through the lens of multiple theories including TCE (Geyskens et al., 2006) and RBV (Holcomb & Hitt, 2007). This discussion focusses on the latter. Explaining this trade-off, in-house production allows the company to maintain control of the production process and safeguard resources that are important in maintaining a competitive advantage (Gilley & Rasheed, 2000). On the other hand, outsourcing allows the company access to specialised equipment and manufacturing know-how (resources) that is otherwise not accessible to the company (Gilley & Rasheed, 2000; Holcomb & Hitt, 2007).

However, in practice the decision as to whether to manufacture products internally or externally outsource production is not binary, and is instead a continuum where many companies have a combination of both (Celo et al., 2018; Mocenco, 2015). In the case of Boeing, the company outsources production of aircraft sub-assemblies to specialised companies across the globe. These sub-assemblies are sent to the US and fully assembled at the company headquarters. This allows the company the benefit of leveraging relationships (relational resources) with other companies who specialise in the production of different aircraft components, while also safeguarding design innovations (Celo et al., 2018). Providing another example, in the case of Zara, the company engages in a combination of outsourcing and in-house production for different kinds of products (Aftab et al., 2018). This is dependent on a multitude of factors and considerations including the strategy of the respective product supply chains. Further supporting the combination of in-house production and outsourcing, Gilley and Rasheed (2000) found that peripheral outsourcing of non-core tasks was a significant predictor of firm performance and innovation performance. In their company, Interviewee #2 noted that, while they outsource some supply chain activities which are mostly peripheral activities, *"the majority of what we do is, is all kind of within our own control."*

Outsourcing can give rise to relational resources (e.g. relationship with the right outsourcing partners), technical resources (e.g. access to specialised equipment) and knowledge resources (e.g. production know-how). However, Leachman et al. (2005) note that too much outsourcing can shift the focal firms' attention away from R&D commitment, increase production lead-time and reduce inventory turnover which, in turn, has a detrimental effect on performance. Hence, considerations such as (i) the extent of outsourcing, as compared to in-house production, (ii) the component and/or activity which is outsourced and (iii) forming relationships with outsourcing partners with whom mutual benefits are gained

are important considerations to a competitive advantage. As such, the dimensions of outsourcing and in-house production are complements and the right balance is needed in the production process to align with the strategy of the supply chain.

Paired with the decision to outsource production or manufacture products in-house is the postponement dimension. Postponement is the ability to defer production until customer orders are received. One of the benefits of postponement is to enable product customisation in enhancing value creation and in developing a competitive advantage (Ivanov et al., 2019). This requires added agility and flexibility in the supply chain and while it reduces the uncertainties in meeting customers' needs, it increases the complexity of the production process (Yang & Burns, 2003). Consequently, linking the type of postponement strategy to the strategy of the supply chain is important. This is illustrated by Ivanov et al. (2019) in noting that a company with a lean, cost-efficient supply chain strategy will likely focus on mass production and adopt a push manufacturing strategy with a limited postponement strategy. On the other hand, an agile supply chain strategy will adopt a pull manufacturing strategy with a greater emphasis on postponement. This is supported by Qrunfleh and Tarafdar (2013), who find that postponement strengthens the relationship between an agile supply chain strategy and supply chain responsiveness.

Alongside the above-mentioned dimensions — (i) product portfolio; (ii) in-house production (iii) outsourcing and (iv) postponement — it is important to support such dimensions with the management of production facilities (facilities management). For example, Ivanov et al. (2019) note that Dell's assemble-to-order postponement strategy requires inventory to be held in central locations until customer orders were received. This emphasises the importance of managing a company's production facilities to carry out postponement activities for instance. The management of a company's production base is

consequently an important dimension as illustrated in *Figure 4-3*. This dimension comprises the (i) number of production facilities and (ii) geographic locale of such production facilities.

Addressing the former, the number of production facilities can lead to increased structural complexity in the firm. However, the number of production facilities can reduce the supply chain vulnerabilities to production risks, through reducing the impact of production facility closures (Free & Hecimovic, 2020). Addressing the latter, the strategic locale of production facilities can lead to competitive advantages through a reduction in lead times. In illustrating this, Jayaram et al. (2004) note that Wal-Mart's production headquarters are in close proximity to the company's biggest supplier and main distribution partner. This has allowed the company to develop relational and structural resources with key supply chain members, as well as enhance flexibility and responsiveness. In another example, recent growth in global demand for respiratory equipment has seen Fisher and Paykel Healthcare (FPH) invest in a third manufacturing facility in Mexico and scoping another in China (Fisher and Paykel Healthcare, 2023)

Increasing global geopolitical tensions have also highlighted the strategic locale of production facilities as a valuable dimension. Campbell et al. (2022) note that due to the trade tensions between the US and China, many car manufacturers either have left or are leaving China and are moving their production factories locally or to other countries. Free and Hecimovic (2020) also note that due to the Covid-19 pandemic and other disruptions companies have started to regionalise and/or localise their production facilities and supply chains. These examples show that physical dimensions such as the number and geographical proximity of production facilities can be a source of competitive advantage.

However, much like in the sourcing and procurement process, the integration of environmental dimensions and social/ethical dimensions in the production process are integral to sustaining a competitive advantage. Environmental dimensions include such things

as climate-related dimensions (*Figure 4-3*). These climate-related dimensions include the management of carbon emissions, energy, water and waste in the production process. Lee (2011, 2012) noted the importance of managing and measuring direct and indirect carbon emissions in production activities and the wider supply chain, in the context of the automotive industry. Interviewee #5 further referred to the importance of monitoring the climate-related impacts of supply chain activities amid the growing risk of climate-related supply chain disruptions. Given this, the minimisation of climate-related impacts can develop resiliency and be an important source of competitive advantage (Tang, 2006). In addition to these environmental dimensions, social dimensions within *Figure 4-3* include such considerations as the health and safety of employees (Deegan & Islam, 2010). The importance of health and safety considerations as a dimension has been emphasised in recent years given the events of the Rana Plaza disaster (Jacobs & Singhal, 2017).

Overall, there are many resources and dimensions that are important consideration in the manufacturing of the product (production process) as noted in *Figure 4-3*. These include dimensions influencing the operational aspects of the production process such as (i) the product portfolio/operating portfolio, (ii) outsourcing, (iii) in-house production, (iv) postponement and (v) production facilities. Further to this, there are dimensions that affect the environmental and social aspects of the production process such as climate-related dimensions and health and safety dimensions, respectively.

In previous studies, researchers have looked at numerous dimensions such as the company's product portfolio (as a measure of structural complexity of the supply chain). This is measured through the number of products the company offers (DeCampos et al., 2022). Further studies have examined dimensions such as outsourcing, postponement and climate-related matters against performance, structural complexity of the supply chain, and capital structure (Lee, 2012; Moon & Phillips, 2021; Yang & Yang, 2010). In the current thesis, the

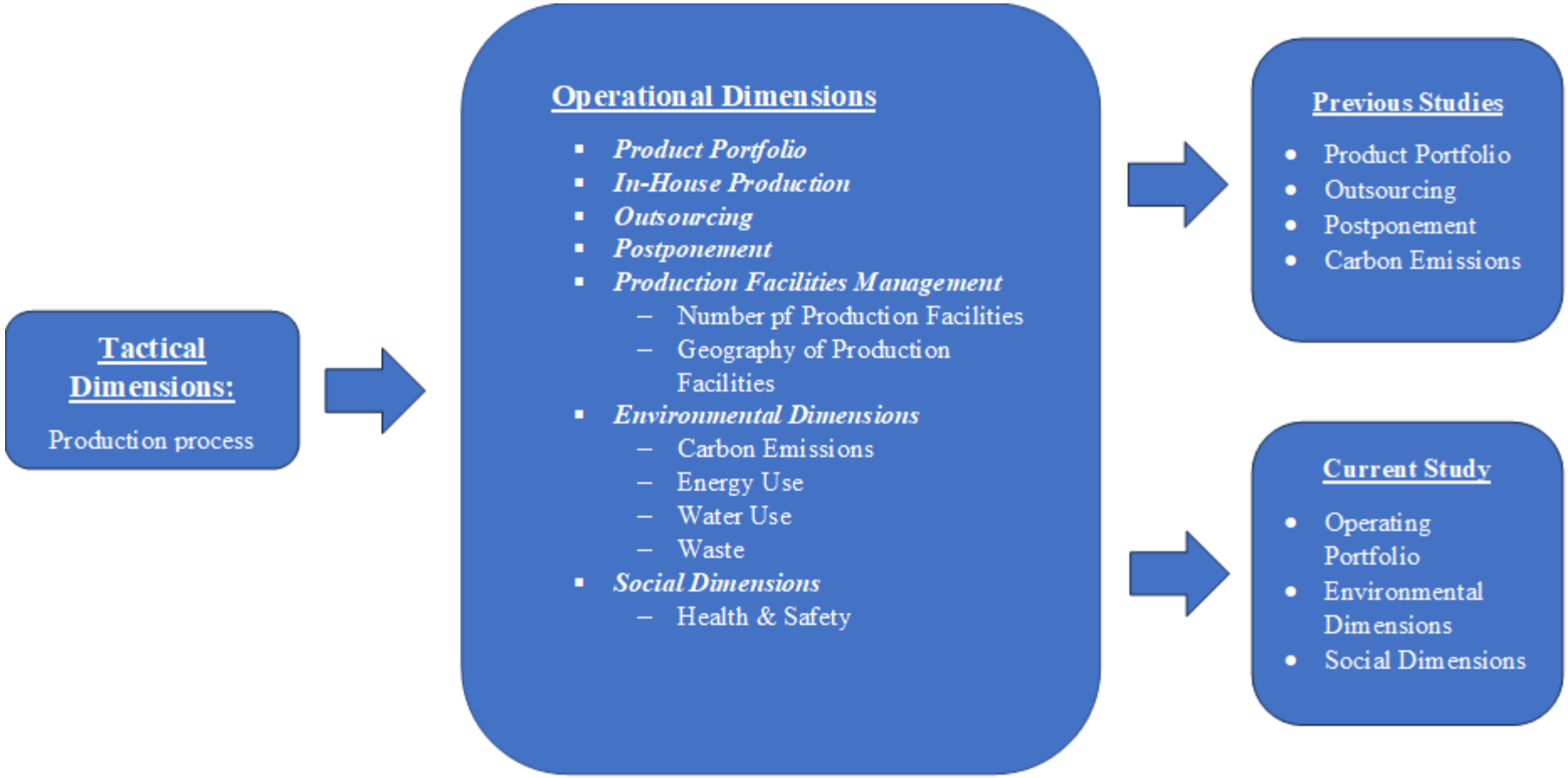
operating portfolio is used as a proxy for supply chain structure to measure the proportion of sales owing to the largest product segment. The current thesis also proxies for climate-related dimensions such as carbon emissions, energy and water usage, and waste, through the composite measure of environmental dimensions. Dimensions reflecting the health and safety of employees are also proxied for through the composite measure of social dimensions.

4.4.4 Logistics and distribution

The third tactical dimension which the supply chain strategy informs is the logistics and distribution process. Gligor (2014) refer to this process as the delivery of products on to distribution partners and subsequently on to the end customer. Li et al. (2006) mention the importance of this process by noting that the delivery of the product to the customer at the right time, and at the right place, and at the lowest possible cost enhances value. As such, this type of value is referred to as value delivery (Norris et al., 2021). Contemporaneously, as supply chains have become more complex and interconnected, supply chain dimensions within the distribution and logistics process have expanded (Rexhausen et al., 2012). These dimensions, include (i) demand management, (ii) customer base management, (ii) warehouse management and (iv) transport management.

I first the discuss the dimension of demand management, which consists of (i) demand forecasting and (ii) segmentation, as noted in *Figure 4-4*. In the context of the distribution and logistics process, these dimensions are seen as a knowledge resource. Interview findings have noted the important role that marketing plays. In illustrating this, Interviewee #8 noted, *"we are like the voice of the sales team."* This is through the dissemination of information relating to customer demand and matching these customer segments with product requirements (Juttner et al., 2007). This role has been magnified through the Covid-19 pandemic. In the context of the pandemic, Interviewee #8 emphasised that *"marketing has*

Figure 4-3: *Production process (Flow of Materials) – Dimensions*



the knowledge of the market needs, the priority markets. So, we work with the sales teams, and we decide which market takes priority over the stock."

Given this, knowledge resources gained through demand management — (i) demand forecasting and (ii) segmentation — can help support the management of a company customer base. Much like a company's supply base, as mentioned above, a company's customer base also affects the structural complexity of the supply chain, through the increased complexity of the downstream supply chain. As an important dimension towards affecting the complexity of the supply chain, a firm's customer base is illustrated in *Figure 4-4*. This provides insights into how to best serve the needs of these customers and structuring the supply chain accordingly. As such, important information within a company's customer base includes information on (i) major customers and (ii) location of customers.

Based on the insights provided through the dimensions of (i) demand management and (ii) a firm's customer base, Rexhausen et al. (2012) note the importance of designing the downstream supply chain accordingly. This is via a combination of (i) warehouse management, (ii) retail management and (iii) transport management. These are important dimensions in aligning the downstream supply chain and are reflected in *Figure 4-4.* Warehouse management can be characterised into the number and geographic locale of distribution facilities, and retail management as the number and geographic locale of retail outlets, as summarised in *Figure 4-4*. In order to enhance value delivery, such distribution facilities and/or retail outlets are suggested to be in close proximity to customers (Jayaram et al., 2004). For example, demand forecasts for FPH's medical equipment is the largest in North America with a growing customer base in Europe (Fisher & Paykel Fisher and Paykel Healthcare, 2020). As a result, FPH has set up production facilities across Mexico and third-party distribution outlets in Europe. This allows the company greater flexibility and responsiveness when dealing with its customer base. This can create a competitive advantage

over rival companies who do not have a physical presence or distribution alliances in local markets.

The dimensions of demand forecasting and segmentation (demand management) and warehouse management (physical dimensions) are significant dimensions in influencing firm performance (Rexhausen et al., 2012). However, they are not the only dimensions important to sustaining a competitive advantage and enhancing value delivery. Logistical dimensions such as transport management have been magnified through the effects of the Covid-19 pandemic. This is exemplified through delays from shipping disruptions caused by the Covid-19 pandemic as noted by Interviewee #3 who explained,

> *Previously the ships used to have a specific time it arrived and departed, and some were late and some early, but there was. You always knew when the ships were coming in, now you don't know. So, for us it changed that whole business model.*

Transport management plays an important role in getting products to the customer at the right place and at the right time (Rexhausen et al., 2012). This is illustrated through Fisher & Paykel Healthcare's use of air freight as alternative transportation to sea freight during the pandemic. This enabled shorter lead times which, in the context, sustained the firm's competitive advantage given the urgent need for these products during the peak of the pandemic (Fisher and Paykel Fisher and Paykel Healthcare, 2020). Further to this, Renwick (2023) noted the importance of not just having alternative transportation methods, but diversifying the transporting of goods. They note that roughly 93% of freight gets delivered by road networks in New Zealand, and this lack of diversification has caused major supply chain disruptions with the effects of external climate-related events such as flooding. A major part of this is as pointed out by Interviewee #6 is that *"the rail network is underdeveloped*

and under capacity" and further, *"our ports are some of the poorest performing in the world in terms of the turnaround times."* Hence, the leveraging of alternative transportation means, as well as diversifying in getting the product to the customer, is a valuable logistical dimension in sustaining a competitive advantage, especially during disruptions. This is reflected in *Figure 4-4*.

Further to the dimensions of the logistics and distribution process mentioned above, the integration of environmental and circularity dimensions is increasingly important in the sustainability of the supply chain and sustaining a competitive advantage. Firstly, within the overarching environmental dimensions, sub-dimensions such as sustainable/environmental packaging and circularity dimensions (circular economic practices) must be leveraged. This is in order to develop sustainable and green supply chains. Addressing the latter, Farooque et al. (2019) and Geissdoerfer et al. (2018) note that the circular economy concept is based on closed-loop supply chains and the reducing, reusing, remanufacturing, and recycling of material resources. An example of this is the launch of Orba's biodegradable sneakers which can be disposed of organically (Willis, 2021). Incorporating circularity dimensions in supply chain processes and the development of products based on circular principles can also help in generating added revenue, reducing costs and creating economic, environmental and social value (Ellinger et al., 2012; Geissdoerfer et al., 2018). Hence, developing resources to meet circular economic capabilities can be a source of competitive advantage for the company. The overarching environmental dimension of environmental packaging and circularity dimensions, as important to the logistics and distribution process, is summarised in *Figure 4-4*.

Overall, as summarised in *Figure 4*-4, dimensions within the distribution and logistics process include (i) demand management (demand forecasting and segmentation), (ii) customer base, (iii) warehouse management, (iv) retail management, (v) transport

management, (vi) environmental dimensions and (vii) circularity dimensions. These dimensions are important in creating value, through value delivery, and a competitive advantage. Such dimensions have also been examined in previous studies, and include forecasting, segmentation, S&OP, warehouse management and transport management against firm performance (Rexhausen et al., 2012). Studies have also examined the dimensions of customer base by measuring the number of downstream customers (DeCampos et al., 2022). In the current thesis, the customer base is used as a proxy for supply chain structure to measure the proportion of sales made to domestic customers. Further to this, dimensions such as sustainable packaging are used as proxies for supply chain structure. This is through the composite measures of environmental dimensions.

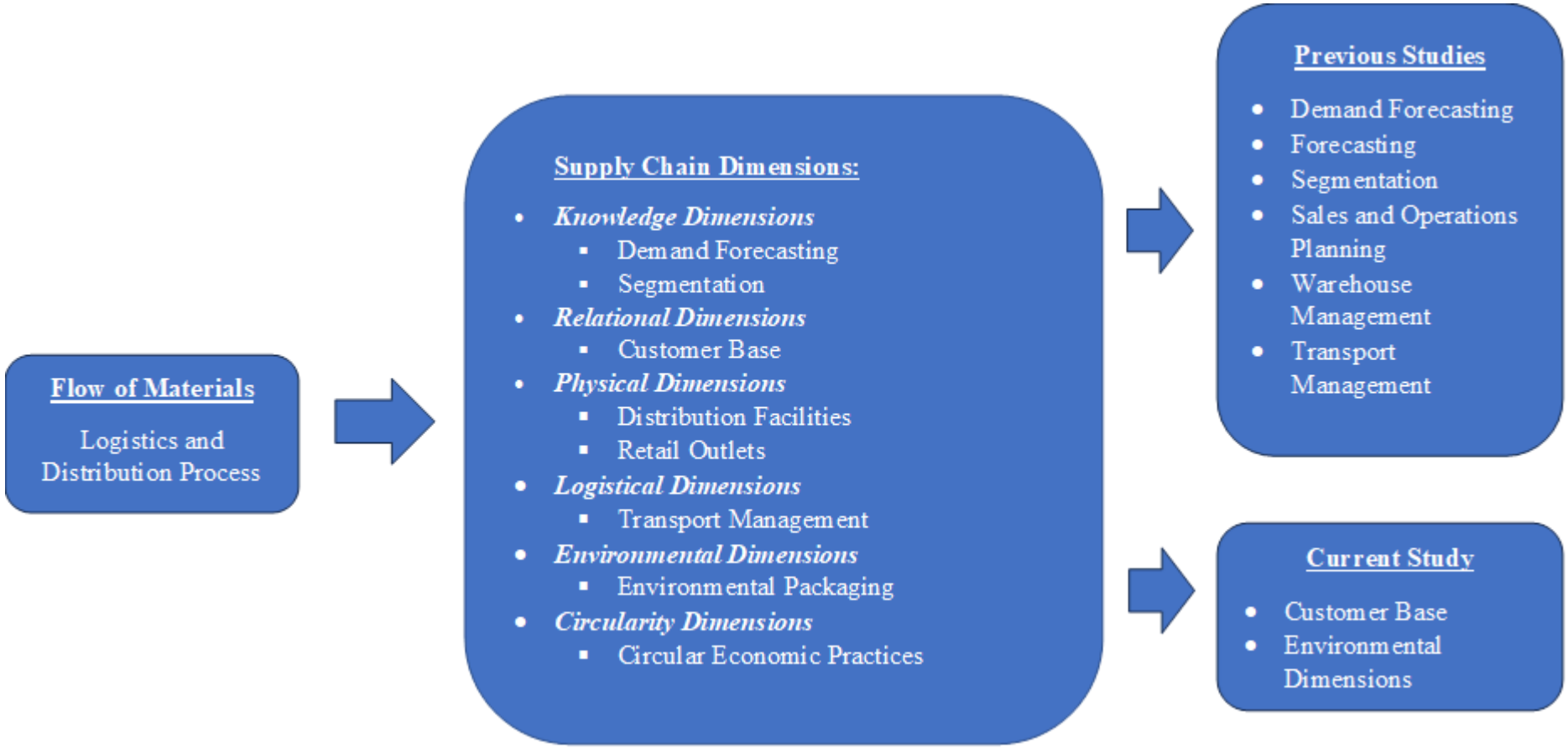
In summary this subsection outlined the flow of materials. It discussed the formulation of supply chain strategy and how this strategy is used to inform and carry out the (i) sourcing and procurement process, (ii) production process and (iii) logistics and distribution process. However, the flow of information and flow of financing are required to facilitate the flow of materials through the supply chain, and I discuss these below.

4.5 Flow of information & flow of financing

4.5.1 Flow of information

Baihaqi and Sohal (2013) note that the flow of information comprises information technology (IT) and information sharing. Information technology includes dimensions such customer relationship management (CRM) technology and enterprise resource planning (ERP) technology, as illustrated in *Figure 4-5*. (Hendricks et al., 2007). Hendricks et al. (2007) examined these two dimensions and found mixed results upon studying the effect of CRM and ERP systems on profitability and stock returns. The study found that ERP positively affected profitability, but not stock returns. However, for early adopters of ERP,

Figure 4-4: *Logistics and Distribution process (Flow of Materials) – Dimensions*



positive effects on performance and stock returns were found. On the other hand, CRM systems were found to have no effect. This shows that only information technology that integrates upstream and downstream processes into a single platform, such as ERP systems, can create a competitive advantage, while CRM systems clearly only facilitate the integration of downstream processes. Further dimensions examined within information technology include environmental management systems. Green et al. (2012) examined the effect of green information systems on performance, through the effect of green procurement, eco-design and other environmental dimensions reflected in the flow of materials. They found a significantly positive relationship.

The second process within the flow of information is information sharing. Li et al. (2006) examined two dimensions of information sharing: level of information sharing and quality of information sharing (*Figure 4-5*), as reflective of SCM practice on firm performance and competitive advantage. They found significant effects. When combined, the integration of information technology and information sharing is important in the flow of information. In support of this, Wu et al. (2006) note that information technology is most beneficial when paired with information exchange and interfirm integration.

However, not only is the integration of information technology and information sharing important, the integration of the dimensions within them and the flow of materials is essential in enhancing performance and value. Wu et al. (2006) and Kim et al. (2013) find that, through the effect on strategic collaboration (sourcing and procurement process) and the capabilities of the supply chain (supply chain strategy), information technology was positively associated with firm performance, and value creation. Kim and Chai (2017) also noted the importance of complementing the flow of information (information technology and information sharing) with the flow of materials (SCM practices) in enhancing performance.

Interview findings further emphasised the importance of integrating the flow of information with the flow of materials. Interviewees noted the bidirectional flows of information: flows from upstream suppliers to the company and vice-versa, as well as from the company to downstream customers and vice-versa. In aligning the distribution and logistics processes with the production processes and sourcing and procurement processes, Interviewee #4 noted, *"So, flows inbound from customers around their forecasts for how much product they're going to consume, which is then translated through our world into which products we want to produce."*

This demand information is subsequently translated into production requirements and requirements of raw materials from upstream suppliers. Interviewee #7 also commented on the importance of information flows to upstream suppliers*: "So, to me, having that logistics information and integrating the suppliers manufacturing or production scheduling with your own scheduling is the ultimate integration of the supply chain."*

This subsection noted that the flow of information comprises (i) information technology and (ii) information sharing. Within the former, previous studies have examined dimensions such as ERP, CRM and environmental management systems (Green et al., 2012; Hendricks et al., 2007). In the current thesis, dimensions such as environmental management systems are used as proxies for supply chain structure. This is through the composite measures of environmental dimensions.

4.5.2 Flow of financing

The flow of financing is the transfer of financial resources between the members of the supply chain. In highlighting the importance of this, Interviewee #7 notes that *"without the flow of financing nothing works."* This is due to the importance of supply chain activities in adding value to the firm with interviewee #7 mentioning that the *"supply chain has*

become a critical component in adding value." As such, the flow of financing comprises such dimensions as the (i) financial supply chain (FSC) and (ii) supply chain finance (SCF) (Gelosmino et al., 2016; Silvestro & Lustrato, 2014) as outlined in *Figure 4-5*.

Addressing the former, Silvestro and Lustrato (2014) noted that the FSC is responsible for the (i) efficiency of financial transactions within the supply chain, (ii) optimisation of supply chain costs and (iii) opportunity costs (*Figure 4-5*). To clarify, the importance of FSC is based on the notion that, while the financial side of the supply chain has always been present, the lack of synchronisation of financial flows with that of material and product flows has been a challenge. According to Fairchild (2005), the matching of product flows, information flows and financial flows is important to effective SCM. In the case of Motorola, Blackman et al. (2013) explain that the company implemented an enterprise resource planning (ERP) system connecting all Motorola entities worldwide, along with standardised business processes, shared information systems, exchange of electronic data, and a netting system facilitating foreign exchange and payments between Motorola operations. This illustrates the role of the FSC in improving the efficiency of financial transactions within the supply chain.

As regards the latter item, SCF, it is recognised that the flow of financing also comprises SCF. SCF is the management of working capital and maintenance of liquidity of all supply chain members (Silvestro & Lustrato, 2014). Gelosmino et al. (2016) outline two ways in which SCF can optimise working capital and asset utilisation: through the (i) finance orientation and (ii) supply chain-orientation dimensions (*Figure 4-5*). The finance-oriented perspective primarily focusses on optimising working capital through solutions provided by financial institutions such as trade credit and discounts provided to (or from) customers (or suppliers) (Banerjee et al., 2004). Further examples include reverse factoring and prepayments (David A. Wuttke et al., 2013). This is supported by interviewees, with

Interviewee #4 recollecting a *"receivables program where there is a bank providing finance for certain customers"* with Interviewees #1 and #6 adding that they pay early (prepayments) to suppliers in times of hardships.

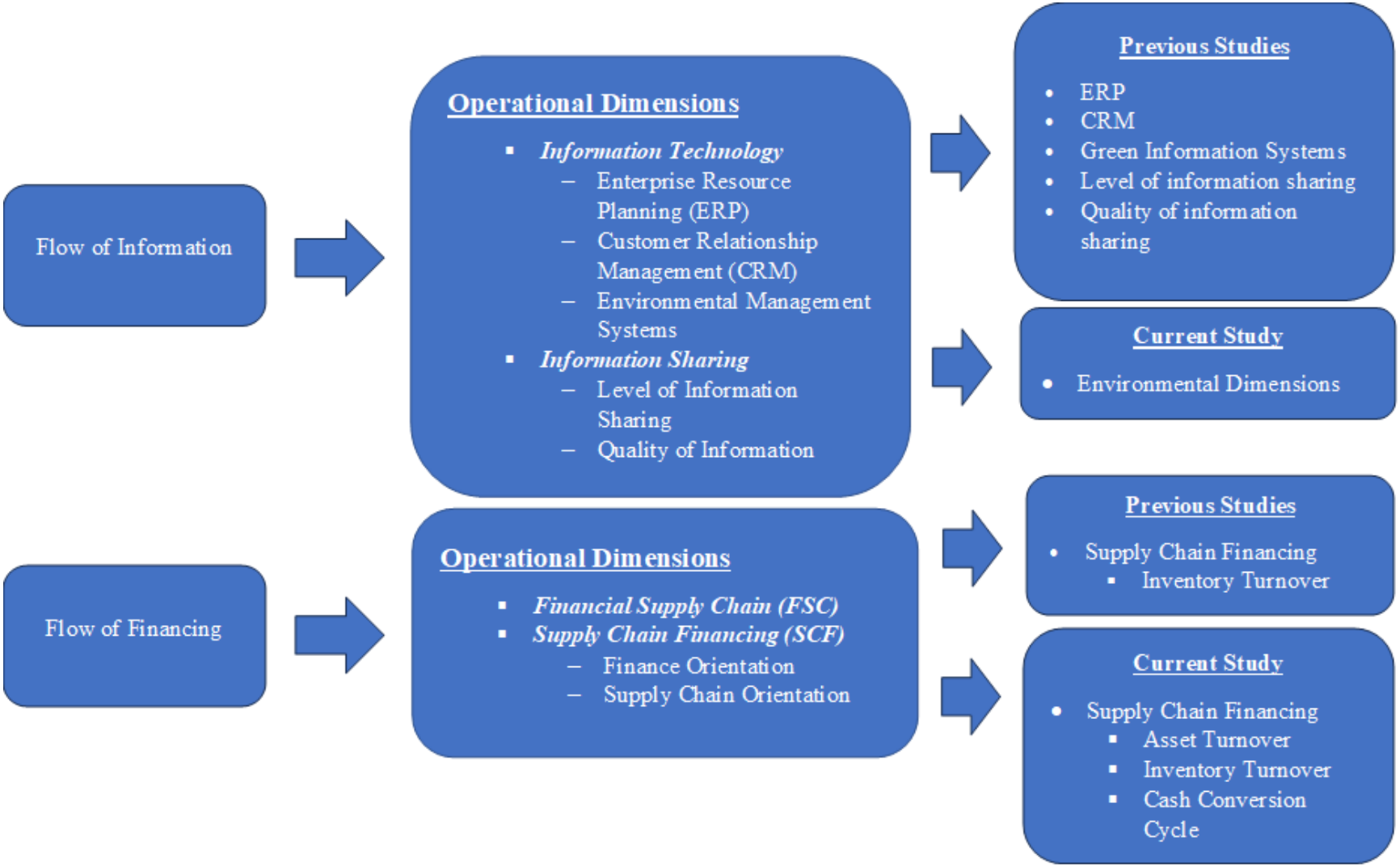
The second way is reflective of the supply chain orientation and primarily focusses on inventory optimisation and asset utilisation using internal tools, as opposed to financial institutions (Gelosmino et al., 2016). Examples of SCF solutions belonging to the supply chain-oriented perspective are vendor-managed inventory and pay-on-production (Gomm, 2010; David A Wuttke et al., 2013). Further examples of supply-chain oriented financing tools includes lease options and right-of-use assets to finance equipment (Gomm, 2010). Interviewee #2 provided an example of this in noting that they sometimes ask suppliers to purchase equipment on behalf the company. Moreover, leasing equipment is becoming more prominent with companies moving towards circular principles in their supply chain, more noticeably in product-as-a-service BMs (Rios & Charnley, 2017).

Previous studies have examined the supply chain orientation using measures such as inventory turnover (DeCampos et al., 2022). In the current thesis, dimensions such as (i) asset turnover, (ii) inventory turnover and (iii) cash conversion cycle are used as moderating variables. This is given that the flow of financing is used to support the flow of materials within the supply chain.

4.6 Supply chain integration

The previous subsections outlined the structure of the supply chain, comprising the (i) flow of materials, (ii) flow of information and (iii) flow of financing. From this, Kim (2006), Baihaqi and Sohal (2013) and Silvestro and Lustrato (2014) mention the importance of integrating these three supply chain flows in firm performance, value creation and in developing and maintaining a competitive advantage.

Figure 4-5: *Flow of Information & Flow of Financing - Dimensions*



In relation to this, Rexhausen et al. (2012) first note that the flow of materials and the four supply chain processes — (i) supply chain strategy, (ii) sourcing and procurement, (iii) production and (iv) logistics and distribution — need to be integrated and aligned to the company strategy. Tarafdar and Qrunfleh (2017) note that the dimensions within the sourcing and procurement process (source), production process (make) and logistics and distribution (deliver) mediate the relationship between supply chain strategy (plan) and firm performance. As Interviewee #2 noted, these activities do not happen in individual silos but are integrated to achieve a continuous process in getting the product to the customer. They note,

> *So, if you think about our logistics and distribution team, they actually work across that whole network to make sure that freight happens in the creation space. It happens in the buying space. It happens in the making space, and it happens in the selling space.*

Only from this starting point can the integration between the three different supply chain flows be accomplished. Tarafdar and Qrunfleh (2017) previously noted the mediating effect of (i) sourcing and procurement processes, (ii) production processes and (iii) logistics and distribution processes in the relationship between supply chain strategy and firm performance. However, the study adds that this mediating effect is even stronger when further mediated by information sharing. Added to this, Wu et al. (2006) note that the integration between the supply chain processes, reflecting the flow of materials, and information sharing, is not sufficient and that there should be further alignment with information technology as well.

In addition to the integration of the flow of materials and flow of information noted above, Silvestro and Lustrato (2014) also mention the importance of integrating the financial supply chain, which reflects the flow of financing. The study notes that improving the

efficiency and movements of financial transactions (financial supply chain) as well as the efficiency of working capital (supply chain financing) via unlocking the cash trapped in the financial supply chain will further improve the efficiency in the flow of materials. This is as depicted in *Figure 3.1* of Silvestro and Lustrato (2014). As such, the flow of materials, information and financing is intertwined and needs to be integrated in order to affect firm performance and competitive advantage.

The success in integrating these three supply chain flows allows for the capture of value through the supply chain (value capture) (Norris et al., 2021). Encapsulating the dimensions that result from the integration of supply chain flows and that influence value capture, is internal supply chain risks (Christopher et al., 2011) which is outlined as a dimension in *Figure 4-6*. Christopher et al. (2011) note that these risks stem from the internal operations of the supply chain and result from the extent to which the supply chain flows are integrated. They go onto highlight the main types of internal supply chain risks: (i) supply risks, (ii) process and control risks (manufacturing risks) and (iii) demand risks.

Supply risks are those associated with the upstream supply of materials, for example, global sourcing risks (Christopher et al., 2011). This is aptly illustrated through Apple's supply disruptions of mobile chip components from Broadcom and Texas Instruments, which ultimately affected customer and shareholder value (Wu, 2021). Manufacturing risks are those risks and uncertainties associated with the production process, such as the shortage of staff and capacity constraints at existing production facilities. These risks were experienced in FPH's supply chain during the peak of the pandemic (Fisher and Paykel Fisher and Paykel Healthcare, 2020). Lastly, demand risks are associated with the downstream supply of products, such as inaccurate demand forecasting and the inability to get the product to final customers on time (Ivanov et al., 2019).

Further to the internal supply chain risks, external risks and uncertainties also affect the value and competitive advantages realised by the supply chain. These risks, which are noted in *Figure 4-6,* include (i) political, (ii) economic, (iii) social, (iv) technological (e.g. cyber-security risks), (v) legal, and (vi) environmental (PESTLE) risks, which can stem from within or outside the company (Giannakis & Papadopoulos, 2016). Examples of the most notable risks that have affected supply chains in the recent past and at present include environmental risks (e.g. natural disasters, climate-related risks), economic risks (e.g. 2008 Global Financial Crisis), political risks (e.g. US-China Trade War, BREXIT) and the recent Covid-19 pandemic (Free & Hecimovic, 2020). These risks either directly affect the supply chain or, in most cases, like that of the Covid-19 pandemic, affect the internal supply, manufacturing, and demand risks.

Giannakis and Papadopoulos (2016) and Huang et al. (2015) subsequently noted that the approach to managing these internal supply chain and external risks affect the performance of the supply chain and the firm. Nielsen and Roslender (2015) point out that value capture is the realisation of revenue as a result of the process of value creation and value delivery. In simple terms, it is the performance of the company and its supply chain. Consequently, the financial performance of the company is summarised as a supply chain dimension in *Figure 4-6*. The measures of firm performance, which are reflective of the supply chain, include measures such as sales growth, total cost reduction, return on investment, return on assets and net profit (Kim, 2006). Such overall measures also include the gross profit margin, which considers the effectiveness of the upstream supply chain in optimising costs and cost savings (Haksever et al., 2004). Interviewee #7 also alludes to the importance of the gross profit margin: *"gross profit is the black box within which your supply chain is always constantly working."* Further measures include the return on capital employed (ROCE), which measures the efficiency and effectiveness of the supply chain in

utilising its resources and assets (Huang et al., 2015), and total shareholder return (TSR), which captures the value generated over the long-term.

This subsection outlined the importance of integrating the flow of materials — (i) supply chain strategy, (ii) sourcing and procurement, (iii) production and (iv) logistics and distribution — with the flow of information and flow of financing. The extent of this integration, or rather the lack of integration, leads to the magnitude of internal supply chain risks. Subsequently, the combination of internal supply chain risks and external risks, and the approach by which these risks are managed affect firm performance and the value created for stakeholders. *Figure 4-6* lists these dimensions of supply chain integration: internal supply chain risks, external risks, firm performance and value created for stakeholders. Previous studies have looked at internal supply chain risks and firm performance as dimensions of the supply chain (Christopher et al., 2011; Kim, 2006). However, none of these dimensions are examined as part of the four supply chain dimensions referred to at the start of this thesis.

Following the integration of the (i) flow of materials, and the four processes that comprise it, (ii) flow of information and (iii) flow of financing and the dimensions within, the study develops a supply chain framework. This framework illustrates the overall structure of the supply chain in *Figure 4-7*.

Following this, I look at an example of the different flows, processes and dimensions of the supply chain in action. This is done by looking at the effects of the Covid-19 pandemic on supply chains.

4.7 Example: Covid-19 pandemic

The importance of the above-mentioned supply chain processes within the flow of materials, alongside the flow of information and financing, in developing and maintaining a

competitive advantage can be illustrated through the effects of the Covid-19 pandemic. The epidemic was first discovered in December 2019 in Wuhan, China. Fast-forward a few years, what was an epidemic is now a global pandemic and presents multiple challenges four years on. One of the most prevalent challenges of the Covid-19 pandemic has been in relation to supply chains. The pandemic has had negative effects on the processes within sourcing and procurement activities, production activities, and logistical and distribution activities, and on the flow of information and flow of financing.

The Covid-19 pandemic negatively affected the supply chain dimensions within sourcing and procurement processes. These effects have mainly been focussed towards the size and geographical spread of companies' supply bases. As mentioned earlier, delays by Apple's primary suppliers, Broadcom and Texas Instruments, ultimately caused delays in the release of Apple's iPhone 13. Covid-19 exposed the susceptibility of having a single- or dual-sourcing strategy, with Interviewee #1 saying that *"the other thing that it's made us, made us focus on is having more than one source of supply."*

Disruptions and delays were also emphasised to a greater degree for global supply chains. Due to the pandemic, countries went into lockdown, with only essential services allowed to operate. However, the categorisation of an essential service was not universal, with companies categorised as an essential service in one country not categorised as an essential service in another. This wreaked havoc for global supply chains with Interviewee #1 noting *"In Malaysia, it was much [difficult]. In New Zealand it was quite easy to be considered an essential service"* in reference to getting suppliers to be considered an essential service. In addition, shipping delays from overseas suppliers meant that production orders were delayed, with Interviewee #1 explaining that *"we probably only got out 20% of orders that we processed… So, our lead times just blew out."*

Figure 4-6: *Supply Chain Integration – Dimensions*

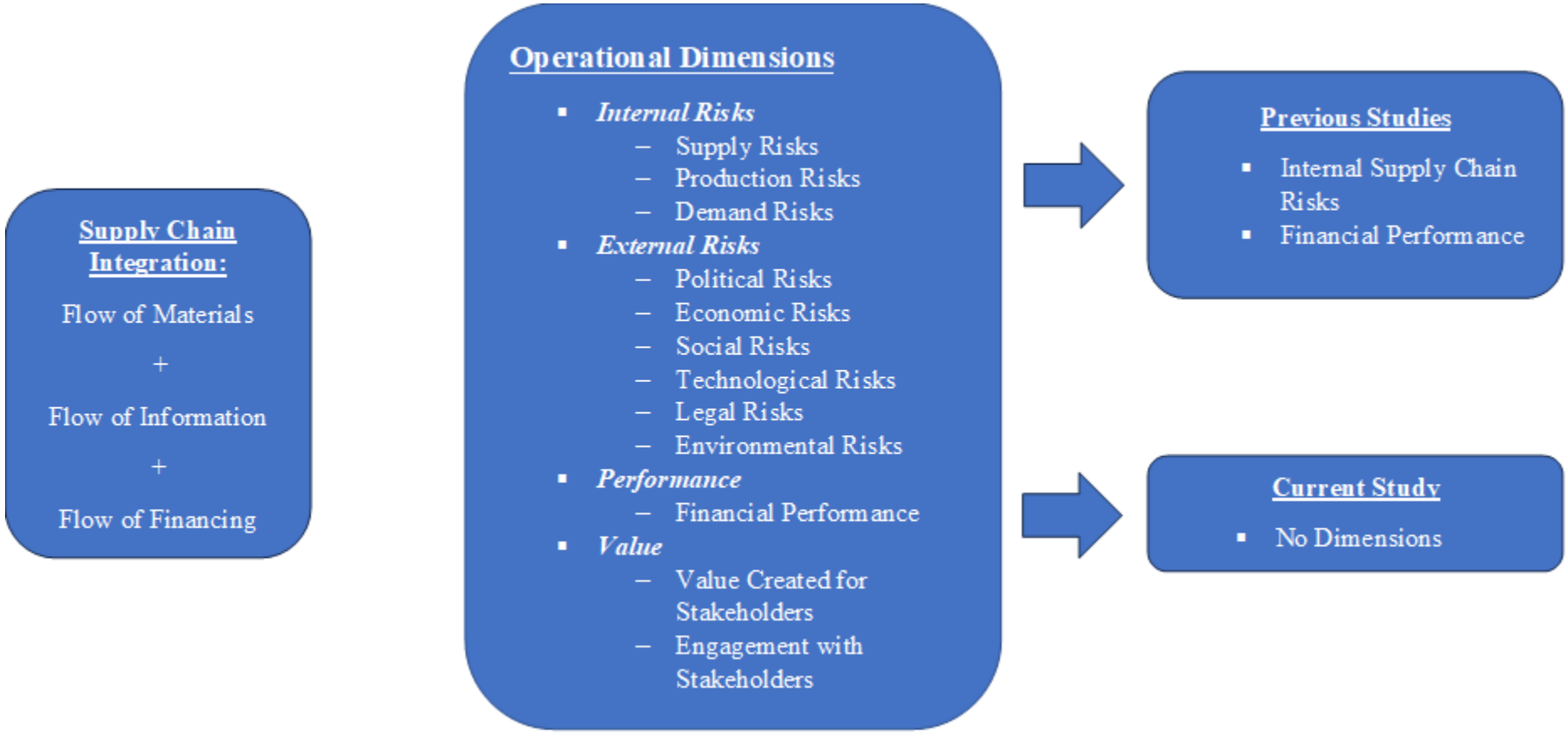
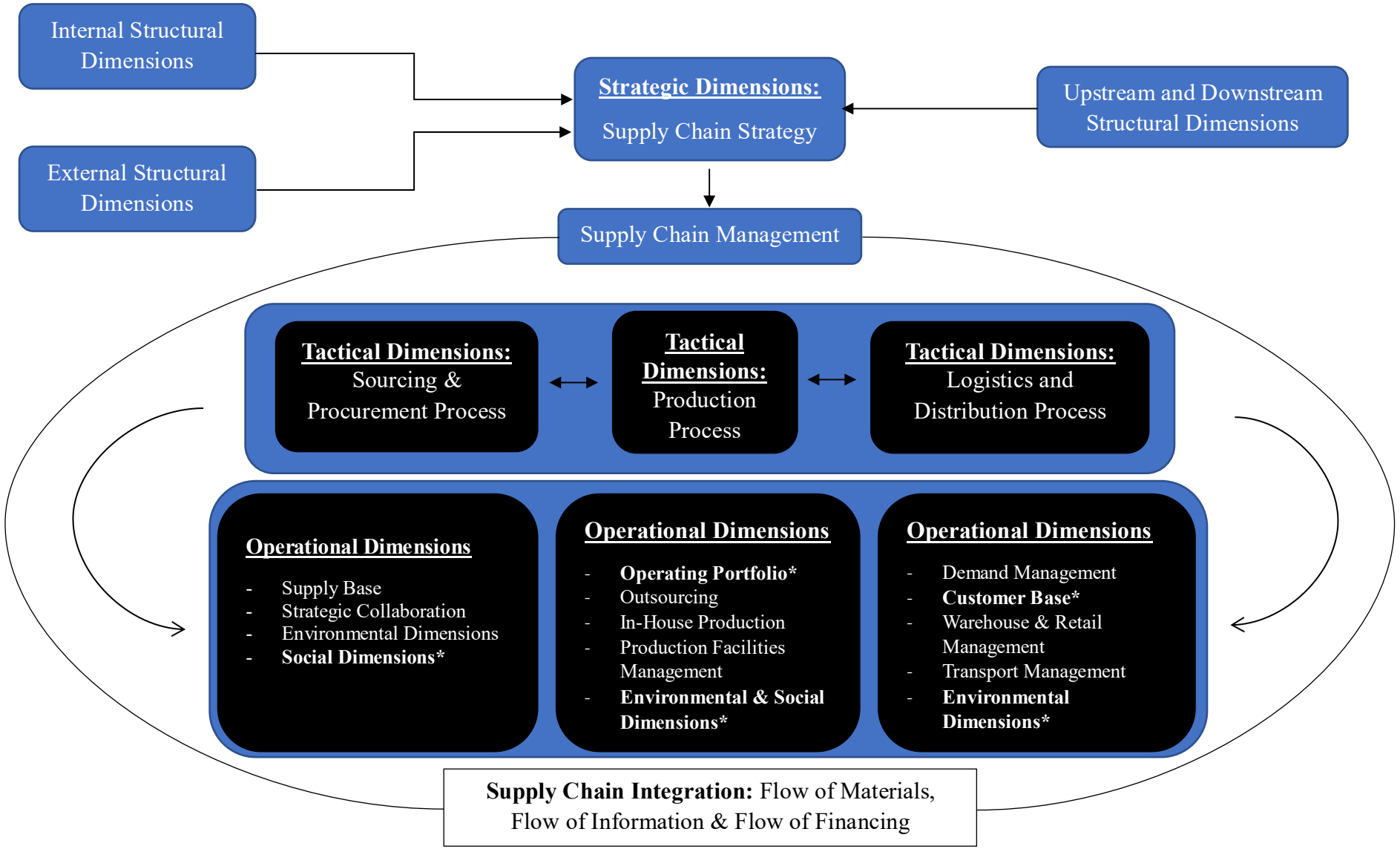


Figure 4-7: *Supply Chain Framework*



As a result of these combined disruptions, Interviewee #1 reflected on this and mentioned the following:

> *Whilst we do get a lot of sewing activity done in Vietnam what it certainly made us realize was you wouldn't want just to scrap all the sewing in the New Zealand factory either. So that if something did happen, then we would still have the capability in New Zealand to sew products.*

Further to this, the pandemic has affected supply chain dimensions within the production process. As previously illustrated, Boeing uses outsourcing in the production of its aircrafts. However, as Bloomberg (2023) and Halpin (2023) noted, the pandemic has created shortages of aircraft components from outsourcing partners that has restricted output, amid demand from airlines requiring production to be ramped up. This example illustrates the consequences of outsourcing. Similarly, Interviewee #2 noted that, due to the pandemic, demand for medical equipment spiked, and they *"had to scale very, very rapidly, so that's always really challenging to do in a short space of time."* In noting this, Interviewee #2 also mentioned that production is done in house, and this has created additional challenges of scaling in-house production. Interviewee #8, who works for the same company, noted that the pandemic has shown *"we should always have cadence in our system to account for them."* As such, optimising the extent of in-house production and outsourcing contribute to enhancing flexibility in production and the ability to ride out future supply chain disruptions.

Further challenges caused by the pandemic arose from labour shortages. As previously noted, Interviewee #1 mentioned that lead time blew out because of supplier closures. In compounding this challenge, Interviewee #1 also explained:

> *One of the biggest challenges . . . we employ a lot of Filipino staff to do a lot of our assembly and sewing and they were incredibly frightened by the pandemic . . . and just wanted to stay at home.*

Interviewee #6 agreed there were challenges posed by labour shortages:

> *So, by locking the country down for three years and closing our borders, we lost a lot of available workforce. We lost international students who typically come to work in our distribution centres part time. And particularly down in Palmerston North, we lost access to a pool of travellers and tourists who come here on work visas.*

In addition to effects in the upstream supply chain and in internal company operations, the pandemic has severely affected downstream supply chain operations concerning logistical and distribution activities. The biggest challenge has been the delays to shipping which have prevented companies from getting the product to the customer at the right place, at the right time and at the lowest possible cost. Interviewee #3 compares the delays in shipping during the pandemic, as compared to the pre-pandemic period:

> *Previously the ships used to have a specific time it arrived and departed, and some were late and some early, but there was... You always knew when the ships were coming in, now you don't know. So, for us it changed that whole business model*.

The delay in shipping has been compounded by increases in the cost of shipping, which has subsequently led to inflation (Interviewee #8). In addition to shipping delays and cost

hikes, shipping lines have prioritised more frequented trading routes. Interviewee #6 recollected this:

> *The impact was felt by shipping lines when the demand, consumer demand boomed in the United States and a lot of shipping lines refocus their efforts on delivering from China to US and less on wanting to come to the Southern hemisphere.*

To sum up the effect of the Covid-19 pandemic, it has caused a combination of supply disruptions in sourcing and procurement processes, production disruptions in internal company operations and demand disruptions in logistical and distribution processes. Interviewee #2 summed it up nicely in mentioning the two most important disruptions: *"One is raw material manufacturing of, of component tree that comes from suppliers and the other one is the freight logistics distribution network that is controlled by freight forwarders."* However, the flow of information and the flow of financing can help mitigate the effect of disruptions and uncertainties caused by the Covid-19 pandemic.

The importance around the flow of information has become more emphasised during the pandemic. As illustrated above, one of the main challenges has been forecasting, given the spike in demand that some companies faced. The importance of information technology in accurate forecasting in such a scenario was noted by Interviewee #7 who explained:

> *Ideally from marketing perspective we want to be able to trust the system. We shouldn't need to monitor the forecast and safety stock levels. . . We actually want the system to be accurate like the system to be able to have self-correcting measures.*

In aligning this forecast with the upstream production and supply, Interviewee #7 highlighted, *"Having that logistics information and integrating the suppliers' manufacturing or production scheduling with your own scheduling is the ultimate integration of the supply chain."* This highlights the importance of IT and information sharing, as supply chain dimensions, during supply chain disruptions.

Furthermore, the flow of financing, especially the dimension of SCF, has become more pertinent. As mentioned previously, the pandemic caused delays in the in-transit shipments between supplier and manufacturer or manufacturer and customer. The pandemic also resulted in companies holding higher stock levels, as compared to pre-pandemic periods. This reflected more cash being tied up in inventory and companies maintaining greater working capital balances. In noting the importance of the flow of financing, Interviewee #7 added that the financing is an important part of your working capital cycle. Summing this up, the effects of the pandemic perfectly illustrate the importance of integrating the flow of information and the flow of financing with the sourcing and procurement, production, and logistics and distribution processes. This enables the company to mitigate supply chain disruptions caused by the pandemic and differentiate itself from competitors via developing resilience in its supply chain.

4.8 Conclusion

This chapter outlined the supply chain framework and the flows, processes and dimensions which comprise the structure of the supply chain. The chapter noted that the structure of the supply chain has three distinct flows: (i) flow of materials, (ii) flow of information and (iii) flow of financing. Further to this, the chapter reviewed the four processes within the flow of materials: (i) supply chain strategy, (ii) sourcing and procurement, (iii) production and (iv) logistics and distribution.

Using the RBV, I drilled deeper into each of these four processes and diagrammatically illustrated through *Figure 4-1* to *Figure 4-4*. Alongside these four processes focussing on the flow of materials was the flow of information and flow of financing. The dimensions reflecting the flow of information and flow of financing are diagrammatically illustrated through *Figure 4-5*. In combination, the integration of dimensions reflected in the flow of materials, flow of information and flow of financing facilitate the efficient movement of goods through the supply chain. The integration of these supply chain dimensions subsequently enhances firm performance and value. However, the lack of integration of these dimensions will result in internal supply chain risks. Combined with these internal risks, the supply chain will also face risks from the external environment. The product of supply chain integration or the lack of supply chain integration can also be identified as supply chain dimensions and is illustrated in *Figure 4-6*.

In this way, the movement of goods through the supply chain can be illustrated through *Figure 4-7*. *Figure 4-7* shows that the strategy of the supply chain is a product of (i) internal company dimensions, (ii) upstream and downstream supply chain dimensions and (iii) dimensions of the external environment. The formulation of the supply chain strategy subsequently informs the (i) sourcing and procurement process, (ii) production process and (iii) distribution and logistics process as in *Figure 4-7*. This trickles down to the supply chain dimensions at the operational level in order to carry out the strategy of the supply chain. This effectively aligns the strategic level of the supply chain and the operational level of the supply chain. *Figure 4-7* shows that this alignment is facilitated through the flow of materials and flow of financing. As such, *Figure 4-7* illustrates the overall structure of the supply chain, which this thesis uses as a foundation to understand the three research questions. The highlighted dimensions illustrate the dimensions used as measures of supply chain structure.

These are (i) customer base, (ii) operating portfolio, (iii) environmental dimensions and (iv) social dimensions.

Chapter Five: Supply Chain Structure and Nature of Financing

5.1 Introduction

In this chapter, I examine the first of the three research questions which investigate the effect of supply chain dimensions on capital structure. This is conducted by examining the effect of (i) customer base, (ii) operating portfolio, (iii) environmental dimensions and (iv) social dimensions on book leverage. Book leverage was used as the primary measure of capital structure because of its use in previous capital structure literature (Chen & Chen, 2011; Kumar et al., 2017). In this study, the measure of book leverage is defined as the proportion of debt financing to total assets. Hereafter, I refer to capital structure and book leverage interchangeably.

Supply chains have been exposed to multiple supply chain disruptions in the recent past, such as the GFC in 2008 and the Covid-19 pandemic (Free & Hecimovic, 2020; Liebl et al., 2016). This has exposed liquidity problems in the supply chain (Mefford, 2009). This being so, this study looks at how supply chain dimensions, reviewed in the previous chapter, affect the financing requirements of the firm. Based on this, operational dimensions reflecting a firm's (i) customer base, (ii) operating portfolio, (iii) environmental dimensions and (iv) social dimensions are examined against book leverage.

In examining the relationship between the four supply chain dimensions mentioned above and book leverage, I briefly review the studies that have examined the effect of supply chain dimensions against capital structure (Chu & Wang, 2017; Huang & Kim, 2019; Kale & Shahrur, 2007). However, in addressing this literature, I find that many of the studies have

focussed on supply chain dimension in the context of dyadic relationships. There have been limited studies which examine the supply chain in its entirety.

I conduct this study using companies listed on the FTSE All-Share Index in the United Kingdom (UK). The study uses companies which are located in the manufacturing and retail industries, as well as companies in the operations of extracting materials. This provides the study with a sample of 80 companies. In conducting the study across four years from 2018 to 2021, I end up with 320 firm-year observations.

In summarising the findings, I find that only customer base significantly affects book leverage. This implies that the more localised a firm's customer base is, the less structurally complex the supply chain is. This is owing to the reduced complexity of the processes within logistics and distribution, which subsequently reduces the complexity of the downstream supply chain. Adding to this, a more localised customer base reduces the vulnerability of the supply chain to global risks and disruptions. This reduced complexity and reduced uncertainty associated with a more localised customer base, lends itself to greater debt financing in a positive and significant relationship.

The remaining three supply chain dimensions — (i) operating portfolio, (ii) environmental dimensions and (iii) social dimensions — have no significant relationship. In the case of a firm's operating portfolio, the greater the proportion of sales to the primary operating segment, the less complex the supply chain is. This reduced operational complexity reduces the operational resources required in the manufacturing of products (production process) and also reduces the operational resources required in having fewer distribution channels (logistics and distribution process). On the other hand, the greater the proportion of sales to the primary operating segment, the greater the vulnerability to supply chain disruptions. Expanding on this, operating segments based on fewer products and/or fewer distribution channels, are more exposed to disruptions affecting products and/or distribution

channels. This, therefore, increases uncertainties in the supply chain. Overall, the reduced complexity (lending to debt financing), and on the other hand, the heightened uncertainty (lending to equity financing) lends itself to an insignificant relationship.

I also conduct additional moderation analyses on the interaction of customer base and operating portfolio with environmental dimensions, social dimensions, and measures of supply chain financing. I find significant relationships in the interaction of customer base and operating portfolio with environmental and social dimensions. I also find some significance in the interaction of customer base and operating portfolio with measures of supply chain financing. In addition to examining these moderating effects, I also investigate the effect of the four hypothesised supply chain dimensions against an alternative measure of capital structure: short-term financing. The results show that the relationship between customer base and the short-term financing remains significant. Environmental dimensions, while insignificant against book leverage, are significant with short-term financing.

This chapter is divided into five sections. The second section reviews the previous literature on the effect of supply chain dimensions on capital structure. This precedes the explanation on the sample size of UK FTSE-listed companies, the list of variables used and the regression equation which is outlined in the third section. The fourth section explains the findings, followed by the discussion of these findings in the last section.

5.2 Prior literature and hypothesis development

This section reviews the previous literature on capital structure. I outline the background and theories underpinning capital structure. This is followed by a discussion of the research conducted on the effect of supply chain dimensions and capital structure. Based on this discussion, I subsequently develop the hypotheses for the four supply chain dimensions: (i)

customer base, (ii) operating portfolio, (iii) environmental dimensions and (iv) social dimensions and the relationship with book leverage.

5.2.1 Previous studies on capital structure

There has been an abundance of prior literature on capital structure and the determinants of capital structure. This subsection defines the capital structure, the elements that comprise capital structure and the different measures that have been used. I briefly review the theories underpinning capital structure and the accounting dimensions that have been examined as determinants of capital structure. Subsequently I discuss prior research that has focussed on the effect of supply chain dimensions on capital structure.

Myers (2001) mentions that capital structure is the mix of securities and financing sources to finance the operations and investments of companies. Thus, capital structure comprises several elements such as working capital, short-term debt financing, long-term debt financing and equity financing. This has brought about different measures used to measure capital structure, such as (i) book leverage, measured as the proportion of debt financing to total assets, (ii) debt-to-equity ratio measuring the ratio of debt financing to equity financing, (iii) the proportion of short-term financing to total assets and (iv) working capital as a proportion of total assets.

A. Background to capital structure

Reviewing the literature on capital structure, Myers (2001) notes that early studies on capital structure linked capital structure to firm value and operational performance. According to the traditional theory of capital structure, the optimal proportion of debt and equity financing is when the weighted-average cost of capital (WACC) and the market value of assets are minimised and maximised respectively. However, numerous theories such as the

trade-off theory and pecking order theory have attempted to explain the optimal capital structure (Chen & Chen, 2011; Myers, 2001).

The trade-off theory is based on the benefits and disadvantages of financing with debt, as compared to equity financing, accounting for the influences of tax and agency costs. It explains the use of debt in the capital structure, weighing up the benefits of lower income tax expense against the costs of liquidation and financial distress (Myers, 2001). In short, while debt financing can reduce income tax expenses, excessive debt financing can increase the costs of liquidation and financial distress and thereby increase the agency costs associated with monitoring the firm.

On the other hand, the pecking order theory compares the agency costs of and information provided by different forms of financing (Luigi & Sorin, 2009; Myers, 2001). The pecking order theory compares the costs of internal financing through retained earnings, external debt financing and external equity financing. It suggests that firms use internal financing as a first option before using short-term debt financing, followed by long-term debt financing and, as a last resort, equity financing. This is based upon the information advantage superiority of managers over debtholders and shareholders, and hence internal financing is the least costly. Next, debt financing is less costly than equity financing because debtholders have a greater information advantage of the firm over investors (Myers, 2001). Debtholders are able to monitor the firm in which they have residual claims to, while shareholders mainly rely on the secondary sources of financial reporting.

This hierarchical structure of financing options can be attributed to the agency costs of monitoring the firm being the greatest for equity financing (Luigi & Sorin, 2009). Linking this to the complexity mechanism in which supply chain dimensions affect firm performance, it can be reasoned that the greater the complexity of supply chain structure, the greater the

costs associated with monitoring the supply chain and consequently the greater the agency costs. This suggests that equity financing is used for more complex supply chains.

Numerous studies have been conducted on the effect of firm dimensions on capital structure, more specifically book leverage. Chen and Chen (2011) studied the dimensions of the firm that affect the choice of financing. They found that firm profitability, growth rate, tax, asset structure and firm size among other firm-specific dimensions affect the capital structure of a firm. They report a negative (positive) relationship between firm dimensions of profitability (tax rate) and debt financing. On the other hand, growth is negatively (positively) associated with debt financing (equity financing). Titman and Wessels (1988) and Rajan and Zingales (1995) also find that firm dimensions such as the tangibility of assets (asset structure), market-to-book-value (growth opportunities), and product uniqueness help determine a firm's capital structure.

Kumar et al. (2017) conduct a comprehensive systematic review of the firm dimensions affecting capital structure. They report that the majority of previous studies found a negative relationship between profitability and book leverage, with positive relationships for firm size, tangibility and firm growth on book leverage. Other firm dimensions have also been examined but not to the same extent. In summary, it can be noted that the extent of uncertainty will affect book leverage. This is likely because greater uncertainty lends itself to greater equity financing.

Overall, previous studies have looked at the effect of numerous firm-specific dimensions on capital structure. Findings from previous literature found that dimensions such as profitability, firm size, growth and tangibility are significant predictors of capital structure. Combined with reasoning underpinning capital structure theories, these studies can offer insights into the relationship between supply chain dimensions and capital structure. In summary, the greater the complexity of the supply chain and/or the greater the uncertainty

associated with the supply chain, the less likely that the firm will be financed with debt financing, thereby resulting in a lower book leverage.

B. *Supply chain dimensions & capital structure*

The previous subsection defined capital structure, outlined the different types of financing sources, reviewed the main theories underpinning capital structure and the accounting dimensions that have been examined against capital structure. It noted that the structure of financing is largely determined by the complexity and uncertainty of the firm. Following prior studies on the accounting dimensions that have been examined against capital structure, this subsection focusses on the supply chain dimensions that affect capital structure. As such, I review the previous studies that have looked at the effects of supply chain dimensions on capital structure.

Previous studies have investigated the effect of supply chain dimensions, more specifically the supply chain strategies that the company uses (i.e. innovation strategies, cost-leadership). O'Brien (2003) found a negative relationship between innovation (as measured by research and development (R&D) intensity) and debt leverage. This is because of the greater financial slack required to operationalise an innovation strategy within the supply chain, and the fact that a lower debt ratio facilitates greater flexibility in supply chain operations. On the other hand, the study finds that a cost-leadership strategy is associated with greater leverage. This suggests that a lean (focussing on cost-leadership) supply chain strategy will use greater debt financing, whereas an agile (focussing on flexibility) supply chain strategy will use greater equity financing to finance its operations.

Huang and Kim (2019) and Chu and Wang (2017) also study the effect of supply chain dimensions on capital structure, albeit at the network-level (or the dyadic buyer-supplier relationship). Huang and Kim (2019) find that decreases in import tariff costs in the

customer's industry decrease the debt leverage ratio of the supplier. This is because import tariff costs make it easier for overseas competitors to compete in the local market, and due to this greater competition, there is greater financial and economic uncertainty which is compensated for by being less leveraged and having lower debt financing. Chu and Wang (2017) examine the capital structure of buyer-supplier relationships according to bargaining power dynamics and find that when customer firms increase their leverage, so do their suppliers in an effort to maintain a position of strength in negotiations. While this shows a positive relationship, a negative relationship exists when the buyer-supplier dyadic relationship is characterised by relation-specific investments due to the risk of bankruptcy. In this case, the risk of one party being highly leveraged is offset by the other company having a low leverage and thus lowering the risk of the supplier-customer dyadic relationship ceasing.

In addition to the above studies, there have been further studies examining supply chain dimensions and the effect on the capital structure policies of customers, and their suppliers. These studies can be divided into multiple streams of literature examining relation-specific investments, supplier concentration, outsourcing and the extent of foreign sales. Addressing the supply chain dimension of relation-specific investments, which are such investments that can only be acquired from relationships with a specific supplier in the upstream supply chain, Banerjee et al. (2008) found that, in such relationships, a negative relationship exists with debt leverage. This is because customers will lower their debt financing when their relationships with suppliers are characterised by relation-specific investments. This is to lower the risk associated with the buyer-supplier dyadic relationships characterised by relation-specific investments. This is similar to the findings of Chu and Wang (2017), mentioned above, and is further supported by Kale and Shahrur (2007). Kale and Shahrur (2007) note that such negative relationships are further strengthened when the customer has high R&D intensity. The logic behind this is that customers with high R&D

intensity are more likely to require relation-specific investments. This also suggests that customers with a high R&D intensity will be more likely to have an innovation supply chain strategy and as such can be tied back to O'Brien (2003) who notes that companies with an innovation strategy have lower leverage.

The above-mentioned studies investigated the effect of supply chain dimensions, at the network-level, on capital structure. Further studies have also investigated the effect of supply chain dimensions, at the supply chain level, and the effect on capital structure. Firstly, I study the supply chain dimension of customer concentration. Kadapakkam and Oliveira (2021) found a negative relationship between the customer concentration of upstream suppliers and leverage. This is likely due to the greater uncertainty associated with the future cash flows of suppliers, especially if a major customer goes into liquidation or bankruptcy. Demirci (2016) reiterates this as a big factor in suppliers' financing policies as customer risk (reflected in greater customer concentration) is negatively associated with debt financing. This is further supported by Campello and Gao (2017) who find that higher customer concentration of suppliers is reflected in increases in interest rate spreads and restrictive covenants, which are unfavourable towards debt financing. Despite this, Cen et al. (2015) show that greater uncertainty of having a more concentrated customer base can be reduced by the reputational effects of the length of these relationships and as a result debt financing becomes more favourable. As such, the negative relationship between customer concentration and book leverage weakens. Yang (2017) and Kadapakkam and Oliveira (2021) show similar reputational effects of having long-term principal customers. All these studies support the fact that higher customer concentration reflects greater uncertainty and results in reduced debt leverage. This consequently shows why longer-term relationships with those customers, which reflect more certainty, have positive moderating effects on leverage.

The above studies on the effects of (i) relation-specific investments and (ii) customer concentration on leverage show a negative relationship due to the greater uncertainty reflected in buyer-supplier relationships with such characteristics. Research has also found that the complexity of the supply chain is another determining factor on debt leverage. Moon and Phillips (2021), Eun and Wang (2016) and Aggarwal and Kyaw (2010) study the effects of the (i) outsourcing dimension of the supply chain and (ii) dimension of foreign sales on leverage. Both of these dimensions have a negative relationship with debt financing and subsequently book leverage. This is because the greater the level of outsourcing, as well as the greater extent of foreign sales, is associated with greater supply chain complexity. This suggests that greater complexity in the dimensions of the supply chain is associated with greater monitoring costs and less debt financing. However, Z. Wang et al. (2020) contradict previous studies on the dimensions of foreign sales. They note that international diversification, reflected in greater foreign sales, reduces systematic risk and makes debt financing more favourable. This is despite the logic that greater foreign sales increase the complexity of the supply chain.

In summarising this collection of literature, previous research examining the effect of supply chain dimensions on capital structure have used book leverage as the proxy for capital structure. As such, this study similarly uses book leverage, and the proportion of debt financing to total assets, as the primary measure of capital structure. The above studies investigated the effect of numerous supply chain dimensions on book leverage. These include supply chain dimensions, reflective of supply chain strategies (e.g. innovation strategy), at the network-level (e.g. relation-specific investments in the buyer-supplier dyadic relationship) and at the supply chain-level (e.g. customer concentration, outsourcing, foreign sales). In summary, the literature concluded that these supply chain dimensions affected book leverage via the complexity and uncertainty of the supply chain.

However, the use of book leverage as the primary measure of capital structure is limited in that it only accounts for debt financing and equity financing. As Silvestro and Lustrato (2014) note, the supply chain also comprises the flow of financing, and the internal financing of supply chain dimensions. To illustrate the importance of considering short-term financing options in supply chain studies, Chod et al. (2019) investigate the impact of suppliers' customer concentration on the extension of trade credit. They report that suppliers who have a greater share of a customers' purchasers are more inclined to extend trade credit to those customers. Banerjee et al. (2004) also investigate the relationship between customer concentration and trade credit (accounts receivable). They find a non-linear relationship where an increase in customer concentration results in an increase of accounts receivable until a certain point before a negative relationship dominates. This is because of the certainty of sales to major customers. However, when there is too high a concentration, uncertainty of the likelihood of liquidation of the few customers dominates the certainty of guaranteed sales. As such, considering short-term financing options such as trade credit provides another dimension to the relationship between supply chain dimensions and financing policies.

Given the importance of short-term financing mechanisms in the supply chain, I conduct further robustness tests based on the proportion of short-term financing to total assets. This variable accounts for internal supply chain financing by differentiating between short-term financing (current liabilities) and long-term debt and equity financing (non-current liabilities and equity). In summary, I use book leverage as the primary measure of capital structure and to which the hypothesis, developed in the next section, is based on. Following this, I further conduct robustness tests on the same four supply chain dimensions against the alternative measures of capital structure; short-term financing.

5.2.2 Hypothesis development

This subsection hypothesises the relationships between the four supply chain dimensions: (i) customer base, (ii) operating portfolio, (iii) environmental dimensions and (iv) social dimensions and book leverage. This leads on from the previous subsection which discussed the earlier literature examining the effect of supply chain dimensions and book leverage. The discussion concluded that the effects of various dimensions on book leverage was owing to the structural complexity of the supply chain, and dimensions contributing to the vulnerability and susceptibility of the supply chain to disruptions. Given this, the hypotheses developed for each of the four supply chain dimensions will be discussed in the context of complexity and/or uncertainty.

Customer Base:

The first supply chain dimension examined against book leverage is a firm's customer base. Recalling the discussion in *Chapter Four*, the dimension of a firm's customer base is related to the distribution and logistics process of the supply chain. The distribution and logistics process comprises the distribution and transportation of products to the final customer. This includes (i) customer management, (ii) warehouse management and (iii) transport management, among other dimensions.

Addressing the dimension of customer management, this involves building relationships with customers. This overarching dimension was measured in Li et al. (2006) in examining the effect of customer relationship management against firm performance. Expanding on customer management, one of the key subdimensions is a firm's customer base, which comprises the (i) size of the customer base and (ii) geographic spread of the customer base. Previous research examined the former in measuring the number of downstream customers (DeCampos et al., 2022). However, this study addresses the

geographical dispersion of the customer base. This is based on a similar measure to the geographical spread of a firm's supplier base, used in Lu and Shang (2017).

In examining a firm's customer base, calculated as the geographic spread of the customer base, I measured this as the proportion of domestic sales to total sales, via the following equation:

$$\frac{Domestic\ Sales\ (\$)}{Total\ Sales\ (\$)}$$

(Equation A)

Domestic sales are defined in this study as sales to downstream customers located within the UK and Europe. This is because the study is based on companies from the UK FTSE index. This information is obtained from the geographic segmentation disclosures in the company annual reports. However, not all geographical segment information is clearly defined. In cases in which the geographical reporting segments combine Europe and other regions (e.g. Europe, Middle East, and Africa (EMEA)), the study categorises these segmental sales as within Europe. This is due to sales within Europe not being able to be separated within the categorisation. As such, this is a limitation of the proxy measuring the company's customer base.

Bode and Wagner (2015) and Lu and Shang (2017) both used a measure reflecting the geographic spread of upstream suppliers. Lu and Shang (2017) noted that the geographic spread of upstream suppliers increases structural complexity. This would be because a more foreign supplier/customer base would lead to increased global supply chain operations and resources. Bode and Wagner (2015) add to this and found that the greater the level of these complexities, the greater the frequency of supply chain disruptions. This is because a more foreign supplier/customer base would require access to more global supply chain resources, which will subsequently result in greater susceptibility to global supply chain disruptions.

These findings, despite measuring upstream suppliers, suggest that a localised customer base (less geographic spread of customers) reduces structural complexity of the supply chain. In addition, a more localised customer base will reduce the frequency of and exposure to supply chain disruptions. This will likely lead to greater debt financing.

Previous studies have used similar measures in their examination against capital structure. Aggarwal and Kyaw (2010) used a measure of the foreign sale ratio of a firm and noted that multinational firms were found to have lower debt ratios, as compared to domestic companies. This implies that the internationalisation of a firm's customer base, and thereby their international activities, would encourage equity financing. Albeit in a different context, Eun and Wang (2016) examined international sourcing in the upstream supply chain. They found a significant negative influence of international sourcing on leverage. The implication of these studies is that a more localised customer base (fewer international activities) positively affects leverage.

Given this, I hypothesise the following.

H_{1A} (Alternate): *There is a positive relationship between a company's customer base, as measured by the extent of domestic sales, and debt financing.*

Operating Portfolio

The second supply chain dimension examined against book leverage is a firm's operating portfolio. A firm's operating portfolio is defined as the number of operating segments or operating divisions a company has, and is based on operating segmental disclosures as required by IFRS 8 (Crawford et al., 2012). In this way, a firm's operating portfolio can encompass the number of products a firm offers (product segments), or the number of distribution channels offered to downstream customers (distribution segments)

among other categorisations. Given this, a firm's operating portfolio measured as product segments can affect the production process. Alternatively, a firm's operating portfolio measured as distribution segments can affect the distribution and logistics process.

Further to this, the complexities of a firm's operating portfolio also affects the supply chain strategy. For example, different product segments may have different operational strategies and core capabilities, such as in Zara (Aftab et al., 2018). Further to this, the complexities of a firm's operating portfolio affects the sourcing and procurement process if, for example, different product segments have different sets of suppliers (Blome & Henke, 2009). As such, a firm's operating portfolio can affect the overall supply chain, and not necessarily be limited to a single process in the supply chain.

As mentioned before, a firm's operating portfolio is based on the operating segments of a company and is regulated by IFRS 8. IFRS 8 aggregates operating segments into a single operating segment if they have similar economic characteristics, production processes and distribution channels (Deloitte, 2007). In using a measure based on operating segments, I measure the structural complexity of the supply chain and calculated it as the proportion of sales owed to the largest operating segment to total sales. The following equation illustrates how the measure is calculated.

$$\frac{Largest\ Operating\ Segment\ (\$)}{Total\ Sales\ (\$)}$$

(Equation B)

There have been a number of previous studies that have measured the complexity of a firm's operating portfolio through the number of product segments a firm has (Bozarth et al., 2009; DeCampos et al., 2022; Kovach et al., 2015). Based on a multi-industry study, Kovach et al. (2015) found that a narrower product scope (fewer product segments) resulted in greater firm performance, and mentioned that this was owed to having more focussed operations.

They also noted that diversified firms may face higher costs in managing more diversified operations. However, in the automotive industry, DeCampos et al. (2022) found a positive relationship between having more product segments and firm performance. This latter result is likely due to the benefits of diversification. As such, diversification is likely to be a double-edged sword with benefits as well as adverse consequences to product diversification. In contrast, Bozarth et al. (2009) found no evidence of a relationship between the number of product segments and firm performance.

Despite previous studies examining a firm's operating portfolio (in the form of product segments) and firm performance, the arguments for and against diversification have implications for the relationship between operating portfolio and book leverage. Applying the findings of the previous studies which measured the number of product segments, I hypothesise that a firm's operating portfolio can have a positive/negative effect on debt financing. Addressing the former, Kovach et al. (2015) noted that a narrower product scope (fewer product segments) results in greater firm performance due to having more focussed operations. Explaining this, having fewer operating segments (reflected in the largest operating segment being attributable for a greater percentage of total sales) will allow the company to focus supply chain resources to more focussed operations. This would subsequently lead to a less complex supply chain, and in turn allow for greater debt financing. Hence, a positive relationship with debt financing.

On the other hand, DeCampos et al. (2022) noted that an increased number of product segments increases firm performance due to the benefits of diversification. In this scenario, having fewer operating segments (reflected in the largest operating segment being attributable for a greater percentage of total sales) will limit the benefits of diversification. This will lead to greater vulnerability to supply chain disruptions, especially when operating segments are adversely affected and, therefore, lend itself to greater equity financing. Hence,

a negative relationship with debt financing is likely. Due to the competing arguments of a positive relationship and negative relationship with debt financing, the following null hypothesis has been suggested.

H_{1B} (Null): *There is no relationship between product portfolio, as measured by the extent of sales attributable to the largest operating segment, and debt financing.*

Environmental Dimension:

The third dimension examined against book leverage is the environmental dimension of the supply chain. The environmental dimension is reflective of the many environmental practices that are integrated into the (i) supply chain strategy, (ii) sourcing and procurement process, (iii) production process and (iv) distribution and logistics process. This is set out in *Chapter Four*. As such, measuring environmental dimensions is reflective of the upstream and downstream supply chains. Given this, the environmental dimension is a composite measure of various environmental subdimensions and is compiled by Refinitiv (Refinitiv, 2022).

Previous studies have examined the environmental dimension through literature review studies (Srivastava, 2007), and empirical studies against various measures of firm performance (Geng et al., 2017; Green et al., 2012) and shareholder value (Subir, 2009). Empirically, Green et al. (2012) conduct a study on various environmental dimensions against firm performance. The study used six dimension of green practices: (i) internal environmental management, (ii) green information systems, (iii) green purchasing practices, (iv) cooperation with customers, to design and produce cleaner production processes and products, (v) eco-design of products, and (vi) investment recovery, which is the process of green manufacturing/remanufacturing through reducing, recycling, repairing/refurbishing,

and remanufacturing (Srivastava, 2007). Linking the environmental dimensions examined in previous studies to the environmental measure developed by Refinitiv, *Table 5-1* outlines the list of practices that the environmental dimension of the supply chain encapsulates. Briefly describing the methodology, the practices within the overarching dimension are unevenly weighted and given a combined score out of 100. This composite measure is termed by Refinitiv as the environmental pillar score.

Table 5-1: *Environmental Dimensions (Refinitiv, 2022)*

Environmental Dimension	
Emissions	*Categories:* Carbon Emissions; Waste; Biodiversity; Environmental Management Systems
Innovation	*Categories:* Product Innovation; Green Revenues; Research & Development; Capital Expenditure
Resource Use	*Categories:* Water Use; Energy Use; Sustainable Packaging; Environmental Supply Chain

In hypothesising the relationship between the environmental dimension and book leverage, it is noted that the implementation of environmental resources in the supply chain can reduce the environmental risk profile of the company and increase the environmental reputation of the company (Caragnano et al., 2020; Gouda & Saranga, 2018). Fernández-Cuesta et al. (2019) and Caragnano et al. (2020) studied the effect of environmental dimensions in the context of greenhouse gas (GHG) emissions in which they both reported a positive relationship between GHG emissions and debt financing. This is likely due to the enhanced reputation of the firm in managing such emissions. This implies that the greater incorporation of environmental resources in the supply chain, as well as the management of environmental effects in the supply chain, will lead to positive reputational effects. Such environmental considerations of the supply chain, combined with positive reputational

effects, will lead to greater certainty in the sustainability of the supply chain. This will lead to increased debt financing in the supply chain, and as such there will be a positive relationship between the environmental dimension of the supply chain and book leverage.

On the other hand, the incorporation of environmental resources and practices in the supply chain requires investments and capital expenditure into green product innovation, as well as R&D expenditure (Aranda-Usón et al., 2019). As such, the implementation of environmental practices in the supply chain will require sufficient financial slack and flexibility and encourage equity financing. This aligns with O'Brien (2003). In this scenario, a negative relationship will exist between the environmental dimension and debt financing. Due to the above arguments made for a positive relationship and a negative relationship with debt financing, the following null hypothesis is developed.

***H*$_{1C}$ (Null):** *There is no relationship between the environmental dimension, as measured by the environmental pillar score, and debt financing.*

Social Dimension:

The fourth supply chain dimension examined against book leverage is reflective of the social dimension of the supply chain. The importance of incorporating social dimensions into supply chain processes is noted by Spence and Bourlakis (2009). The study outlines the evolution from corporate social responsibility (CSR) to supply chain responsibility and extending social practices to the entire supply chain. This is further substantiated by disruptions to the supply chain, such as the Rana Plaza disaster in Bangladesh which highlighted social practices in supply chains (Venkatesh et al., 2020).

Expanding on the dimensions within the overarching social dimension of the supply chain, Awaysheh and Klassen (2010) examined the dimensions of (i) supplier human rights,

(ii) supplier labour practices, (iii) supplier codes of conduct and (iv) supplier audits. Linking the social dimensions examined in previous studies to the social measure developed by Refinitiv, *Table 2* outlines the list of practices that the social dimension of the supply chain encapsulates. Briefly describing the methodology, the practices within the overarching social dimension are unevenly weighted and given a combined score out of 100. This composite measure is termed by Refinitiv as the social pillar score (Refinitiv, 2022).

Table 5-2: *Social Dimensions (Refinitiv, 2022)*

Social Dimension	
Community	
Human Rights	
Product Responsibility	*Categories:* Responsible Marketing; Product Quality; Data Privacy
Workforce	*Categories:* Diversity and Inclusion; Career Development and Training; Working Conditions; Health & Safety

In hypothesising the relationship between the social dimension of the supply chain and debt financing, Andersen and Skjoett-Larsen (2009) note that the implementation of social responsibility in global supply chains enhances firm reputation. Oikonomou et al. (2014) also note that dimensions of corporate social performance, such as community involvement and product safety and quality, reduce credit risk and decrease the cost of debt financing. As such, the incorporation of social resources and practices in the supply chain will increase firm reputation. The enhancement of firm reputation will help in reducing the uncertainties associated with the sustainability of the supply chain. This, along with the reduction in credit risk and reduction in debt financing costs, will encourage greater levels of debt financing. This being so, there are arguments that social responsibility in supply chains encourages debt financing, and hence a positive relationship with debt financing will exist.

On the other hand, the implementation of social responsibility in supply chains requires firms to incentivise suppliers to change their social practices through partnerships and long-term contracts (Andersen & Skjoett-Larsen, 2009). This consequently highlights the importance of long-term relationships with suppliers and reducing the risk of jeopardising the relationship with suppliers. Accordingly, Chu and Wang (2017) note that, in promoting long-term relationships and in reducing the risk of bankruptcy, firms will favour equity financing. Hence, in facilitating the incorporation of social resources and practices in the supply chain, firms will likely enter into long-term relationships with their suppliers, which will encourage equity financing. Thus, firms will reduce their levels of debt financing and a negative relationship with book leverage will exist. Due to the above-mentioned arguments towards a positive relationship as well as a negative relationship with debt financing, the following null hypothesis is developed.

H1D (Null): *There is no relationship between the social dimension, as measured by the social pillar score, and debt financing.*

5.3 Sample selection and variable definitions

5.3.1 Empirical model and variable definitions

In examining the relationship between supply chain structural dimensions and capital structure, the following empirical model is used.

$$Lev = \alpha + \beta_1 CustomerBase + \beta_2 OperatingPortfolio + \beta_3 Environemtal + \beta_4 Social + \beta_5 Control\ Variables + \varepsilon$$

(Regression Model I)

The dependent variable used to measure capital structure is book leverage (*Lev*). The explanatory variables, reflecting the four supply chain dimensions as hypothesised above, include (i) customer base (*CustomerBase*), (ii) operating portfolio (*OperatingPortfolio*), (iii) environmental dimensions (*Environmental*) and (iv) social dimensions (*Social*). The control variables include firm governance (*Governance*) as well as firm-specific control variables, such as firm size (*F_Size*), profitability (*ROA*), tangibility (*Tangibility*) and firm growth (*MTB*). I also include industry-fixed effects and year fixed effects as dummy variables. Industry-fixed effects are used to control for differences in supply chain dimensions between the five different industries: healthcare, consumer discretionary, consumer staples, industrials and basic materials. Year fixed effects are also used to control for the four different time periods: 2018, 2019, 2020 and 2021. In the below explanations, I explain the data and sample used, the primary dependent variable of book leverage, and the two alternative dependent variables used as sensitivity analyses, as well as the explanatory and control variables.

Breuer and DeHaan (2024) and Jennings et al. (2024) further mention that panel datasets across multiple years require firm fixed effects to control for unobserved firm variables. This would suggest that firm fixed effects be included in the current study. However, the inclusion of firm-fixed effects would be inappropriate. Firstly, this would mean controlling for firm features that may overlap with the four supply chain dimensions, which will cause multicollinearity. Secondly, the inclusion of industry-fixed effects in the above-mentioned model, as well as the relatively small sample size across four years (2018-2021) would result in reduced degrees of freedom and limit the statistical power of the model (Breuer & DeHaan, 2024).

5.3.2 Data and sample selection

This study is based on a sample of 80 companies listed on the UK FTSE All-Share Index. I sample these companies across four years spanning 2018 to 2021. This time span was employed because of the effects of the Covid pandemic on the supply chain. In reflecting this, the 2018 and 2019 FYs were during the pre-pandemic period and the 2020 and 2021

FYs during the post-pandemic period. Hence, the final sample equivalates to 80 companies and 320 observations.

In mentioning the data sources, the list of companies on the FTSE index was collected from Mergent online, and this was reduced to a final sample of 80 companies. The dimensions of the supply chain were collected from online databases including Refinitiv and company annual reports. More specifically, data on a firm's customer base and operating portfolio were collected from company annual reports. This data was accompanied by data on environmental dimensions and social dimensions from Refinitiv workspace. Information on book leverage and the control variables were collected from Datastream.

5.3.3 Measures of capital structure:

I employ three different proxies to measure for capital structure. The primary measure is book leverage. I measure book leverage as the proportion of the book value of total debt to the book value of total assets. This measure has been most frequently used measure to proxy for capital structure including studies examining the effect of supply chain structural dimensions on capital structure (Kale and Shahrur, 2007; Chu and Wang, 2017; Huang and Kim, 2019).

$$\frac{Total\ Debt\ Financing}{Total\ Financing}$$

(Equation C)

In addition to the primary dependent variable of book leverage, I also use an alternative dependent variable — short-term financing — to examine the effects of supply chain dimensions.

As mentioned previously, supply chain financing (SCF) is an important financing dimension of the supply chain, which is used to internally finance supply chain operations. Such SCF mechanisms include trade credit and lease financing. Banerjee et al. (2004)

previously investigated the relationship between buyer-supplier relationships and trade credit and noted the importance of internal financing using trade credit in such dyadic relationships. Furthermore, Gomm (2010) noted that companies can finance assets in their supply chain, using pay-on-production methods in which companies finance assets based on their production while using the asset. Further to this, Pan et al. (2023) noted the importance of SCF in a firm's capital structure in finding that SCF significantly speeds up capital structure adjustments. In addition, SCF improves cash turnover and firm values, and lowers financing costs.

From this it can be seen that SCF is an example of short-term financing and important in the capital structure of a company. Hence, the measure of capital structure should include short-term financing. Book leverage which only differentiates between debt and equity financing is a drawback. As such, I use a measure of short-term financing which is operationalised by measuring the proportion of short-term financing to total assets. In this way, the study differentiates between short-term financing and long-term financing. Data on both short-term and long-term financing is collected from company annual reports and is calculated as follows.

$$\frac{(Short - Term\ Debt\ Financing)}{Total\ Assets}$$

(Equation D)

5.3.4 Determinants of capital structure

As mentioned previously, I examine the effect of four supply chain dimensions: (i) customer base (*DomesticSales)*, (ii) operating portfolio (*Primary_OperatingSegment*), (iii) environmental dimensions (*Environmental*) and (iv) social dimensions (*Social*). These dimensions have been previously defined and need no further explanation.

Apart from the main regression above, further moderation analyses are conducted. The first set of analyses moderate the (i) environmental and (ii) social dimensions of the supply chain with the dimensions of (a) customer base and (b) operating portfolio. The second set of analyses moderate the dimension of (i) customer base and (ii) operating portfolio with the flow of financing. The flow of financing is proxied for using three different measures – (i) asset turnover, (ii) inventory turnover and (iii) cash conversion cycle.

- Asset Turnover (*AssetTurn*) – the efficiency of asset utilisation as measured by net sales divided by total assets.
- Inventory Turnover (*InventoryTurn*) – the efficiency of turning over inventory to generate revenue as measured via cost of goods sold divided by average closing inventory.
- Cash Conversion Cycle (*CCC*) – the period of time it takes from converting cash spent on inventory to cash received from selling the product. It is calculated via the sum of accounts payable turnover, inventory turnover and accounts receivable turnover (Pavlis et al., 2018).

In addition, there are numerous factors that affect the proportion of debt financing to total assets. Previous studies examined the effect of firm-specific factors on capital structure, such as firm size, profitability, tangibility and growth (Chen & Chen, 2011; Kumar et al., 2017). These firm-specific determinants will be controlled for, as similarly done in previous studies which examined the effect of supply chain dimensions on book leverage (Chu & Wang, 2017; Huang & Kim, 2019; Kale & Shahrur, 2007).

- Firm size (*F_Size*) – the log of total book assets.
- Profitability (*ROA*) – net income divided by average total assets (return on assets)
- Tangibility (*Tangibility*) – net property plant and equipment divided by total assets.
- Market-to-Book (*MTB*) – market value of ordinary equity divided by book value of ordinary equity.

- Firm governance (*Governance*) – measures the governance of a company based on the company performance on (i) CSR strategy, (ii) company management and (iii) company shareholders (Refinitiv, 2022).

5.4 Results

This section outlines the findings of the investigation into the effect of supply chain dimensions: (i) customer base, (ii) operating portfolio, (iii) environmental dimensions and (iv) social dimensions, on book leverage. In examining this relationship, I perform a multitude of tests. Prior to running the main regression, I note the descriptive statistics of the dependent, explanatory, moderation and control variables. I also conduct a correlation analysis in identifying any endogeneity problems, as well as an independent samples t-test to examine the changes between the Pre- and Post-pandemic period. After this, I regress the main regression in answering the hypotheses developed. Additional tests are also carried in the form of moderation effects between (i) customer base and (ii) operating portfolio with (a) environmental dimensions, (b) social dimensions and (c) SCF dimensions. Lastly, robustness tests are carried out on the main regression examining the four supply chain dimensions against short-term financing.

5.4.1 Descriptive statistics

Table 5-3 presents the descriptive statistics for the list of dependent, explanatory and control variables included in *Regression Model I* above.

The primary dependent variable used, book leverage (*Lev*), has a mean of 56.708 which shows that the sample of 80 companies across the four years (2018-2021) are financed slightly more by debt, than equity. The alternate dependent variable of short-term financing (*ST Finance*) shows a mean statistic of 24.763 which indicates that, on average, companies

Table 5-3: *Descriptive Statistics*

						Skewness		Kurtosis	
	N	Mean	Std Dev	Min	Max	Statistic	Std Error	Statistic	Std Error
Lev:	320	56.708	17.115	12.446	93.147	-0.050	0.136	-0.732	0.272
ST Finance:	320	24.763	11.118	3.380	70.310	0.978	0.136	1.514	0.272
Customer Base:	320	58.912	31.836	0.000	100.000	0.104	0.136	-1.483	0.272
Operating Portfolio:	320	65.854	23.522	19.080	100.000	0.032	0.136	-1.358	0.272
Environmental:	320	56.109	22.072	0.550	95.810	-0.149	0.136	-0.625	0.272
Social:	320	65.419	18.839	16.590	97.210	-0.433	0.136	-0.470	0.272
AssetTurn:	320	0.937	0.490	0.170	3.100	1.410	0.136	2.713	0.272
InventoryTurn:	320	7.208	8.358	0.740	66.260	3.995	0.136	20.370	0.272
Ln_InventoryTurn:	320	1.635	0.757	-0.301	4.194	0.618	0.136	1.020	0.272
CCC	320	64.588	81.650	-213.317	396.584	0.188	0.136	2.866	0.272
Governance	320	68.596	16.653	17.670	97.670	-0.426	0.136	-0.307	0.272
F_Size	320	21.748	1.651	18.457	25.709	0.626	0.136	-0.266	0.272
ROA	320	6.651	9.076	-16.946	58.003	1.960	0.136	8.455	0.272
Ln_ROA	320	3.067	0.599	-2.927	4.318	-5.830	0.136	51.157	0.272
Tangibility	320	32.955	20.021	3.530	94.656	0.799	0.136	0.407	0.272
M2B	320	3.399	2.683	0.110	16.670	1.899	0.136	4.777	0.272
Ln_M2B	320	0.947	0.767	-2.207	2.814	-0.258	0.136	0.370	0.272

are one-quarter financed by short-term financing. The standard deviation, skewness and kurtosis of both measures of capital structure show that there is sufficient variation and that the samples are normally distributed.

The independent variables in the model are (i) customer base, (ii) operating portfolio, (iii) environmental dimensions and (iv) social dimensions. The variable of customer base shows that the sample size consists of firms that do not operate in the UK and have an international customer base (0%) as well as firms that solely have a regionalised or localised customer base (100%). The mean statistic of customer base is 58.912 meaning that, on average, companies have a slightly greater local or regional customer base, as opposed to an international customer base. In relation to the operating portfolio there are firm-year observations that have a single operating segment within the company's portfolio as illustrated by the primary operating segment comprising 100% of total sales. The mean statistic of 65.854 indicates that the average company accounts for approximately 65% of sales as owing to its primary operating segment within its portfolio. As regards the third independent variable, the environmental dimension (*Environmental*) reveals that some companies in the sample have very low environmental and ethical performance (indicated by the minimum statistic of 0.550) and very high environmental performance (maximum statistic of 95.810). Lastly, the social dimension indicates companies with very high social performance (97.210). A bottom limit of 16.590 exists for companies with low societal performance in their supply chain. The social performance of the sampled companies is, on average, higher than their environmental performance. The skewness and kurtosis levels of all the explanatory variables show a normal distribution.

The main regression model examining the three supply chain dimensions, against book leverage is subsequently moderated by financing variables, namely (i) asset turnover, (ii) inventory turnover and (iii) cash conversion cycle. In *Table 5-1*, the skewness and

kurtosis levels of asset turnover and cash conversion cycle suggest a normal distribution. However, the variable of inventory turnover is not normally distributed. *Table 5-3* shows a mean statistic of 7.208 which is much closer to the minimum value of 0.740, as compared to the maximum statistic of 66.260. This indicates a right-skewed distribution, supported by a skewness of 3.995. This is as expected because of the industry difference in inventory turnover. For example, companies in the consumer discretionary and consumer staples sector may have a much higher inventory turnover than companies in the industrials sector. Moreover, *Table 5-3* also shows that inventory turnover is also severely affected by kurtosis. A kurtosis of 20.370 indicates a leptokurtic distribution. As such, a logarithmic procedure is conducted to normalise the distribution, and this variable is shown as *Ln_InventoryTurn* in *Table 5-3*.

It is also important to note the descriptive statistics of the control variables. These control variables include firm governance (*Governance*), as well as control variables employed in previous capital structure research – firm size (*F_Size*), return on assets (*ROA*), tangibility and market-to-book ratio (*MTB*). The reported kurtosis levels for firm governance, firm size and tangibility show acceptable skewness and kurtosis levels, whereas ROA and MTB show high kurtosis levels, otherwise known as leptokurtic distribution. The same procedure performed on inventory turnover is performed with the variables, ROA and MTB. While the logarithmic measure of MTB (*Ln_MTB*) is normally distributed, the logarithmic measure of ROA (*Ln_ROA*) shows a greater leptokurtic distribution. As such, the unchanged measure of ROA (*ROA*) and the logarithmic measure of MTB (*Ln_MTB*) are used in the multivariate regression analyses.

5.4.2 Bivariate analysis

This section shows the bivariate analyses which comprise the correlation analysis and the pre- and post-Covid T-Test. *Table 5-4* presents the correlation analysis.

Table 5-4 notes that there are no highly correlated relationships between the dependent variable, book leverage and any of the explanatory and control variables. There are, similarly, no high correlation statistics between the alternative dependent variable — short-term financing — with any of the explanatory or control variables. Moving to the three explanatory variables, customer base has a significant correlation with operating portfolio ($0.537, p < 0.01$). There is also a significantly high correlation between environmental dimensions and social dimensions ($0.731, p < 0.01$). The latter is expected as the environmental and social dimensions are constructs from the same Refinitiv database and in combination constitute two of the three dimensions of the ESG score. Hence, there may be significant overlaps between the composition of the environmental dimension and social dimension. The two correlations between (i) customer base and operating portfolio and (ii) environmental dimensions and social dimensions may potentially affect multicollinearity and, as these dimensions are regressed in the same model, they may affect the results.

Hence, there may arise endogeneity concerns with running *Empirical Model I*. Firstly, in controlling for the significant multicollinearity between the explanatory variables, I control for variables such as firm governance, firm size and profitability. The high multicollinearity between environmental dimensions and social dimensions is likely because they are both components of the overall ESG score. Thus, controlling for firm-specific attributes such as firm size may reduce such multicollinearity. In any case, the variance inflation factor (VIF), upon running the model is informative of the effect of such multicollinearity on the results (Kim & Davis, 2016). Controlling for firm governance, alongside other firm characteristics, also allows the study to reduce the effect of omitted variable bias on the results. Further to

Table 5-4: *Correlation Analysis*

	Lev	*ST Finance*	*Customer Base*	*Operating Portfolio*	*Environmental*	*Social*	*AssetTurn*	*Ln_InventoryTurnover*	*CCC*	*Governance*	*F_Size*	*ROA*	*Tangibility*	*Ln_MTB*
Lev:	*1.00*													
ST Finance:	*-0.545***	*1.00*												
Customer Base:	*0.212***	*0.333***	*1.00*											
Operating Portfolio:	*0.128**	*0.260***	*0.537***	*1.00*										
Environmental:	*0.161***	*0.041*	*-0.256***	*-0.079*	*1.00*									
Social	*0.090*	*-0.155***	*-0.438***	*-0.263***	*0.731***	*1.00*								
AssetTurn:	*0.179***	*0.650***	*0.392***	*0.267***	*-0.183***	*-0.369***	*1.00*							
Ln_InventoryTurn:	*0.254***	*0.222***	*0.440***	*0.181***	*-0.152***	*-0.133**	*0.231***	*1.00*						
CCC:	*-0.292***	*-0.155***	*-0.370***	*-0.256***	*-0.024*	*0.032*	*-0.118**	*-0.567***	*1.00*					
Governance:	*0.037*	*-0.077*	*-0.385***	*-0.207***	*0.403***	*0.449***	*-0.209***	*-0.124***	*0.051*	*1.00*				
F_Size:	*0.226***	*-0.064*	*-0.359***	*-0.130**	*0.641***	*0.656***	*-0.285***	*-0.015*	*-0.147***	*0.493***	*1.00*			
ROA:	*-0.339***	*-0.079**	*-0.062*	*-0.002*	*-0.076*	*-0.105**	*0.240***	*-0.211***	*0.179***	*-0.067*	*-0.108*	*1.00*		
Tangibility:	*0.066*	*-0.179***	*0.246***	*0.172***	*0.026*	*0.016*	*0.024*	*0.411***	*-0.252***	*-0.116*	*0.011*	*-0.031*	*1.00*	
Ln_M2B:	*0.133**	*0.172***	*-0.157**	*-0.099*	*0.007*	*-0.074*	*0.183***	*-0.230***	*0.359***	*-0.050*	*-0.224***	*0.336***	*-0.147**	*1.00*

**, ** Significant at 0.05 level and 0.01 levels, respectively*

this, reverse causality is unlikely to be an issue given that capital structure is unlikely to influence the structure of the supply chain.

Next, I examine the univariate analysis of the dependent and explanatory variables between the pre- and post-Covid periods. *Table 5-5* presents the results of the T-test between the pre- and post-Covid periods. The pre-Covid period consists of the 2018 and 2019 FY observations, while the post-Covid period consists of the 2020 and 2021 FY observations. As mentioned previously, the Covid-19 pandemic has had a significant impact on organisations' supply chains across multiple industries (Dai et al., 2020). One of the main consequences of the Covid-19 pandemic is that the disruption has forced companies to restructure their external financing.

Moreover, companies have looked to reduce the complexity of their supply chains in the face of the uncertainty. Among other steps, companies have looked to regionalise their supply chains (Free & Hecimovic, 2020). While this is part of companies' long-term planning, the pandemic might have affected an increase in regional and domestic sales. Further to this, companies may have looked to decrease the complexity of their supply chains by focussing on fewer product segments or operating segments. Sarkis (2020) also noted that the pandemic highlighted opportunities to move towards sustainability in supply chains. Lahane et al. (2020) added to this, mentioning that incorporating environmental practices into supply chain operations as well as moving towards circular supply chain management developed resiliency in global supply chains. As such, the Covid-19 pandemic may have resulted in an increase in the variables of customer base, operating portfolio, environmental dimensions and social dimensions.

Table 5-5: *Capital Structure and Supply Chain Dimensions - Pre- and Post-Covid*

		Means		Levene's Test for Equality of Variances		Significance	
		Pre-Covid (%)	Post-Covid (%)	F	Sig.	One-Sided p	Two-Sided p
Lev	Equal variances assumed	56.212	57.203	3.185	0.075	0.303	0.605
ST Finance	Equal variances assumed	74.621	75.853	0.230	0.632	0.161	0.322
Customer Base	Equal variances assumed	59.275	58.549	0.003	0.955	0.419	0.839
Operating Portfolio	Equal variances assumed	65.413	66.295	0.103	0.749	0.369	0.738
Environmental	Equal variances assumed	52.285	59.934	2.394	0.123	0.001	0.002
Social	Equal variances assumed	63.502	67.336	1.255	0.263	0.034	0.069

Table 5-5 shows the results of an independent samples t-test performed on the above-mentioned explanatory variables, across the full sample. *Table 5-5* shows that Levene's test examining the equality of variances is not significant for the two measures of capital structure and the four supply chain dimensions. This indicates that the standard deviations of the pre- and post-Covid samples are equal. The findings also reveal that the mean values for the pre- and post-Covid samples are not significant as revealed by the two-sided p-value being larger than 0.05 (5% level). This applies for all the dependent variables, as well as customer base, operating portfolio and social dimensions of the supply chain. A reason for this is that the Covid-19 pandemic is a prolonged event which has stretched from December of 2019 and is ongoing. Thus, the 2020 and 2021 periods are not truly in the post-pandemic period. As such any effects of the pandemic on these variables may have not been fully realised. A significant effect may only be seen in the longer term when organisations' supply chains are re-designed in the moving towards regionalisation or localisation (Free & Hecimovic, 2020).

However, the findings of the mean values for the pre- and post-Covid samples for the environmental performance are significantly different. This is shown by the two-sided p-value of less than 0.01 (< 0.01). This might potentially be because of the effects of the Covid-19 pandemic and the ability of environmental practices to develop resiliency in global supply chains (Lahane et al., 2020). However, this might also be because of the increasing awareness of environmental practices in supply chains, in moving toward green supply chain management and circular supply chain management (Farooque et al., 2019; Green et al., 2012).

5.4.3 Main regression

After examining the descriptive statistics, bivariate correlation analysis and independent samples t-test, the study regresses '*Empirical Model I*'. In testing the hypotheses developed, I

conducted an OLS linear regression. This regression examined the effect of (i) customer base, (ii) operating portfolio, (iii) environmental dimensions and (iv) social dimensions, against book leverage. In controlling for this effect, I included the following control variables: firm governance, firm size, tangibility, profitability and market-to-book ratio as well as industry and year fixed effects. *Table 5-6* presents the findings.

Table 5-6, Model A and *Model B* show the results for the main regression. *Model A* regresses the explanatory and control variables against book leverage, whereas *Model B* also controls for industry and year-dummy variables. The model notes that the R-squared value is 0.382 (38.2% for *Model* A) and 0.464 (46.4% for *Model B*) which means that the predictors (explanatory, control and dummy variables) account for sufficient variation in leverage. Additionally, the adjusted R-squared indicates the variation in leverage that is accounted for by the explanatory and control variables, other than that of customer base. The adjusted R-squared is 0.364 (36.4% for *Model* A) and 0.436 (43.6% for *Model B*). These results show that the model is valid ($F < 0.01$). To support this, the VIFs for both *Model A* and *Model B* were mostly between 1 and 2 with none exceeding 4. This indication was applied previously in Cahan et al. (2005) in assessing multicollinearity. This suggests that multicollinearity is unlikely to be an issue.

Next, in discussing the findings of the supply chain dimensions against book leverage according to the hypotheses, I document the findings as reported in *Model B*, which controls for industry and year fixed effects. The first hypothesis ($H1_A$) proposes that there is a positive relationship between a company's customer base and book leverage. In line with previous studies (Aggarwal & Kyaw, 2010), the results find a significantly positive effect ($\beta = 0.265$, $p < 0.01$), on book leverage suggesting that, as customer base increases, so does the book leverage of the firm. This is expected, as when a company's local customer base increases, the complexity of the company's downstream supply chain operations decrease. As such, the

Table 5-6: *Supply Chain Dimensions and Book Leverage*

	Model A (Lev):	***Model B (Lev):***	***Model C (Lev):***	***Model D (Lev):***	***Model E (Lev):***
CustomerBase	*0.389*** *(6.322)*	*0.265*** *(4.205)*	*0.030* *(0.244)*	*0.148** *(2.233)*	*0.362*** *(4.048)*
*CustomerBase*AssetTurn*					*-0.039* *(-0.596)*
*CustomerBase*Ln_InventoryTurn:*					*-0.123*** *(-2.717)*
*CustomerBase*CCC:*					*-0.001*** *(-3.196)*
OperatingPortfolio	*0.012* *(0.225)*	*-0.052* *(-0.983)*	*0.092* *(0.485)*	*-0.065* *(-1.263)*	*0.274** *(1.965)*
*OperatingPortfolio*AssetTurn*					*-0.164** *(-2.143)*
*OperatingPortfolio*Ln_InventoryTurn*					*-0.062* *(-1.012)*
*OperatingPortfolio*CCC*					*-0.001* *(-1.323)*
Environmental	*-0.057* *(-0.799)*	*-0.024* *(-0.334)*	*-0.171* *(-1.184)*	*-0.043* *(-0.575)*	*-0.050* *(-0.838)*
*Environmental*CustomerBase*			*-0.009*** *(-4.267)*		
*Environmental*OperatingPortfolio*			*0.011*** *(3.818)*		
Social	*-0.006* *(-0.082)*	*0.070* *(0.942)*	*0.173* *(0.936)*	*0.108* *(1.490)*	*0.085* *(1.261)*
*Social*CustomerBase*			*0.010*** *(3.822)*		
*Social*OperatingPortfolio*			*-0.011*** *(-3.115)*		

AssetTurn				*0.191***	*22.152***
				(3.588)	*(3.825)*
Ln_InventoryTurn				*0.041*	*12.443**
				(0.665)	*(2.401)*
CCC				*-0.126**	*0.090*
				(-2.233)	*(1.816)*
Governance	*-0.021*	*-0.015*	*-0.038*	*-0.018*	*-0.024*
	(-0.398)	*(-0.292)*	*(-0.704)*	*(-0.349)*	*(-0.459)*
F_Size	*0.472***	*0.361***	*3.974***	*0.346*	*4.251***
	(6.906)	*(5.185)*	*(5.378)*	*(4.990)*	*(5.860)*
ROA	*-0.418***	*-0.450***	*-0.785***	*-0.449*	*-0.835***
	(-8.759)	*(-9.440)*	*(-8.795)*	*(-9.411)*	*(-9.054)*
Tangibility	*0.014*	*-0.025*	*-0.002*	*-0.017*	*0.029*
	(0.305)	*(-0.513)*	*(-0.040)*	*(-0.318)*	*(0.611)*
Ln_M2B	*0.442***	*0.432***	*10.080***	*0.423***	*10.301***
	(8.643)	*(8.399)*	*(8.734)*	*(8.117)*	*(8.826)*
Industry_Healthcare		*-0.105**	*-9.368**	*-0.060*	*0.360*
		(-2.168)	*(-2.430)*	*(-1.244)*	*(0.092)*
Industry_ConsumerDiscretionary		*0.321***	*6.494**	*0.279***	*11.223***
		(5.382)	*(2.059)*	*(4.552)*	*(3.790)*
Industry_ConsumerStaples		*0.163***	*3.554*	*0.144***	*9.381***
		(3.059)	*(1.272)*	*(2.763)*	*(3.247)*
Industry_Industrials			*-2.438*		*0.970*
			(-0.963)		*(0.383)*
Industry_BasicMaterials		*0.035*		*-0.009*	
		(0.627)		*(-0.167)*	
Year_2018			*2.032*	*-0.053*	*1.084*
			(0.982)	*(-1.014)*	*(0.534)*
Year_2019		*-0.059*	*-0.653*	*-0.107**	*-1.005*
		(-1.129)	*(-0.321)*	*(-2.084)*	*(-0.503)*
Year_2020		*0.016*	*3.013*		*3.102*
		(0.291)	*(1.480)*		*(1.570)*
Year_2021		*-0.051*		*-0.070*	
		(-0.941)		*(-1.368)*	

Observations:	*320*	*320*	*320*	*320*	*320*
R-Squared:	*0.382*	*0.464*	*0.499*	*0.506*	*0.541*
Adjusted R-Squared:	*0.364*	*0.436*	*0.465*	*0.475*	*0.502*
Industry FE	*No*	*Yes*	*Yes*	*Yes*	*Yes*
Year FE	*No*	*Yes*	*Yes*	*Yes*	*Yes*

**, ** Significant at 0.05 level and 0.01 levels, respectively*

complexity of the supply chain should decrease. Secondly, the greater the proportion of a company's customer base that is localised, the reduced vulnerability to supply chain disruptions. This is especially given the effects of the pandemic on global supply chains (Free & Hecimovic, 2020). This will likely result in increased debt leverage. The significance of this relationship is to 0.01 (1% significance level) and as such $H1_A$ *is accepted*.

In terms of economic significance[3], for every 1% increase in customer base, book leverage increases by 0.265%. This suggests that for every 1 standard deviation increase in customer base (31.836%), book leverage will increase by 8.44%. As this increase in book leverage is less than 1 standard deviation (17.12%), the effect is not economically significant. Hence, the relationship between the company's customer base and book leverage is statistically significant but not economically significant.

The second hypothesis ($H1_B$) examines the effect of the operating portfolio on book leverage which develops a null hypothesis that there is no relationship. This was hypothesised because of the contradictory arguments of more focussed operations and reduced complexity versus increased uncertainty due to the lack of diversification. The finding in *Model B* shows that the result is negative and not significant either ($\beta = -0.052, p > 0.05$). Thus, the null hypothesis $(H1_B)$ that there is no relationship between operating portfolio and book leverage is accepted. Discussing the economic significance of the relationship, a 1% increase in the operating portfolio decreases book leverage by 0.052%. To put this into context, a 1 standard deviation increase in the operating portfolio (23.522%) will decrease book leverage by 1.223%. Hence, the relationship between operating portfolio and book leverage is not statistically nor economically significant.

[3] Economic significance explains the economic impact of a 1 standard deviation change in the independent variable on the dependent variable. It is calculated by multiplying the 1 standard deviation change in the independent variable by the magnitude of the coefficient between the independent and dependent variable.

The third hypothesis *($H1_C$)* examines the effect of the environmental dimension on book leverage which develops a null hypothesis that there is no relationship. The null hypothesis was developed because of the contradictory arguments that greater environmental and ethical performance require big investments which requires companies to have greater financial slack and financial resources (Aranda-Usón et al., 2019; O'Brien, 2003). On the other hand, greater environmental and ethical performance would enhance firm reputation, leading to greater certainty of future cash inflows and increased book leverage (Gouda & Saranga, 2018). The results from the regression show that the coefficient is negative and insignificant in *Model B* ($\beta = 0.024, p > 0.05$). Thus, the null hypothesis *($H1_C$)* that there is no relationship between environmental dimensions and book leverage is accepted. Discussing the economic significance of the relationship, a 1% increase in the environmental dimension decreases book leverage by 0.024%. To put this into context, a 1 standard deviation increase in the environmental dimension (22.072%) will decrease book leverage by 0.529%. Hence, the relationship between the environmental dimension and book leverage is not statistically nor economically significant.

The last hypothesis *($H1_D$)* examines the relationship between social dimensions on book leverage which develops a null hypothesis that there is no relationship. Model B shows a positive but not significant relationship ($\beta = 0.070, p > 0.05$). Thus, the null hypothesis *($H1_D$)* that there is no relationship between social dimensions and book leverage is accepted. In regard to economic significance, a 1% increase in the social dimension will increase book leverage by 0.070. To put this into context, a 1 standard deviation increase in the social dimension (18.839%) will increase book leverage by 1.319%. Hence, the relationship between the social dimension and book leverage is not statistically nor economically significant.

Lastly, I review the findings resulting from regressing the control variables and industry, and year-dummy variables. Firstly, reviewing the control variables, I note that firm size, ROA and log of the market-to-book ratio are all significantly associated with leverage to the 1% significance level in both *Model A* and *Model B*. This is in line with many previous studies that control for such variables (Chu & Wang, 2017; Huang & Kim, 2019). However, contradicting previous literature, the control variable of tangibility has an insignificant effect on leverage. The study also addresses the results for the industry and year fixed effects. These findings of the dummy variables are solely examined in relation to the effect on leverage.

In regard to the industry effects, it can be surmised that, despite controlling for these effects as control variables, industry effects can be examined as another supply chain dimension that affects the nature of financing. The structure of a company's supply chain is heavily dependent on the industry that they are in, and, therefore, industry effects play an important role in determining how a company's supply chain operations are financed. The importance of industry effects is illustrated in the findings in *Table 5-6*.

The findings show a significant difference in relation to leverage for the following industries: consumer discretionary, consumer staples (1% level) and healthcare industry (5% level). In this context it is important to note that the intercept (α) comprises the industrial industry sample. This means that the industry-fixed effects are compared to the industrial companies. Expanding on the results, the consumer discretionary and consumer staples industries have a positive association with book leverage, suggesting greater debt financing in these industries as compared to industrial companies. A reason for this result could be that companies in the consumer discretionary and, to a lesser extent, the consumer staples industry are in the downstream supply chain. In noting this, Ivanov et al. (2019) note the bullwhip effect of market demand creates greater uncertainty in the upstream supply chain, as compared to the downstream supply chain. Therefore, it could be that companies in the

consumer discretionary and consumer staples industries (downstream supply chain) have less uncertainty than industrial companies who are in the upstream supply chain. Thus, they have greater debt financing. On the other hand, the healthcare industry has a negative association suggesting greater equity financing than in the industrials sector. The reason could be that companies in healthcare undertake more R&D than industrial companies and, therefore, require greater financial slack (O'Brien, 2003). Thus, they have greater equity financing.

In controlling for the year fixed effects, the findings show an insignificant difference suggesting that the relationship between the different years and book leverage is not significantly different. Further to this regression model, I construct another model using a post-Covid dummy variable of "1" for years encompassing 2020 and 2021, and "0" for years encompassing 2018 and 2019. The post-Covid dummy variable replaces the yearly dummy control variables. The findings show similar significance levels to *Model A* and *Model B*. The post-Covid dummy variable shows a positive coefficient, albeit insignificant. The results are not shown due to similarities with *Table 3.5*, *Model A* and *Model B*.

Overall, the findings of *Model A* and *Model B,* suggest that a company's customer base has a significant relationship with book leverage. The company's operating portfolio, environmental dimensions and social dimensions have no relationship with book leverage. In addition to this, three of the control variables — firm size, ROA and M2B — are significantly associated with book leverage as follows from prior studies. Furthermore, the findings of the industry fixed effects show that the industry in which the company operates are important dimensions of the supply chain in affecting book leverage.

5.4.4 Moderation Analysis

I conduct additional tests in the form of moderation effects. The first set of moderation tests comprise the moderating effects between (i) customer base and (ii) operating portfolio with (a) environmental dimensions and (b) social dimensions. These results will be outlined and discussed in *Section 5.4.4 (A)*. The second set of moderation tests comprise the moderating effects between (i) customer base and (ii) operating portfolio with (a) asset turnover, (b) inventory turnover and (c) CCC. The findings of the second set of moderation tests will be outlined and discussed in *Section 5.4.4 (B)*.

A. *Moderation between (i) customer base and (ii) operating portfolio with (a) environmental dimensions and (b) social dimensions*

It was outlined previously that the integration of environmental and social dimensions into the four supply chain processes comprising the flow of materials is important to sustaining the competitive advantage of the supply chain (Awaysheh & Klassen, 2010; Green et al., 2012). They mentioned the importance of such integration in enhancing firm performance and progressing towards green supply chain management (GSCM) and sustainable supply chain management (SSCM).

In reasoning this, I moderate the effect of environmental dimensions and social dimensions with (a) customer base (logistics and distribution process) and (b) operating portfolio (production process/logistics and distribution process) against book leverage. *Table 5-6 Model C* regresses these moderation effects; (i) environmental*customer base, (ii) environmental*operating portfolio, (iii) social*customer base and (d) social*operating portfolio. The findings reveal a significant effect for all four moderation effects.

Firstly, explaining the interaction with the environmental dimension, *Table 5-6 Model C* shows a significantly negative relationship for the first moderation effect (E*nvironmental* *

Customer base) against book leverage. In explaining this, M*odel B* shows that the environmental dimension has a negative, albeit not significant, relationship with leverage ($\beta = -0.024, p > 0.05$). This is reflective of enhanced environmental performance requiring greater environmental investments in the supply chain which will make the internal supply chain more complex (Macchion et al., 2020). Hence, when interacting with customer base, which is associated with less supply chain complexity, the coefficient of the interaction term remains negative, but the magnitude of the coefficient is less and is significant ($\beta = -0.009, p < 0.01$). It can be said that the reduced complexity of a more localised customer base increases the negative relationship between environmental dimensions and book leverage.

Next, the findings for the second moderating effect (*Environmental * Operating Portfolio*) show a significantly positive relationship against book leverage. Like the first moderating effect, environmental dimension has a negative, albeit insignificant, relationship with leverage ($\beta = -0.024, p > 0.05$). However, the interaction with the operating portfolio reduces supply chain complexity and shifts the moderation effect towards debt financing. Hence, a significantly positive effect ($\beta = 0.011, p < 0.01$) is found. It can be said that the reduced complexity of a more concentrated operating portfolio weakens the negative relationship between environmental dimensions and book leverage. The extent is sufficient for the relationship to turn positive.

Secondly, explaining the interaction with the social dimension, *Table 5-4 Model C* shows a significantly positive relationship for the third moderation variable (*Social * Customer Base*) against book leverage. As noted in *Model B*, social performance has a positive, albeit insignificant relationship with book leverage ($\beta = 0.070, p > 0.05$). Awaysheh and Klassen (2010) note that increases in social performance enhance a company's brand image and reputation. Thus, with greater social performance and an enhanced company reputation, this might reflect a greater loyalty to the company's brand and

greater certainty to future cash flows. This increased certainty of future cash flows might reflect in the company's ability to access more debt and result in an increase in debt leverage. Hence, when interacting with customer base, which is associated with greater uncertainty as a result of less geographical diversification, the interaction term with customer base remains positive. The magnitude of the coefficient is less and is significant ($\beta = 0.010, p < 0.01$). It can be said that the increased uncertainty of a more localised customer base strengthens the positive relationship between social dimensions and book leverage.

The findings for the last moderating effect (*Social * Operating Portfolio*) shows a significantly negative relationship with book leverage. The social dimension has a positive, albeit insignificant relationship with leverage ($\beta = 0.070, p > 0.05$). However, the interaction with the operating portfolio (reflective of greater proportion of sales owing to the primary operating segment) increases uncertainty in the supply chain and shifts the moderation effect toward equity financing. Hence, a significantly negative effect ($\beta = -0.011, p < 0.01$) is found. It can be said that the increased uncertainty of a more concentrated operating portfolio weakens the positive relationship between social dimensions and book leverage. The extent is sufficient for the relationship to turn negative.

Concluding this subsection, the findings show that all four moderation effects significantly affect book leverage and that this is due to the mechanisms of complexity and uncertainty.

B. Moderation between (i) customer base and (ii) operating portfolio with SCF

In *Section 4.4.7* of *Chapter Four* it was mentioned that supply chain integration requires the integration between the flow of materials and the flow of financing (Pfohl & Gomm, 2009; Silvestro & Lustrato, 2014). Breaking this down, this requires the integration

of (i) supply chain strategy, (ii) sourcing and procurement, (iii) production and (iv) logistics and distribution with the flow of financing.

As mentioned, and examined previously, customer base (logistics and distribution process) and operating portfolio (production process/logistics and distribution process) were used as dimensions of the flow of materials. In examining the moderation effects with the flow of financing, Pfohl and Gomm (2009) identified the main dimension as SCF. SCF underlies the main utilisation of assets within the supply chain, and the organisation of working capital of all members in the supply chain. I use Rahiminezhad Galankashi and Mokhatab Rafiei (2022), who review financial performance measures of the supply chain, in identifying appropriate measures of SCF. These measures include (i) asset turnover, (ii) inventory turnover and (iii) cash conversion cycle. The purpose of integrating financial flows and SCF with the operational aspects of the supply chain is to enhance efficiency of the supply chain. Therefore, the integration of the flow of financing with the flow of materials will likely simplify the complexities of the supply chain and impact the structure of debt financing and equity financing.

However, prior to investigating the moderation effects, I run the regression of the four supply chain dimensions, alongside the moderating variables and control variables. The findings are presented in *Table 5-6 Model D*. The model is significant to the 1% significance level (0.001) with an r-squared of 0.506 and an adjusted r-squared of 0.475. The findings of the four supply chain dimensions show similar results to *Model B. C*ustomer base has a significantly positive relationship, whereas operating portfolio, environmental dimensions and social dimensions have a non-significant coefficient.

Further to this, *Model D* reports the findings of the effects of the three moderating variables on book leverage. A positive and significant relationship exists between asset turnover ($0.191, p < 0.01$) and book leverage. This is expected because, as asset turnover and

the utilisation of assets increase, the firm becomes more productive, thereby creating more certainty of future cash flows. This will subsequently increase accessibility to debt financing. On the other hand, a negative and significant relationship exists between CCC (*-0.126, p < 0.05*) and book leverage. As the cash conversion cycle increases, the working capital should increase as a result of less money tied up in inventory, which should reduce the need for debt financing, thereby reducing book leverage. Lastly, the relationship between inventory turnover (*0.041, p > 0.05*) and book leverage is not significant.

Subsequently, I moderate the effect of (i) customer base and (ii) operating portfolio with (a) asset turnover, (b) inventory turnover and (c) cash conversion cycle, against book leverage. The findings are presented in *Table 5-6 Model E*. The R-squared is 0.541 with an adjusted R-squared of 0.502. The findings note all the six moderating effects have a negative coefficient. This suggests that the moderation effects of asset turnover, inventory turnover and CCC free up cash tied up in working capital and provide greater access to equity financing.

However, only three of these moderation effects are significant. Firstly, I find that the moderation effect between customer base and both inventory turnover *(β = -0.123 p < 0.01)* and CCC *(β = -0.001 p < 0.01)*, against book leverage are negative and significant to the 1% level. This is likely because inventory turnover and CCC become more efficient when customer base (domestic sales) is greater. Explaining this further, it is likely to be easier to turn over inventory and collect outstanding debts in a more localised/regionalised customer base, than it is for a globalised customer base. This ideally means less cash is tied up in inventory or accounts receivable, thereby increasing working capital. This means companies are less reliant on debt financing. I also note a significant negative interaction term between operating portfolio and asset turnover *(β = -0.164 p < 0.01)*, against book leverage. This can be explained, as a reduced operating portfolio is likely to require fewer operating assets to

support the reduced complexity of the supply chain. This will enable a more efficient asset turnover and asset utilisation. As a result, more revenue can be generated with fewer assets, which will enable companies to be less reliant on debt financing.

Overall, the findings of *Model A* through to *Model E* suggest that only a company's customer base has a significant relationship with book leverage. The company's operating portfolio, environmental dimensions and social dimensions have no relationship with book leverage. The subsequent interaction of (i) customer base and (ii) operating portfolio with environmental and social dimensions in the supply chain contribute to significant relationships with book leverage. Additionally, the interaction of customer base and operating portfolio with financing dimensions — (i) asset turnover, (ii) inventory turnover and (iii) CCC — also contribute to significant relationships with book leverage, Therefore, such findings reinforce previous literature in that the flow of materials requires the integration of environmental and social dimensions of the supply chain, and flow of financing to effect book leverage (*Chapter Four*).

5.4.5 Alternative measure: extent of short-term financing

Apart from the main regression analysis investigating the four supply chain dimensions (explanatory variables) against book leverage, the study also conducts robustness tests using alternate measures of capital structure. This subsection examines the effect of the four supply chain dimensions on the extent of short-term financing. *Empirical Model II,* below, shows this.

$$ST\ Finance = \alpha + \beta_1 CustomerBase + \beta_2 OperatingPortfolio + \beta_3 Environemtal + \beta_4 Social + \gamma Control\ Variables + \delta_i + \mu_t + \varepsilon$$

(Empirical Model II)

The regression between the explanatory and control variables, against short-term financing, are shown in *Table 5-7*. *Model A* excludes the industry and year fixed effects. This is followed by *Model B* with the inclusion of industry and year fixed effects.

The findings reveal that the r-squared of the two models are 0.290 (29.0% for *Model A*) and 0.327 (32.7% for *Model B*) which suggests that the explanatory, control and industry and year dummy variables explains sufficient variation in short-term financing. The adjusted r-squared is 0.270 (27.0% for *Model* A) and 0.292 (29.2% for *Model B*). I then move onto the findings of the explanatory variables. The finding pertaining to the customer base *(0.376 $p < 0.01$)* is positive and significant to the 1% level. The notion that the greater the extent of domestic sales the less complexity and less uncertainty reflects in greater short-term financing.

Regressing the environmental dimension against short-term financing reveals a positive coefficient *($\beta = 0.162$ $p < 0.05$)* which is significant to the 5% level. This finding is surprising as enhancing environmental performance would mean the incorporation of environmental practices in the supply chain, which is likely to be part of the long-term plan of an organisation. Hence, environmental performance should adopt long-term financing, as opposed to short-term financing. This can be illustrated through Fonterra's issuance of "green bonds and sustainability-linked bonds and loans" to align funding with circular economic projects (Fonterra, 2022). However, the findings suggest a significant positive relationship which suggests that greater environmental performance is associated with greater short-term financing. A potential explanation for this is provided by Benlemlih and Cai (2020) who note that environmentally responsible firms use short-term debt to signal quality and enhanced firm reputation. This would allow firms favourable financing conditions in the future and as such they will use short-term financing to take advantage of this.

Table 5-7: *Supply Chain Dimensions and Short-Term Financing*

	Model A (ST Finance):	***Model B (ST Finance):***
DomesticSales:	*0.396*** *(-6.011)*	*0.376*** *(-5.328)*
Primary_OperatingSegment	*0.109* *(-1.882)*	*0.105* *(-1.781)*
Environmental	*0.186** *(-2.423)*	*0.162** *(-1.979)*
Social	*-0.168** *(2.071)*	*-0.115* *(1.391)*
Governance	*0.010* *(-0.172)*	*-0.004* *(0.071)*
F_Size	*0.127* *(-1.732)*	*0.083* *(-1.058)*
ROA	*-0.144*** *(2.806)*	*-0.190*** *(3.552)*
Tangibility	*-0.262*** *(5.203)*	*-0.291*** *(5.229)*
MTB	*0.273*** *(-4.976)*	*0.316*** *(-5.483)*
Industry_Healthcare		*-0.165*** *(3.040)*
Industry_ConsumerDiscretionary		*0.040* *(-0.603)*
Industry_ConsumerStaples		*0.077* *(-1.293)*
Industry_BasicMaterials		*0.068* *(-1.105)*
Year_2019		*0.002* *(-0.038)*
Year_2020		*-0.025* *(0.420)*
Year_2021		*-0.047* *(0.785)*
Observations:	*320*	*320*
R-Squared:	*0.290*	*0.327*
Adjusted R-Squared:	*0.270*	*0.292*
Industry FE	*No*	*Yes*
Year FE	*No*	*Yes*

**, ** Significant at 0.05 level and 0.01 levels, respectively*

Considering both arguments, the magnitude and the length of time that environmental projects need to be financed for determines the length of financing arrangements. For example, circular economic projects which require a longer timeframe to be implemented would likely require long-term financing, whereas smaller environmental projects which can be quickly implemented will likely require short-term financing. In the case of the environmental dimension, the positive relationship suggests that the dimension is reflective of more short-term environmental projects than long-term environmental projects. This is certainly the case with a large scope of environmental dimensions covering emissions and resource use, as mentioned in *Table 5-1*.

Lastly, the findings pertaining to the operating portfolio and social dimensions have a non-significant relationship with short-term financing. However, the relationship between operating portfolio and short-term financing is positive and significant to the 10% level. I further review the findings of the control variables and dummy variables. The coefficients for ROA and tangibility are negative and significant (1%), whereas the coefficient for the logarithm of market-to-book ratio is positive and significant (1%). The findings for the dummy variables show that there is no significant difference in relation to the extent of short-term financing for different industries, with the exception being for the healthcare industry, which has a significantly negative coefficient, suggesting less short-term financing. The coefficients for the different years are insignificant.

5.4.6 Summary

In summarising the examination of the effect on book leverage of supply chain dimensions — (i) customer base, (ii) operating portfolio, (iii) environmental dimensions and (iv) social dimensions — I accept all the four hypotheses developed. The first hypothesis between customer base and book leverage proposed a positive relationship and in accordance

with this a significant positive relationship was found. On the other hand, a null hypothesis suggesting no relationship between (i) operating portfolio, (ii) environmental dimensions and (iii) social dimensions with book leverage was proposed. Similarly, in accordance with the hypotheses, no relationship was found for any of the dimensions.

The study subsequently examines (i) the integration of the flow of materials: customer base and operating portfolio with environmental and social dimensions of the supply chain; and (ii) the integration of the flow of financing: asset turnover, inventory turnover and CCC with the flow of materials. In both studies, the results show mostly significant findings. In addition, I examined the four supply chain dimensions against short-term financing. Customer base and environmental dimensions were significantly associated with both alternative measures. On the other hand, operating portfolio and social dimensions were not significantly associated with both alternative measures.

5.5 Discussion

This chapter studied the effect on book leverage of supply chain structural dimensions: (i) customer base, (ii) operating portfolio, (iii) environmental dimensions and (iv) social dimensions. This section proceeds to discuss the findings of this effect in the context of the RBV.

Sharifi et al. (2006) previously noted that the supply chain is an important source of competitive advantage, and Hertzel et al. (2008) and Campello and Gao (2017) found that the supply chain is an important consideration in equity and debt financing. Hence, it is important to examine the structure of the supply chain and its relationship to equity and debt financing, as many previous studies have done (Huang & Kim, 2019; Kadapakkam & Oliveira, 2021). In the recent past, Liebl et al. (2016) noted that during the GFC late payments from firms contributed to suppliers going bankrupt and disruptions to supply chains.

Prior to the main findings, the study examined if there was a change in the structure of the supply chain (proxied by the above dimensions) between the pre-Covid period (2018-2019) and post-Covid period (2020-2021). The lack of significant differences, except for the environmental dimensions, suggests that the effect of the Covid-19 pandemic on supply chains did not significantly change the structure of the supply chain. Firstly, in regard to the significant change in environmental dimensions, the greater awareness of the environmental impacts of the supply chain is likely a reason for greater environmental performance in the supply chain (Green et al., 2012; Srivastava, 2007).

Secondly, the non-significant change in customer base and operating portfolio is expected as Gualandris et al. (2021) note that changes in supply chain structure are reported to be minimal. On the other hand, Free and Hecimovic (2020) mentioned the exacerbation of the pandemic on global supply chains and the subsequent shift toward the regionalisation and/or localisation of supply chains. The regionalisation and/or localisation of supply chains are slowly being seen, for example, in the shift of Apple iPhone production to Mexico (Chatterjee et al., 2020). However, these changes might only be reflected in the company's customer base in the long-term and not in the immediate years after Covid.

However, while the structure of the supply chain has not changed significantly, as compared to before the pandemic, the question is whether changes in the structure of the supply chain influence how the firm finances their supply chain. Using the RBV, the study reasoned that the dimensions of the supply chain will influence the firm's nature of financing via the complexity of supply chain structure and/or the risk of the supply chain structure to disruptions (Campello & Gao, 2017; Kale & Shahrur, 2007).

Addressing the first dimension, I hypothesised that a localised customer base will require fewer resources in the downstream supply chain. This reduces the structural complexity of the supply chain. This reduction of global resources will also reduce the

susceptibility of the supply chain to global supply chain risks and disruptions. In this way, I hypothesised a positive relationship with debt financing. Overall, the findings confirm the hypothesis developed and are in line with the findings of previous studies (Aggarwal & Kyaw, 2010; Eun & Wang, 2016).

In regard to a firm's operating portfolio, a larger proportion of sales to the primary operating segment suggests a narrower focus of operations (Kovach et al., 2015). Hence, fewer resources will be required to focus on a narrower scope of operations and will reflect less structural complexity in the supply chain. However, a narrower scope of operations may also be detrimental to the benefits of diversification (DeCampos et al., 2022) and reflect greater susceptibility to supply chain risks and disruptions. As such, I hypothesised that there was no relationship between operating portfolio and book leverage. In line with this hypothesis, the findings reported a non-significant relationship. This provides support to the fact that both of the arguments made above may affect the relationship.

Similarly, with the incorporation of environmental resources and social resources in the supply chain, this would enhance the sustainability of supply chain operations and enhance firm reputation in the long-term (Caragnano et al., 2020; Oikonomou et al., 2014). This would favour debt financing. However, the incorporation of environmental resources and social resources would require further financial investment and encourage long-term relationships with suppliers (Andersen & Skjoett-Larsen, 2009; Aranda-Usón et al., 2019). This would encourage equity financing. As such, no relationship was hypothesised in regard to environmental dimensions and social dimensions. In line with this hypothesis, the findings reported a non-significant relationship. This provides support to the above arguments and the theory that while there are complexities around incorporating environmental and social practices in the supply chain, there are positive reputational effects.

However, *Chapter Four* noted the importance of supply chain integration, as emphasised by (Kim, 2006). (Lockett et al., 2009) also noted the importance of resource integration in the supply chain by outlining the importance of resource recombinations (an element of the RBV). Resource recombinations, as mentioned previously, is the combination of resources in achieving dynamic capabilities and a subsequent competitive advantage. These resource recombinations, in creating dynamic capabilities, would also enable greater efficiency of the supply chain (Pfohl & Gomm, 2009) and likely affect the structure of firm financing.

This supply chain integration included the integration of environmental and social dimensions with the four mentioned supply chain processes, which reflect the flow of materials (Awaysheh & Klassen, 2010; Green et al., 2012). In addition, the integration of the flow of materials with the flow of financing is essential to supply chain integration (Pfohl & Gomm, 2009). This is similarly referred to as the integration of the physical supply chain with the financial supply chain (Silvestro & Lustrato, 2014). This motivated the moderating relationships of customer base and operating portfolio with (i) environmental and social dimensions and (ii) dimensions reflecting the flow of financing and SCF.

The first set of moderating relationships found that the complexities of integrating environmental dimensions into the supply chain was less complex in supply chains with a greater domestic customer base and companies with a reduced operating portfolio (fewer operating segments). On the other hand, the enhanced brand reputation and reduced uncertainty of future cash flows in integrating social dimensions into the supply chain weakened with a greater domestic customer base and reduced operating portfolio. This is because of the greater uncertainty associated with a greater domestic customer base and reduced operating portfolio. The second set of moderating relationships found that the integration of the financial supply chain with the physical supply chain made the supply chain

more efficient. This is illustrated through increased asset turnover, inventory turnover and CCC enabling increased working capital and, therefore, less reliance on debt financing.

Apart from the additional moderation analyses, alternative measures of capital structure (other than book leverage) were employed. Myers (2001) noted that debt and equity financing are not the only two financing mechanisms and also include short-term financing, which is utilised a lot in the supply chain through trade credit solutions (Banerjee et al., 2004). As Banerjee et al. (2004), Gomm (2010) and Silvestro and Lustrato (2014) noted, short-term financing and the financing of operating activities using SCF plays an important role in the supply chain. Hence, the study used the proportion of short-term financing to total assets as an alternative measure of capital structure. The findings showed a positive relationship between customer base and short-term financing. This suggests that with fewer global supply chain resources, less money is tied up in supply chain resources. The consequences of less cash being tied up allows for greater short-term financing. Secondly, environmental dimensions have a significant positive impact on the extent of long-term financing. According to Benlemlih and Cai (2020) the former finding suggests that environmentally responsible firms use short-term debt financing to signal superior quality and to take advantage of favourable financing conditions in the future. Further to this, the complexity of incorporating environmental resources in the supply chain requires greater cash on hand. Addressing the remaining two dimensions of operating portfolio and social dimensions, neither of these dimensions has a relationship with either of the alternative measures of capital structure.

Overall, the findings suggest that having fewer global supply chain resources (as reflected in a greater domestic customer base) is associated with less complexity and less uncertainty, resulting in a positive relationship with book leverage. The remaining dimensions of (i) operating portfolio, (ii) environmental dimensions and (iii) social

dimensions have no relationship with book leverage. Additionally, the resource recombinations of environmental and social resources towards GSCM and SSCM significantly influence the capital structure. Further to this, combining the resources of the financial and physical supply chain also influences the structure of debt and equity resources. Lastly, the study used an alternative measure of capital structure which equalled the proportion of short-term financing to total assets.

Chapter Six: Determinants of Supply Chain Disclosure

6.1 Introduction

The growth in globalisation and the increase in competition has highlighted the role of supply chains in company performance as well as in value creation and competitive advantages of a company. This has subsequently led to various stakeholders calling for companies to disclose information on the complexities of their supply chain (Bayne et al., 2022; Burritt & Schaltegger, 2014). This has been further emphasised by the Covid-19 pandemic. Dai et al. (2020) have noted that the pandemic exposed a lack of planning, internal visibility, and external transparency in supply chains. Adding to this, Baker McKenzie (2020) mention that the pandemic highlighted the lack of diversification in sourcing strategies and the importance of risk management. Regarding this issue, Mickle and Kubota (2020) noted analysts' and investors' concerns over Apple's over-reliance on Foxconn. These concerns over the supply chain, have had negative flow-on effects on the company. As a result, Moss Adams (2020a, 2020b) noted the types of disclosures that have become more material, such as going concern disclosures of the company, in which the supply chain of the company has a huge bearing.

Hence, this study examines the effect of supply chain dimensions on the extent of supply chain disclosure (SCD) provided in company annual reports. In conducting the study, I use a sample size of 80 companies listed on the UK FTSE All-Share index, across the 2018 and 2021 financial year. This results in 160 firm-year observations. I subsequently perform a content analysis to examine the provision of SCD in these companies.

Previous literature has uncovered an abundance of studies researching SCD. Many of these studies have been in the context of social and environmental SCDs. For example, Stevenson and Cole (2018) examine modern slavery in supply chains, while Islam and Van Staden (2018) study the comprehensiveness of conflict mineral disclosures. Further to this, Deegan and Islam (2010) and Deegan and Islam (2014) study the disclosure of social responsibility and workplace practices in supply chains. Doorey (2011) also study the transparency of supply chains in regard to workplace conditions in their suppliers' operations.

More on the operational aspects of the supply chain, Arvidsson (2011) and Bayne and Wee (2019) noted a lack of operational information, concerning non-financial KPIs, in SCM. Further to this, Bayne et al. (2022) examined the current status of SCD among Australian companies and the preferences of stakeholders in relations to SCD. They found a high level of supply chain risk disclosures, However, in agreement with Bayne and Wee (2019) who studied the disclosure of non-financial KPIs in Australian companies, the study found a lack of disclosure in relation to supply chain KPIs in 2016/17 and 2017/18. Bayne and Wee (2019) showed that, while disclosure such as KPIs around health and safety, procurement, engagement, environmental and social, improved, it was still at low levels. The findings also noted calls from stakeholders for disclosures around supplier identities, geographical locations and supply chain risk (Bayne et al., 2022).

Responding to the lack of SCD, Marshall et al. (2016) developed a SCD radar which focussed on four type of disclosures. This comprised operational aspects as well as environmental and social aspects of the supply chain. In the current study, I develop a more comprehensive SCD index consisting of types of information proposed by Marshall et al. (2016) and Bayne et al. (2022) as well as information concerning the BM. I also contribute to previous research by examining the determinants of such SCD.

This chapter is divided into five sections. The second section reviews the existing literature on (i) internal visibility and external transparency, (ii) the strategies towards disclosing supply chain information and (iii) the role of SCM in financial reporting and accounting disclosure. The third section explains the sample selection and empirical model alongside the construction of the disclosure index and the independent and control variables. Subsequently, the fourth and fifth sections outline the findings and discuss the results, respectively.

6.2 Prior literature & hypothesis development

The second research question addresses the effect of supply chain dimensions: (i) customer base, (ii) operating portfolio, (iii) environmental dimensions and (iv) social dimensions on SCD. In integrating the RBV, I note that SCD is the external communication of the dimensions of the supply chain. This section firstly differentiates the literature examining internal visibility and external transparency. Subsequently, I outline the literature around the operationalisation of SCD: mandatory disclosures surrounding SCD, the enablers and barriers towards SCD, disclosure strategies, and the relatedness of SCD to integrated reporting and BM reporting. Lastly, in developing the hypotheses, I review the literature which has previously studied the effect of supply chain dimensions on accounting disclosure.

6.2.1 Supply chain transparency

A. Internal visibility

According to Montecchi et al. (2021), internal visibility is the process of collecting and analysing information about supply chain operations and processes from upstream suppliers and downstream customers. This information is used for internal purposes and is

used to improve efficiency of internal supply chain operations and manage the company's exposure to supply, production and demand risks (Sodhi & Tang, 2019).

Sodhi and Tang (2019) expanded on the benefits of enhancing internal visibility of the supply chain. They note that the effects of disruptions, such as earthquakes and floods, on upstream suppliers can delay the delivery of raw materials which subsequently delays production and downstream delivery to customers. This can be illustrated through the supply delay of mobile chips from suppliers, Broadcom and Texas Instruments, to Apple, which subsequently delayed the release of the iPhone 13 (Wu, 2021). Such supply chain risks can be mitigated through tools that enhance visibility such as supply chain mapping, which Choi et al. (2020) note has come to the forefront in the midst of the Covid-19 pandemic.

Sodhi and Tang (2019) also mention that enhancing internal visibility can reduce reputational damages as a result of negative publicity towards supplier practices. This can be exemplified through the negative publicity faced by Fonterra as a result of an upstream supplier being linked to deforestation practices (Flaws, 2021). Such damage to a company's reputation via its supply chain can be reduced through such tools as issuing a supplier code of conduct to suppliers outlining unethical practices, on-site visits of suppliers, conducting interviews and questionnaires with suppliers, and supplier audits (Doorey, 2011; Sodhi & Tang, 2019).

B. External transparency

While internal visibility deals with enhancing the flow of information within the supply chain through various tools, Egels-Zandén et al. (2015) note that external transparency is the disclosure of information pertaining to the supply chain to shareholders. The study notes that transparency transfers power from the firm to its shareholders via a reduction in

information asymmetry, allowing these external parties to make informed decisions. Hence, supply chain transparency closely aligns to the underpinnings of agency theory.

Many studies have noted the benefits of external transparency towards shareholders including gaining the trust of investors and consumers which will enhance customer value and shareholder value. Further to this, external transparency assists in conformity to regulations, preventing bad publicity and the monitoring of suppliers through crowdsourcing (Sodhi & Tang, 2019). However, Egels-Zandén et al. (2015) note that the extent of such transparency depends on certain trade-offs. For example, external transparency of the company's supply chain will be beneficial such as through the external disclosure of a company's suppliers as done by H&M and Nike. However, too much transparency of supplier details can sever collaboration with suppliers' and threaten the continuity of such relationships.

Additionally, it needs also to be considered whether supply chain transparency is a way to become accountable to shareholders and as a means to improve sustainability and supply chain performance. On the other hand, such disclosure could become ends in themselves and simply for the sake of disclosing supply chain information (Egels-Zandén et al., 2015). This will determine the extent of transparency efforts. Egels-Zandén and Hansson (2016) also note that previous studies have observed that supply chain transparency can be used as a tool to hold companies accountable to improve their sustainability (consumer tool) and as way to increase revenues (corporate tool). In their case study of Nudie Jeans, a Swedish company, the study finds that supply chain transparency is used as a corporate tool. However, depending on whether supply chain transparency is used as a consumer tool or a corporate tool, or both, will determine the extent of such supply chain transparency efforts. While this study examines the extent of SCD, it is not within the scope to investigate the purpose of such disclosure.

6.2.2 Supply chain disclosure strategy

Initial corporate disclosure research investigated accounting disclosure (Botosan, 1997; Hossain et al., 1995). Rupley et al. (2017) noted that disclosure soon encompassed environmental and social disclosures, followed by sustainability disclosures in the early 21st century. Bukh (2003) and Bukh et al. (2005) also note that during this time intellectual capital disclosures became more prominent.

Recently, there has been a growing area of research into supply chain disclosure (Bayne et al., 2022; Marshall et al., 2016) which Arvidsson (2011), Bayne and Wee (2019) and Bayne et al. (2022) found to be lacking. Arvidsson (2011) conducted a study on the disclosure of non-financial KPIs in Swedish companies. The study found that (i) relational KPIs, focussing on customer groups, networks of suppliers and distributors, and strategic alliances, and (ii) R&D KPIs, focussing on R&D activities and innovation, were among the categories that were disclosed the least. Similarly, Bayne and Wee (2019) conducted a study of non-financial KPI reporting among Australian companies. They found the least disclosed categories of KPIs were those concerning (i) supply chain management KPIs focussing on supplier audits and local procurement and (ii) operations and innovation. Based on these findings, Bayne and Wee (2019) suggested that companies disclose few KPIs concerning their supply chain operations.

Bayne et al. (2022) examined the issue of SCDs more deeply. They performed archival analysis of companies' annual reports in Australia. Based on archival analysis, they found that management approach to supply chain risk and to SCM was well disclosed. However, very few firms disclosed their supply chain KPIs. Further to this, KPIs that were disclosed did not have comparisons or performance targets. Interviews were also conducted with stakeholders to investigate their preferences in relation to SCD. They found that there

were calls for disclosures around supplier identities, geographic locations and supply chain risk classifications. These studies mostly look at the disclosure of KPIs relating to the supply chain with the latter looking at the preferences of stakeholders. As mentioned previously, this study looks at SCD more comprehensively with the inclusion of a much wider set of supply chain information. Further differentiating this study from previous studies, I also examine the supply chain dimensions that affect the extent of SCD.

Having said that, there are many factors that affect external transparency and the disclosure of supply chain information. These factors include (i) the growing mandatory regulations around such disclosure, (ii) the technology enabling such disclosure to be collected, (iii) the barriers of cost of collecting supply chain information, (iv) the choice of disclosure strategies decided on by the firm and (v) the recent calls for integrated reporting and BM reporting. The following subsections discuss these factors.

A. Mandatory Disclosure

Recent studies in SCD have largely focussed on the ethical and social aspects of the supply chain. These types of disclosures include information on human rights in the supply chain and the effects of supply chains on society (McCarthy et al., 2017). The most comprehensive of these issues is modern slavery with many countries having released mandatory requirements: California Transparency in Supply Chains Act (CTSCA) in 2010 (California, US), UK Modern Slavery Act in 2015 (UK), The French Duty of Vigilance Law (France) and Due Diligence on Child Labour Act (Netherlands).

Stevenson and Cole (2018) and Islam and Van Staden (2021) study the UK Modern Slavery Act. The former study investigates the content of such disclosures which pertain to the detection and remediation of modern slavery practices in companies' supply chains. On the other hand, Islam and Van Staden (2021) examine the drawbacks of the disclosure

requirements of the Act, with stakeholders noting that the focus was on reducing the risks in supply chains, as opposed to preventing modern slavery practices in supply chains. While this may be ineffective in reducing modern slavery practices in the short-term, if the risks are significant, this might consequentially reduce modern slavery practices in the long-term. While these studies examine the mandatory disclosure requirements pertaining to modern slavery, Christ et al. (2018) study the current voluntary disclosure practice of Australian companies. The findings of Christ et al. (2018) reveal that the quality of disclosures is low when conducted on a voluntary basis and they are predominantly driven by institutional competitive pressures. On the other hand, the mandatory yet 'soft' disclosures of the UK Modern Slavery Act do not make a significant difference to the reporting of modern slavery practices (Islam & Van Staden, 2018; Stevenson & Cole, 2018).

She (2022) further performed a study investigating the real effects resulting from the mandatory disclosure of human rights and modern slavery in the supply chain, as regulated by the CTSCA. In spite of the drawbacks pointed out by Islam and Van Staden (2021), She (2022) notes that firms covered within the coverage of the CTSCA increased their supply chain due diligence after the regulation. In noting this, She (2022) measured supply chain due diligence as the combination of supplier assessment, audit, certification, internal accountability, and training. This relationship further strengthened with the external pressures from NGOs, socially conscious shareholders, and for companies with suppliers located in countries with high-risk of labour abuse. However, Chilton and Sarfaty (2017) study the limitations of human rights and modern slavery disclosure regimes, focussing on CTSCA. They note that there is no significant difference in consumer confidence towards those companies that have high supply chain due diligence, as compared to low levels of due diligence.

In addition to the growing legislation regulating modern slavery in supply chains, there has also been regulation surrounding the sourcing of conflict minerals. Conflict minerals are minerals and raw materials sourced from regions such as the Democratic Republic of Congo which are used to fund conflicts. Due to the relative recency of such mandatory disclosures and similarly to modern slavery requirements, these disclosures are minimum requirements (Islam & Van Staden, 2018). As such, the study examines the effects of company collaborations with NGOs and the influence of activist protests on the extent of conflict mineral disclosures. They find that collaboration with NGOs and the presence of activist protests influence more comprehensive and transparent disclosures. However, Griffin et al. (2014) find that the costs of this disclosure outweigh the positive effects. Kim and Davis (2016) find that the complexity and size of the supply chain is the greatest obstacle towards the monitoring of conflict minerals in the supply chain. On the other hand, Swift et al. (2019) note that more visibility into conflict mineral disclosures improves profitability and stock market valuations. As with all mandatory disclosure regimes, especially nonfinancial disclosure regimes, the studies suggest that the effectiveness of mandatory disclosures is limited if they are stand-alone. Instead, these mandatory disclosure requirements should be paired with pressure from external stakeholders such as NGOs, shareholders, and consumers.

B. Enablers and Barriers to SCD

The above-mentioned studies along with Marshall et al. (2016) have noted the pressures to disclose, which can come from mandatory regulation. Coupled with mandatory regulations, voluntary disclosures play an important role, especially in the disclosure of supply chain information. Hence, the extent and comprehensiveness of SCD depends on various factors that enable or prevent transparency.

In noting the enablers to external transparency of SCD, the facilitation of internal visibility within the supply chain plays an important role. This is done through tools such as supply chain mapping, supplier audits and supplier code of conduct requirements, as pointed out previously. Further to this, Marshall et al. (2016) note that information technologies such as Enterprise Resource Management (ERM) and Customer Relationship Management (CRM) systems can help enhance transparency. Added to this, newer technologies such as Radio Frequency Identification Devices (RFID), Internet of Things (IoT), Artificial Intelligence (AI) and blockchain technology can enable transparency of more complex supply chains (Ben-Daya et al., 2019; Saberi et al., 2019; Wang et al., 2019). The impact of big data has also contributed to an overload of information (Warren et al., 2015).

Focussing on the newer forms of technology that can enhance external transparency, Ben-Daya et al. (2019) look at the effect of IoT and artificial intelligence technologies (e.g. RFID). This allows the real-time tracking of raw materials and finished goods through (i) planning, (ii) sourcing, (iii) production and (iv) distribution activities of SCM. Saberi et al. (2019) and Wang et al. (2019) study the benefits of blockchain technology in enhancing visibility, traceability and transparency. They note that blockchain technology can provide a record of the flow of materials through the supply chain. The benefit of blockchain in recording transactions chronologically and being tamper-proof allows for the traceability of products and enhances the reliability and authenticity of information. Wang et al. (2022) and M. Wang et al. (2020) also note that blockchain can facilitate the identification, coordination and compliance of sustainability standards of supply chain members as well as facilitate supply chain integration which the latter study links to reducing carbon emissions. Columbus (2015) looks at big data as a method of information sharing within the supply chain. They look at the scope and depth of supply chain information, integration of this information into planning, demand forecasting, supplier collaboration and risk analysis, and the effects on

supply chain operational measures. Warren et al. (2015) additionally note the benefits that big data has on the extent of accounting information. Through the effects on enhancing internal visibility of the supply chain, these technologies will help in increasing the external transparency of SCD.

However, Marshall et al. (2016) also note that cost plays a big role in the extent of SCD. The study notes that the cost of collecting and reporting supply chain information increases when the supply chain is increasingly complex. This is supported by Kim and Davis (2016) who note that the certainty of which companies can disclose on conflict minerals is determined by the complexity and size of the supply chain. Many companies already perform supplier audits and require suppliers to comply with environmental standards or be environmentally certified (e.g. ISO 14000). Such information such as the engagement in supplier audits, environmental certifications and climate-related disclosures are externally disclosed. However, more comprehensive disclosures require new information technologies that are more costly and require the company to expend more effort to collect data and report on it.

The extent of SCD is not only determined by the resources available to the company to collect and report information, but also the willingness of management to disclose such information. The benefits of SCD towards reducing information asymmetry is in direct opposition to the costs of disclosing proprietary information which can give a company a competitive advantage. Numerous previous studies have noted the importance of proprietary costs attached to information that gives a company a competitive advantage. Ellis et al. (2012) and Li et al. (2017) note that proprietary costs are the most important factor in not disclosing supply chain information. Ellis et al. (2012) find that companies are less likely to disclose major customer information if they have greater R&D expenditures, intangible assets, and advertising expenditure. Furthermore, at the industry-level, disclosure choices are

a result of choices of competitors and product market competition. Hence, the extent of SCD depends on the extent to which technologies are used to collect such information, against the costs of revealing proprietary information.

C. Disclosure Strategies

In examining the external transparency of SCD, it is important to note the growing mandatory requirements surrounding SCD as well as the enablers and barriers towards the voluntary disclosure of supply chain information. In combination with the motives and strategies of the company in disclosing SCD, the forces behind the extent of SCD can be inferred.

In noting the strategies towards disclosing SCD, McCarthy et al. (2017) and Marshall et al. (2016) discuss the categories of SCD. The former construct a disclosure radar which comprises four types of disclosures: (i) membership information, (ii) provenance information, (iii) environmental information and (iv) social information. Membership information pertains to disclosures on suppliers and customers (e.g. number and location of suppliers/customers, 1st tier suppliers) while provenance disclosures relate to the materials used in production and the location the materials were extracted from. Environmental disclosures relate to the consumption of energy and water throughout the supply chain, the amount of waste-to-landfill, carbon emissions and so forth, while social disclosures refer to information on human rights, and the presence/non-presence of modern slavery and conflict minerals in the supply chain.

Overall, these disclosures can be categorised as critical, strategic, optional, and non-critical information (Marshall et al., 2016). Critical and strategic information comprises information that impacts company value. However, critical information comprises

information that poses a risk to the performance and success of the company, whereas strategic information are those types of information that provide value but are not of high-risk (Marshall et al., 2016). Examples of the former include modern slavery disclosure while the latter includes disclosures that signal product differentiation (e.g. green procurement practices). The remaining two categories, optional and non-critical information, are disclosures that are of low value to the company and their shareholders. However, optional disclosures are information that is of high-risk in the supply chain, whereas non-critical information is of low value to the company and of low risk in regard to the supply chain (Marshall et al., 2016). Hence, with the growing importance of the supply chain in the success and performance of the company, critical, strategic, and optional information are important to be disclosed.

Marshall et al. (2016) also notes the extent to which these types of information (comprising SCD) are disclosed. The study notes that companies can employ the following disclosure strategies: (i) transparent strategies, (ii) secretive strategies, (iii) distracting strategies or (iv) withholding strategies. The type of disclosure strategy is dependent on the degree of knowledge of the supply chain, which is based on the technology available to collect and gather this knowledge versus the cost of gathering the information. The disclosure strategy is also based on the willingness to disclose such information, which is dependent on information asymmetry versus proprietary costs.

A company with a transparent disclosure strategy opts to be open with supply chain information and views such disclosure as a core competence or a source of competitive advantage and looks to reduce information asymmetry. On the other hand, a secretive disclosure strategy chooses to conceal information from competitors due to the proprietary costs of such information, such as revealing secret product formulas (Marshall et al., 2016). Companies that do not have much knowledge and information on their supply chain, can opt

for a distracting disclosure strategy which distracts stakeholders to favourable supply chain information, or a withholding disclosure strategy which focusses on the non-disclosure of supply chain information either because the information is unfavourable or due to a lack of supply chain knowledge (Marshall et al., 2016).

Overall, (i) the extent to which supply chain information is mandatorily regulated, (ii) the enablers and barriers (costs) to collecting supply chain information and (iii) the willingness and motives of the company to disclose supply chain information (disclosure strategies) determine the extent of SCD. In noting the forces behind the external transparency of SCD, I also note the links between SCD and recent academic research into both integrated reporting and BM reporting. These links to both integrated reporting and BM reporting are likely to facilitate strategies towards SCD. Hence, I briefly review the literature in both of these strands.

D. Integrated Reporting and BM reporting

The growing literature on SCD and SCD strategies has coincided with increasing studies on integrated reporting and calls for BM reporting. This has manifested from the shift in financial disclosure from communicating firm performance to communicating value creation (De Villiers et al., 2014).

As previously noted, SCD is the communication of the dimensions of the supply chain. Alongside this, *Chapter Four* recalls that the dimensions of the supply chain comprise the three types of information flows and four supply chain processes. Within these processes, further subdimensions of supplier collaboration and outsourcing, for example, are identified. These dimensions of the supply chain can be similarly thought of as capitals that add value to the company. For example, supplier collaboration is a form of relational capital. Thus, the

combined disclosure of these supply chain dimensions through SCD is closely linked to that of integrated reporting.

As De Villiers et al. (2014) note, integrated reporting (IR) is the integrated thinking of all sources of capital used to create value for the company and the reporting of this information to stakeholders. Marr et al. (2004) and Guthrie et al. (2012) list these different sources of capital: (i) financial capital, (ii) physical capital, (iii) human capital, (iv) relational capital, (v) structural capital, (vi) strategic capital, (vii) social capital and (viii) natural capital. Rupley et al. (2017) further note that IR subscribes to the disclosure of (a) organisational overview and business models, (b) strategic objectives, (c) operating context, including the associated risks and opportunities within the operating context, and (d) the future outlook and value creation of the company. As Barnabè et al. (2019) note, the aim of IR is to develop and report a holistic model of the management of resources in the creation of value. This suggests that IR and SCD have many commonalities. However, whereas IR focusses on the disclosure of organisational sources of capital, SCD focusses on disclosing the dimension of the supply chain.

Further to this, the focus of SCD and IR on communicating value creation has brought about links to BM reporting. The concept of business models (BM) has been around for a long time. Despite this, there has been limited research on BMs prior to the 21st century. Shafer et al. (2005, p. 202) define BM as "a representation of a firm's core logic and strategic choices for creating and capturing value within a value network". Veit et al. (2014) further note that a company's BM is a breakdown of a company's strategy, which communicates the business processes of a company. Hence, BMs can be thought of as comprising multiple sources of capital and comprising the overall supply chain and the business processes within the supply chain. As such, BM reporting can be thought of as the context in which IR and SCD can be achieved. The link between IR and BM reporting is supported by Rupley et al.

(2017) and Sukhari and De Villiers (2019) who noted BM and strategy disclosures as a function of IR. However, the focus on IR is not within the scope of this study. Consequently, I focus on the links between SCD and BM reporting and the operationalisation of SCD through BM reporting.

In noting the key elements of the BM, Lewandowski (2016) illustrates this using the business model canvas. The business model canvas incorporates key partners, key activities, key resources, value propositions, customer relationships, customer segments, distribution channels, revenue streams and cost structure as key tenets of the BM. Shafer et al. (2005), in their business models' definition above, highlight strategic choices, and the creation and capture of value as important elements. Combining these, Norris et al. (2021) outline that the BM comprises value proposition, value creation, value delivery and value capture.

Linking the elements of the BM to the operationalisation of SCD, Nielsen and Roslender (2015) note that BM reporting needs to incorporate an inter-organisational perspective of the supply chain, as opposed to looking at it from an organisational-centric lens. Abdelkafi and Pero (2017) further explain that BM describes how company and supply chain strategy is achieved and simplifies the complexities of supply chain operations while synthesising the supply chain activities that add value. Hence, BM reporting needs to incorporate the reporting of supply chain information through SCD. As such, the operationalisation of the SCD is through the four elements of BM reporting as laid out in Norris et al. (2021): (i) value proposition, (ii) value creation, (iii) value delivery and (iv) value capture.

6.2.3 Supply chain accounting

The previous section discussed the factors that determine the level of SCD. This has coincided with the growing supply chain accounting literature focusing on the role of financial reporting and accounting disclosure in the supply chain. Within this strand of

research, many studies have examined the effect of supply chain dimensions on financial reporting (Dou et al., 2013; Hui et al., 2012) and accounting disclosure (Cahan et al., 2005; Cho et al., 2020; Crawford et al., 2020). In addition, recent studies have also started to investigate supply chain transparency (Cai et al., 2023; Gualandris et al., 2021; Kim & Davis, 2016) From these studies, many factors affect the extent of disclosure, including the information asymmetry hypothesis, the proprietary information hypothesis and the agency problem hypothesis.

Firstly, I briefly review the previous research that has studied the effect of supply chain dimensions on accounting disclosure. Cho et al. (2020) find a positive relation between the issuance of a customer's earnings guidance and the company's external disclosure. However, this is only when the customer's earnings guidance deviates greatly from market expectations. To put it simply, this suggests that greater uncertainty in the supply chain results in greater information asymmetry and greater disclosure. In regard to the complexity of the supply chain, Crawford et al. (2020) show that greater customer concentration is associated with fewer sales and management forecasts. They show that this is because greater customer concentration is associated with less complexity and, as such, less monitoring is needed. On the other side of the complexity spectrum, Cahan et al. (2005) find a positive relationship between the global diversification of operations and the voluntary disclosure of accounting information. The study argues that this is because of the increased information asymmetries (stemming from increased complexity of the supply chain) and transaction costs of monitoring global operations. These three studies suggest that greater uncertainty and/or greater complexity in the supply chain requires greater disclosure. This is in alignment with the information asymmetry hypothesis.

The second strand of literature examines supply chain transparency. Marshall et al. (2016) previously noted in *Section 6.2.2* that cost is a big factor in the extent of SCD. Kim

and Davis (2016) examine the supply chain dimensions that affect the extent to which a company discloses their use of conflict minerals. They found that international diversification and the complexity of the supply chain, measured by the number of suppliers, made it more difficult for the company to verify if their materials were sourced from conflict zones. This is because of the greater cost the company incurs in collecting information when the supply chain is more complex. This argument is supported by Gualandris et al. (2021) who find that supply chain density (interconnectedness of the supply chain) is positively associated with supply chain transparency. This finding suggests that more interconnected supply chains are less complex due to greater cohesiveness within the supply chain. This leads to greater information sharing within the supply chain, which subsequently translates to greater external transparency of supply chain information.

Gualandris et al. (2021) also find that supply chain clustering has a weak negative relationship with supply chain transparency. They define clustering as the measure of the network's structure and how members, including subsuppliers, engage with each other. This suggests that a supply chain comprising multiple different clusters is a more complex and fragmented supply chain. This makes it more difficult to share information through the supply chain. The two studies of Kim and Davis (2016) and Gualandris et al. (2021) offer the explanation that more complex supply chains are associated with less supply chain transparency. This is due to more difficulty in sharing information between supply chain members. This, therefore, contradicts the information asymmetry hypothesis that predicts that greater complexity leads to greater disclosure.

The proprietary cost hypothesis also has an effect on the extent of SCD. The findings of Gualandris et al. (2021) further state that geographical heterogeneity is positively associated with supply chain transparency. The study notes that this is because supply chain members which are geographically spread out are less likely to be in direct competition with

each other, and as such will likely disclose greater supply chain information. This explanation suggests that less competition will reduce the proprietary costs attached to disclosing supply chain information. Chen et al. (2022) find that companies in more competitive industries disclose less supply chain information, in the form of customer and supplier information. This is due to the competitive advantage that competitors can gain from using such information.

Further on the proprietary costs explanation, Dai et al. (2021) investigate the relationship between global outsourcing and voluntary disclosure and find a negative relationship. They explain this result as owing to the reluctance of disclosing proprietary information to global competitors. Further to this, global outsourcing creates greater complexity in the supply chain, resulting in less voluntary disclosure. Explaining this further, Dai et al. (2021) note that, on one hand, greater outsourcing forces management to expedite more resources to track outsourcing engagements and, thus, incurring added costs of preparing disclosure. This results in fewer external disclosures. This conforms to the influence of cost in influencing supply chain transparency. Moreover, information on global outsourcing can be leveraged by firms to gain a competitive advantage over other firms and is therefore a source of proprietary information. This conforms to the influence that supply chain complexity and the effect of proprietary information has on influencing supply chain transparency.

On the other hand, Dai et al. (2021) also note that global outsourcing increases information asymmetry between the company and shareholders. This would increase information disclosure. Hence, the company will have to consider the trade-offs between not disclosing proprietary information (proprietary cost hypothesis) (Ellis et al., 2012) and the benefits of reducing the monitoring costs for stakeholders (information asymmetry hypothesis) (Healy & Palepu, 2001).

This leads to Cai et al. (2023) who examine the influence of information asymmetry, proprietary costs and the agency problem on the disclosure of supply chain information. Testing the proprietary cost hypothesis, Cai et al. (2023) find that companies with greater R&D intensity, as a proxy for proprietary information, in their supply chain are associated with less disclosure of supply chain information. The finding is the same when proprietary costs is measured through the number of patent applications, in that there is a negative relationship between patent applications and supply chain transparency. The same study tests the agency problem hypothesis. They find that good corporate governance is likely to result in the disclosure of less supply chain transparency. This is because good corporate governance will lead to greater alignment between the interests of managers and shareholders. As such, this alignment of incentives will lead to the safeguarding of proprietary information and reduced supply chain information (Cai et al., 2023).

In taking note of these studies, the first strand of research focussed in on the dimensions of the supply chain but in the context of accounting disclosure. The second strand of literature focussed on supply chain transparency. Gualandris et al. (2021) and Cai et al. (2023) address the effect of supply chain dimensions on supply chain transparency to some extent. However, Gualandris et al. (2021) look at supply chain transparency in the context of ESG disclosures within a firm's customers, suppliers and subsuppliers. Alternatively, Cai et al. (2023) look at supply chain transparency encompassing the trade volume and identity information of the top-5 customers and suppliers within Chinese firms. In contrast, the current study examines the effect of supply chain dimensions on supply chain transparency, comprising a wider scope of supply chain-related information, as mentioned above.

In concluding *Section 6.2,* the literature first briefly looked at previous studies on internal visibility and external transparency. In focussing on SCD, the section subsequently focussed on the latter and two different areas of literature: (i) SCD and the strategies affecting

external transparency and SCD, and (ii) the effect of supply chain dimensions on accounting disclosure and supply chain transparency. These two areas prove important in outlining the contributions that the current study makes.

The first area of research, reviewed in *Section 6.2.2,* outlined that previous research has studied the lack of SCD with an emphasis on supply chain KPIs (Arvidsson, 2011; Bayne & Wee, 2019) and calls for greater supply chain information from stakeholders (Bayne et al., 2022). McCarthy et al. (2017) went a step further and created an SCD radar based on membership information, provenance information, environmental information and social information. However, as mentioned previously, this study contributes in two major ways. This is through (i) developing a more comprehensive disclosure index that goes further than any of the other previous studies and (ii) investigating the effect of supply chain dimensions on SCD.

The second area of research, reviewed in *Section 6.2.3,* in discussing the previous literature on the effect of supply chain dimensions on supply chain transparency, diminishes the second contribution. In mentioning this, neither Gualandris et al. (2021) nor Cai et al. (2023) examine a comprehensive scope of SCD. In the current study, I develop a more comprehensive SCD index consisting of (i) membership information, (ii) provenance information, (iii) environmental information, (iv) social information, (v) supply chain KPIs and (vi) supply chain risk disclosures. In addition, I include information neither highlighted in Bayne and Wee (2019) and Bayne et al. (2022) nor accounted for in the SCD radar developed by Marshall et al. (2016). These include information concerning the BM as well as accounting disclosures (i.e. accounts receivable) that have supply chain implications. Thus, the primary contribution of this study is focussed on the comprehensiveness of the disclosure index developed. This is accompanied by the secondary contribution of investigating the effect of supply chain dimensions on SCD, which adds to the growing literature on this topic.

6.2.4 Hypothesis development

This section develops the hypotheses investigating the effect on SCD of supply chain dimensions: (i) customer base, (ii) operating portfolio, (iii) environmental dimensions and (iv) social dimensions.

Customer Base:

The first supply chain dimension hypothesised in relation to SCD is the customer base of the company's supply chain. As mentioned in the previous chapter, I use the extent of domestic sales to proxy for this supply chain dimension, which is calculated via the proportion of domestic sales to total sales.

In hypothesising the relationship with SCD, Cahan et al. (2005) in their study find a positive relationship between the global diversification of operations and the voluntary disclosure of accounting information. The study argues that this is because of the increased information asymmetries (stemming from increased complexity of the supply chain) and transaction costs of monitoring global operations. In line with this it can be hypothesised that the more localised a firm's customer base is, the less supply chain information will be disclosed. This would suggest a negative relationship. As such, I hypothesise the following.

H_{2A} (Alternate): *There is a negative relationship between the extent of domestic sales and the extent of supply chain disclosure (SCD).*

Operating Portfolio

The second supply chain dimension investigated in relation to SCD is the complexity of the company's operating portfolio. This dimension is measured via the primary (largest) operating segment which is calculated as the extent of sales of the primary operating segment as a proportion of total sales. Herrmann and Thomas (2000) note that operating segment

reporting is illustrative of the way that management organises internal business operations. This can be through the number of product categories in the company's product portfolio or through the number of distribution channels in distributing products to customers. Regardless, the greater the proportion of sales owing to the primary segment, the less complex the internal business operations of the firm will be.

Consequently, in hypothesising the relationship with SCD, Cahan et al. (2005) note the influence of information asymmetry in the positive relationship between global diversification and voluntary disclosure. This is because the company is more complex with global diversification. Given this, the greater the proportion of sales owing to the primary segment, the less complex the internal business operations of the firm will be. Hence a negative relationship is likely between operating portfolio and SCD.

On the other hand, Cai et al. (2023) find that more concentrated supply chains are more likely to disclose supply chain information. This is due to the greater uncertainty and susceptibility of the supply chain to supply chain disruptions. In the context of a company's operating segments, a company with a greater proportion of sales owing to the largest operating segment will have a more concentrated operating portfolio. This is regardless of whether the operating portfolio is based on the number of product categories or distribution channels. This will bring about greater uncertainty in the supply chain as well as more risks if the market for that product decreases. This heightened uncertainty will lead to increased levels of SCD and, as such, a positive relationship will exist between a company's operating portfolio and SCD.

In summary, the decreased complexity resulting from a greater proportion of sales owing to the primary operating segment hypothesises a negative relationship. On the other hand, the increased uncertainty hypothesises a positive relationship. These arguments are at opposing ends, and thus, the study develops a null hypothesis as follows:

H_{2B} (Null): *There is no relationship between operating portfolio and the extent of supply chain disclosure (SCD).*

Environmental Dimension:

The third dimension examined in relation to SCD is the environmental dimension of the supply chain. As mentioned previously, the environmental dimension is measured via the environmental pillar score, developed by Refinitiv Workspace, and comprises: (i) emissions, (ii) environmental innovation and (iii) resource use.

In hypothesising the relationship with SCD, Macchion et al. (2020) note that the complexity of the supply chain increases with the implementation of environmental/ sustainable supply chain practices. This included collaborations with suppliers towards developing and designing environmentally sustainable products and changes to the downstream supply chain to facilitate reverse logistics and investment recovery (Green et al., 2012; Macchion et al., 2020). According to the information asymmetry hypothesis, this increased complexity will increase information asymmetry, and thereby increase the extent of SCD. Further to this, Deloitte (2022) note that stakeholders are becoming increasingly environmentally conscious in regard to the production of products. This suggests that environmentally responsible firms will be more likely to disclose supply chain information to signal the superiority of their supply chain. These arguments suggests that a positive relationship will exist.

However, Kim and Davis (2016) note that the complexity of the supply chain is a significant obstacle to disclosing conflict minerals due to the cost expedited in tracking the supply chain. Similarly, the increased complexity associated with the implementation of environmental supply chain practices may increase the costs associated with monitoring and

reporting on the supply chain. Hence, the incorporation of supply chain practices may reduce the extent of SCD.

Despite the arguments of Kim and Davis (2016), Green et al. (2012) and Geng et al. (2017) noted that the incorporation of environmental practices in the supply chain leads to increased operational and firm performance. Subir (2009) further notes that green supply chain management practices also create value for shareholders. Thus, there are benefits to disclosing environmental practices in the supply chain to shareholders. As such, the following hypothesis is developed.

H_{2C} (Alternate): *There is a positive relationship between the environmental dimension of the supply chain and the extent of supply chain disclosure (SCD)*

Social Dimensions:

The final dimension examined in relation to SCD is the social dimension of the supply chain. As mentioned previously, the social dimension is measured via the social pillar score, developed by Refinitiv Workspace, and comprises (i) community, (ii) human rights, (iii) product responsibility and (iv) workforce.

In hypothesising the relationship with SCD, Awaysheh and Klassen (2010) and Andersen and Skjoett-Larsen (2009) note socially responsible supply chains enhance brand reputation. On the other side, Doorey (2011) noted that socially irresponsible supply chain decisions made by Levi's in the 1990's damaged Levi's reputation as a good corporate citizen. As such, to signal the social responsibility of supply chain operations and enhance brand reputation, firms will be more likely to disclose supply chain information. Thus, a positive relationship will exist.

However, Andersen and Skjoett-Larsen (2009) note that increasing corporate social responsibility in supply chains requires long-term relationships with suppliers. Egels-Zandén et al. (2015) subsequently note that disclosing supply chain practices can threaten collaborations with suppliers via exposing supplier practices. As such, increased corporate social responsibility in supply chains may be associated with reduced SCD in order to safeguard suppliers. Hence, in taking these opposing arguments into consideration, it is unclear whether the incorporation of social practices in the supply chain encourages SCD. Thus, this study hypothesises the following.

H_{2D} (Null): *There is no relationship between the social dimension of the supply chain and the extent of supply chain disclosure (SCD)*

6.3 Sample selection and variable definitions:

This section outlines the sample, empirical model and variables used to investigate (i) the relationship between the four supply chain dimensions and SCD. This section is laid out as follows. Firstly, I use the same sample of 80 companies, as previously used to address *RQ1*. As this sample is based on companies listed on the UK FTSE All-Share Index, I outline the disclosure environment in the UK prior to outlining the sample size and firm observations. The section subsequently illustrates the empirical model to be used and the definitions of variables used in the empirical model.

6.3.1 UK disclosure environment

In outlining the disclosure environment in the UK, it is noted that listed companies on the FTSE Index are regulated by the 2006 Companies Act which requires the preparation of a strategic report within the company's annual report. This strategic report emphasises the

disclosure of the operational activities of the company and is headlined by the disclosure of the organisation's business model. This emphasises the importance standard setters place on the disclosure of operational and supply chain information. However, despite the requirement to prepare a strategic report, there remains discretion as to what information the strategic report should contain.

That being said, there are growing mandatory requirements in regard to supply chain information. In addition to the mandatory disclosures surrounding company strategy, financial information, and financial and environmental KPIs, there has been growing regulation since the 2010s. In 2014, the Companies Act required listed companies to disclose their BM as part of their strategic report, which requires a brief outline of the company's operations and how it creates value (Simoni et al., 2022). This was part of a broader directive by the European Union with an aim of taking advantage of the BM concept. Moreover, in 2015, amidst rising concerns over modern slavery practices, for example, sweatshops, in supply chains, it became mandatory for companies to disclose their modern slavery practices. This was regulated under the UK Modern Slavery Act 2015 and required companies to prepare a modern slavery statement (Islam & Van Staden, 2021). Despite being separate from the annual report, the study analyses whether there are references made to such a statement, in the annual report.

Alongside such mandatory disclosures, there have been further disclosures that have been in the process of becoming mandatory, as of the 2021 analysis. Farrar (2022) note that in April 2022, it was made compulsory to make environmental-related disclosures surrounding greenhouse gas (GHG) emissions (scope 1 – 3), recycling, energy consumption, water usage and waste. Further to this, there is much progress towards the Taskforce of Climate-related Financial Disclosures (TCFD) disclosures. However, as of the 2021 analysis, this climate-related supply chain information is considered voluntary.

The increase in mandatory disclosures, as well as the growing regulation surrounding climate-related disclosures of supply chain-relevant information shows the growing importance of the supply chain in firm performance and in the communication of such supply chain dimensions. Despite this growth in mandatory disclosures, there remains room for voluntary supply chain disclosures. Hence, the mix of mandatory and voluntary disclosures in the UK context make it an ideal sample to analyse the extent of SCD.

6.3.2 Data and sample selection

The sample used in this study consists of companies listed on the UK FTSE All-Share index. Following the same exclusions as in the previous chapter, the sample consists of 80 companies in the manufacturing, retail and basic materials industries, namely (i) healthcare, (ii) consumer discretionary, (iii) consumer staples, (iv) industrials and (v) basic materials. These companies are sampled across the 2018 financial year and the 2021 financial year. Given that the Covid-19 pandemic had a profound impact on the supply chain, and calls for greater disclosure of supply chain information (Moss Moss Adams, 2020a, 2020b), the study employs a pre-pandemic sample (2018) and a post-pandemic sample (2020). As such, the total sample consists of 80 companies (160 firm-year observations).

6.3.3 Empirical model

In examining the relationship between supply chain structural dimensions and SCD, I regress the following model.

$$\text{DSCORE}\ (\%) = \alpha + \beta_1 \text{CustomerBase} + \beta_2 \text{OperatingPortfolio} + \beta_3 \text{Environemtal} + \beta_4 \text{Social} + \beta_5 \text{Control Variables} + \varepsilon$$

(Empirical Model II)

In the above regression model, the dependent variable is the extent of supply chain disclosure (DSCORE). The construction of the disclosure index and the scoring methodology used to quantitatively measure the extent of SCD will be explained in greater detail in the next subsection. Secondly, the explanatory variables examined are the same as in the previous chapter: customer base (*CustomerBase*), operating portfolio (*OperatingPortfolio*), the environmental dimension (*Environmental*) and the social dimension (*Social*). Thirdly, the variables controlled for include firm governance (*Governance*), book leverage (*Lev*), firm size (*F_Size*), profitability (*ROA*), growth (*MTB*) and analyst following (*Analyst_Following*). Lastly, I control for industry-fixed effects and include a post-Covid dummy variable. Industry-fixed effects control for the five different industries in our sample of 80 companies which are (i) healthcare, (ii) consumer discretionary; (iii) consumer staples, (iv) industrials and (v) basic materials. The post-Covid dummy variable controls for firm-year observations belonging to the 2021 sample.

6.3.4 Dependent variable

As shown in empirical model II above, the dependent variable is the extent of SCD provided in company annual reports and is measured via the disclosure score (*DSCORE*). The following subsection outlines (i) previous studies that have constructed disclosure indices, (ii) the construction of the SCD index used to measure *DSCORE,* (iii) the quantification of the *DSCORE* and (iv) the analysis of company annual reports according to the SCD index.

A. Previous studies:

Early studies that developed disclosure indices first appeared in the context of accounting disclosure (Marston & Shrives, 1991). Hossain et al. (1995) constructed a disclosure index to investigate the determinants of voluntary accounting disclosure in New

Zealand, while Botosan (1997) developed an index to examine the effect of accounting disclosure on the cost of equity capital. Later studies have also developed disclosure indices in the context of sustainability (Herbohn et al., 2014), intellectual capital (Bukh et al., 2005) and, more recently, integrated reporting disclosures (Sukhari & De Villiers, 2019). These studies have either used self-constructed disclosure indices or indices that have been externally developed. In the current study, I develop a disclosure index in the context of the supply chain.

There have not been many disclosure indices based on supply chain information. However, previous studies have suggested information that should be included and that of which there has been a lack (Arvidsson, 2011; Bayne et al., 2022; Bayne & Wee, 2019). McCarthy et al. (2017) went a step further and constructed a disclosure radar based on (i) membership information, (ii) provenance information, (iii) environmental information and (iv) social information in the context of the supply chain. This study constructs a more comprehensive disclosure index, as mentioned previously.

B. Construction of the disclosure index:

The second subsection outlines the information that is included in the disclosure index. The construction of the index is based on the structure of the supply chain as discussed in *Chapter Four*. To recall, the structure of the supply chain is categorised into three supply chain flows: (i) flow of materials, (ii) flow of information and (iii) flow of financing, and four processes reflecting the flow of materials: (i) supply chain strategy, (ii) sourcing and procurement, (iii) production and (iv) logistics and distribution. As seen through *Figure 4-1* to *Figure 4-6*, these flows and processes can be further narrowed into supply chain dimensions. This was done through the application of the RBV. Subsequently, the discussion

of these dimensions, as outlined in *Chapter Four*, provides the foundation to the construction of the disclosure index.

In constructing the disclosure index, the application of the RBV to identify the supply chain dimensions was paired with the elements of BM reporting. This teases out the theoretical framework of the thesis as outlined in *Chapter Two.* Explaining this further, the pairing of the RBV with BM reporting provides the structure behind the disclosure index. Supporting this, Shafer et al. (2005, pp. 202) view the BM as "creating and capturing value within a value network". In this context, the supply chain can be associated with a value network through which value is created and captured. Hence, SCD can be thought of as the external communication of supply chain dimensions used in creating and capturing value. This is done by pairing the dimensions of the supply chain (categorised into the four supply chain processes) with the elements of BM reporting: (i) value proposition, (ii) value creation; (iii) value delivery and (iv) value capture. This uncovers important supply chain information to be disclosed. Within the four BM elements, the supply chain dimensions are further categorised into information that communicate (a) financial/ economic dimensions, (b) environmental and social dimensions and (c) supply chain membership and provenance dimensions. These categorisation are based on Botosan (1997) and McCarthy et al. (2017). Further to this, supply chain differences across each of the five industries led to subtle differences in the disclosure index applied to companies in each industry. This is to avoid scoring disclosure items that are not applicable to certain industries.

Value Proposition:

In *Section 4.4.1,* I noted that the process of supply chain strategy and the dimensions within are guided by the value proposition of the company. In this way, the dimensions within supply chain strategy (*Figure 4-1*) and the information disclosures they communicate

are linked to the communication of value proposition. *Table 6-1* lists the information to be disclosed. They include information that communicates (i) company and supply chain strategy, (ii) internal company dimensions such as product offerings and (iii) external industry and market dimensions such as industry competition and market overview. In addition, *Table 6-1* communicates performance dimensions, such as financial KPIs, environmental/social KPIs and supply chain KPIs, that measure company performance. Information on the company's business model is also communicated, thereby providing an overall picture of how the company operationalises its strategy in the supply chain. Such disclosure items are common across all five industries.

Table 6-1: *Value Proposition Disclosures (Supply Chain Strategy)*

Financial/ Economic Dimensions:	**Environmental/ Social Dimensions:**
- Product Offerings (M)	- Environmental/ Social KPIs (M)
- Company Strategy/ Purpose and Vision (M)	- Sustainability Strategies (V)
- Financial KPIs (M)	- Sustainability Development Goals (V)
Supply Chain Membership/ Provenance Dimensions:	
- Supply Chain KPIs (V)	- Market Overview (V)
- Core Capabilities (V)	- Company's Business Model (M)
- Industry Competition (V)	

Value Creation:

Secondly, *Section 4.4.2* and *Section 4.4.3* noted that the processes of (i) sourcing and procurement and (ii) production communicate how value is created through the supply chain. As such, *Table 6-2* lists the information to be disclosed in communicating how value is

created in the sourcing and procurement process. This includes information that communicates (i) the supply base, such as the number and geographic spread of suppliers and (ii) strategic supplier collaboration, such as R&D expenditure, product information and R&D facilities.

In addition, information communicating environmental dimensions, such as on green procurement and eco-design information, is disclosed. Information communicating social dimensions, such as the conducting of supplier audits and preparation of modern slavery statements, are also disclosed in *Table 6-2*.

Similarly, the dimensions within the production process and in *Figure 4-3* and the information disclosures they communicate are linked to the communication of value creation. Such disclosures are illustrated in *Table 6-3*. This includes information that communicates the production base, such as the number and geography of production facilities. In addition, information communicating (i) environmental dimensions, such as carbon emissions which is inclusive of direct (scope 1) and indirect (scope 2 & 3) emissions and (ii) social dimensions, such as the health and safety of employees, are also disclosed.

Due to industry differences, the disclosure index was tailored according to the applicability of disclosure items to the specific industries. Disclosure items which are not applicable to all industries, and instead applicable to a single/ few industries are identified in *Table 6-2* and *Table 6-3* with relevant footnotes.

Table 6-2: *Value Creation Disclosures (Sourcing and Procurement Process)*

Financial/Economic Dimensions:	**Environmental/ Social Dimensions:**
- Procurement Spend (V)	- Conflict Mineral Statement[4] (V)
- Major Suppliers (V)	- Modern Slavery Statement (M)
- Research & Development Expenditure (V)	- Supplier Code of Conduct Requirements (V)
- Breakdown of Accounts Payable (M)	- Green/Sustainable Procurement (V)
	- Eco-Design Disclosures (V)
	- Supplier Audits (V)
	- Ethical Research disclosures[5] (V)
Supply Chain Membership/ Provenance Dimensions:	
- Major Suppliers (V)	- Statement on Outsourcing[6] (V)
- Number of Suppliers (V)	- Materials/Components Used in Production[7] (V)
- Number of R&D Facilities (V)	- Mineral Reserves[8] (V)
- Geography of Suppliers (V)	- Upstream Transportation Disclosures (V)
- Geography of R&D Facilities (V)	- Statement on 1st Tier Suppliers[9] (V)
- Relationship Length with Suppliers[10] (V)	- Product Innovation (V)

[4] Conflict minerals statement – Basic materials industry only
[5] Ethical research disclosures – Healthcare industry only
[6] Statement on outsourcing – All industries excluding basic materials industry
[7] Materials / component used in production - All industries excluding basic materials industry
[8] Mineral reserves – Basic materials industry only
[9] Statement of 1st tier suppliers - All industries excluding basic materials industry
[10] Relationship length with suppliers - All industries excluding basic materials industry

Table 6-3: *Value Creation Disclosures (Production Process)*

Financial/ Economic Dimensions:	**Environmental/ Social Dimensions:**
Operational Disclosures:	- Health and Safety Disclosures (V)
- Breakdown of Inventory (M)	- Scope 1 Direct Carbon Emissions (V)
	- Scope 2 Carbon Emissions (V)
Financial Disclosures:	- Scope 3 Indirect Carbon Emissions (V)
- Changes in Working Capital (M)	- Waste Disclosures (V)
- Breakdown of PPE (M)	- Water Withdrawal (V)
- Operating/Finance Leases (M)	- Electricity Consumption (V)
	- Environmental Certifications (V)
	- Circular Economic Activities (V)
Supply Chain Membership/ Provenance Dimensions:	
- Number of Production Facilities/ Smelters/ Refineries (V)	- Number of Mines[11] (V)
- Production Volume (V)	- Geography of Mines[12] (V)
- Geography of Production Facilities/ Smelters/ Refineries (V)	
- Supply Chain Finance Disclosures (V)	

Value Delivery:

Thirdly, looking into value delivery disclosures, *Section 4.4.4* noted that the process of logistics and distribution and the dimensions within reflect the delivery of the product to the customer. In this way, the dimensions within logistics and distribution (*Figure 4-4*) and the information disclosures they communicate are linked to the communication of value delivery. Such disclosures are illustrated in *Table 6-4*. This includes information that

[11] Number of Mines – Basic materials industry only
[12] Geography of Mines – Basic materials industry only

communicates (i) the customer base, such as geographic segment sales, (ii) distribution base, such as the number and geographic spread of distribution facilities, and (iii) retail base, such as the number and geographic spread of retail outlets. Logistical dimensions such downstream transportation methods are also disclosed. In addition, information communicating environmental and circularity dimensions, such as recycling and packaging, is also disclosed.

Due to industry differences, the disclosure index was tailored according to the applicability of disclosure items to the specific industries. Disclosure items which are not applicable to all industries, and instead applicable to a single/ few industries are identified in *Table 6-4* with relevant footnotes.

Complementing the supply chain dimensions within each of these four processes reflecting the flow of materials are the dimensions within the flow of information and flow of financing (*Figure 4-5*). Whether these dimensions support any of the four processes: (i) supply chain strategy, (ii) sourcing and procurement, (iii) production or (iv) logistics and distribution, depends on the element of the BM they communicate, and in which of the four *Tables* they are. However, it is noted that some of the supply chain dimensions identified throughout *Chapter Four* are excluded. This is due to such supply chain dimensions being of proprietary information or not relevant for external disclosure. Adding credibility to this, this was based on the insights of interviews into the factors affecting disclosure and the disclosure items unlikely to be disclosed.

Table 6-4: *Value Delivery Disclosures (Logistics and Distribution Process)*

Financial/ Economic Dimensions:	**Environmental/ Social Dimensions:**
- Operating Segmental Sales (M)	- Recycling (V)
- Geographic Segmental Sales (M)	- Packaging (V)
- Major Customers (V)	
- Breakdown of Accounts Receivable (M)	
- Selling, Distribution and Admin Expenses (M)	
- Business/ Operating Review (V)	
Supply Chain Membership/ Provenance Dimensions:	
- Number of Distribution Centres[13] (V)	- Geography of Retail Outlets[14] (V)
- Number of Licensed Retail Outlets[15] (V)	- Distribution Channels (V)
- Geography of Distribution Centres[16] (V)	- Downstream Transportation Disclosures (V)

Value Capture:

Lastly, in constructing the disclosure index, it was noted in *Section 4.4.7* that the integration of supply chain flows, processes and dimensions plays a role in the value that is captured from the operations of the supply chain. As such, the dimensions of such supply chain integration — (i) internal supply chain risk, (ii) external risk, (iii) firm performance and (iv) value created *(Figure 4-6)* — and the information disclosures they communicate are linked to the communication of value capture. Such disclosures are illustrated in *Table 6-5*. This includes information that communicates (i) internal risk dimensions and (ii) external risk

[13] Number of Distribution centres – Consumer staples and consumer discretionary industries only
[14] Number of licensed retail outlets – Consumer staples and consumer discretionary industries only
[15] Geography of distribution centres – Consumer staples and consumer discretionary industries only
[16] Geography of licensed retail outlets – Consumer staples and consumer discretionary industries only

dimensions, such as geopolitical risks, economic risks and legal risks, to name a few. Further to this, information communicating (i) performance dimensions, such as gross profit margin and total shareholder return, and (ii) value dimensions, such as the value created for stakeholders, is also disclosed. Such disclosure items are common across all five industries.

Table 6-5: *Value Capture Disclosures (Supply Chain Integration)*

Financial/ Economic Dimensions:	**Value Dimensions:**
- Gross Profit Margin (M)	- Engagement with stakeholders (V)
- Return on Capital Employed (M)	- Value created for stakeholders (V)
- Total Shareholder Return (M)	
Risk Dimensions	
- Internal supply chain risks (V)	- Legal Risks (M)
- Strategic Risks (M)	- Technological Risks (M)
- Geopolitical Risks (M)	- Environmental/Sustainability Risks (M)
- Brexit Risks (V)	- Covid-19 Pandemic Risks (V)
- Economic Risks (M)	- Viability Risks (M)
- Social/Health & Safety Risks (M)	- TCFD Disclosures (V)

In addition to classifying the information disclosures into (i) value proposition, (ii) value creation, (iii) value delivery and (iv) value capture, I also note that the information disclosures comprise both mandatory and voluntary disclosures. To support the inclusion of both mandatory and voluntary disclosures in the same index, Marston and Shrives (1991) noted that disclosures indices can be based on solely mandatory information, solely voluntary information, or a combination of the two. The differentiation of mandatory from voluntary disclosures is highlighted throughout *Table 6-1* to *Table 6-5* by the indicator (M) for mandatory information and (V) for voluntary information.

C. Scoring methodology:

This subsection outlines how the information disclosures within the disclosure index are quantified into a disclosure score (*DSCORE*). Marston and Shrives (1991, p. 197) note that disclosure is an "abstract concept that cannot be measured directly" and as such a measurement framework/scale is required to reliably measure the extent of disclosure. They also note that the measurement/framework scale needs to be consistent and reliable such that it can be replicated by another researcher.

Joseph and Taplin (2011) mention that a disclosure index can be constructed based on disclosure occurrence or disclosure abundance. The former relates to whether an item of disclosure is disclosed or not and is typically scored as 1 if the item is disclosed and 0 otherwise, whereas the latter relates to the extent of such disclosures and as such, scores are attributed according to whether it is disclosed and to what extent it is disclosed. Joseph and Taplin (2011) further note that disclosure abundance can be measured on whether the disclosure item is (i) quantitatively or qualitatively disclosed, or both, (ii) disclosed for a single year or for two years or more and based on the number of sentences pertaining to the disclosure item.

The disclosure index in the current study uses both disclosure occurrence and disclosure abundance. Both type of scoring scales are used as the disclosure items include a variety of different information such as financial information, quantitative information and qualitative information. The scoring of the following types of disclosures are based on the scoring systems previously used by Botosan (1997), Sukhari and De Villiers (2019) and Yi and Davey (2010).

- KPI Disclosures/Other performance indicators (out of 3) – Not Disclosed (0); Disclosed for 1 year (1); More than 1 year (2)

- Financial Disclosures (out of 3) – Not Disclosed (0); Disclosed as a line item (1); Disclosed in detail in the notes (2)
- Supply Chain Membership Disclosures – Not Disclosed (0); Disclosed (1)
- Qualitative Disclosures – No Disclosure (0); Short statement – 1 sentence (1); Detailed explanation – multiple sentences (2)
- Risk Disclosures – No Disclosure (0); Risk description only (1); Full risk disclosure with assessment/mitigation (2)

D. Content analysis of annual reports:

This last subsection explains the analysis of company annual reports in accordance with the disclosure index. In applying the disclosure index, a content analysis of the company annual reports is performed. In conducting the content analysis, I comprehensively read through each company's annual report and investigate whether each of the disclosure items is disclosed. In the event I have missed disclosures, keywords in the disclosure item (e.g. suppliers, supply, customers, production, distribution, etc.), or related words, are used to search for such disclosure items across the report. The researcher proceeds to read the surrounding text to identify whether the text provides information on such disclosure items and whether this information is in the context of the supply chain. This process is similar to Steenkamp and Northcott (2007) who performed a pilot study using content analysis to investigate voluntary intellectual capital reporting among New Zealand companies. I subsequently allocate a disclosure score based on the above scoring system and divide it by the total available score to calculate the score (*DSCORE*) as a percentage (%). The purpose of calculating the disclosure score as a proportion of the total available score is because of minor differences in the disclosure index applied to the five different industries, dependent on whether each disclosure item is applicable to the industry.

6.3.5 Explanatory and control variables

The explanatory variables comprise the supply chain dimensions of (i) customer base, (ii) operating portfolio, (iii) environmental dimensions and (iv) social dimensions. The explanatory variables have been explained in the *Chapter Three*, and as such won't be discussed further. In regard to the control variables, previous studies have examined disclosure, including studies examining firm-specific determinants of disclosure. These studies have controlled for factors such as firm size, profitability, firm growth (Hossain et al., 1995; Mangena et al., 2016; Raimo et al., 2021). Further to this, Botosan (1997) and Cahan et al. (2005) control for analyst following. Several studies have also controlled for shareholder spread, foreign ownership, board size and board independence (Cahan et al., 2005; Debreceny & Rahman, 2005; Hossain et al., 1995). Hence, I control for the following variables.

- Firm size (*F_Size*) – the log of total book assets.
- Profitability (*ROA*) – net income divided by average total assets (return on assets)
- Market-to-Book (*M2B*) – market value of ordinary equity divided by book value of ordinary equity.
- Analyst Following – Total # of analysts tracking the performance of the company.
- Leverage – proxy for capital structure and measured as the proportion of total liabilities to total assets of the company.
- Governance – measures the governance of a company based on the company performance on (i) CSR strategy, (ii) company management and (iii) company shareholders (Refinitiv, 2022).
- Float Shares – Amount of share capital available to ordinary investors and measured as the proportion to the total # of shares.

- Foreign Ownership – Proportion of total shares held by an institution(s) domiciled in a country other than that of the issuer,
- Board Size – Total # of board members
- Board Independence – Proportion of independent board members to the total # of board members.

6.4 Results

This section shows the findings of the second research question, which investigates the effect of supply chain dimensions: (i) customer base, (ii) operating portfolio, (iii) environmental dimensions and (iv) social dimensions on SCD. Firstly, I conduct an exploration of the types of supply chain information disclosed in annual reports. This is done by analysing the word frequency of key words related to the supply chain and SCM. This is alongside a factor analysis to investigate the supply chain messages most frequently communicated. Further to this, I also investigate the extent of SCD in annual reports. These exploratory analyses are performed Pre-pandemic (2018) and Post-pandemic (2021).

Secondly, the results move onto regressing the determinants of supply chain structural dimensions on SCD. This is performed through a series of descriptive statistics, bivariate correlations and multivariate regressions. As in *Empirical Model II,* the main regression examines the above relationship, controlling for the control variables, industry-fixed effects and the post-Covid dummy variable. This multivariate regression is used to answer the hypotheses developed in H2. Additional analyses are also conducted for each of the five industries separately, and for each of the four value elements of the BM. Further analysis also examines the effect of the four supply chain dimensions on an aggregate measure of SCM keywords, as an alternative measure to SCD.

6.4.1 Exploratory findings of supply chain information

A. *Information content of annual reports*

I conduct a word frequency search of key words in the SCM literature, performing a comparison between the 2018 (pre-pandemic) and 2021 (post-pandemic) annual reports for the sample of 80 companies. The purpose of this is to investigate whether there is greater information content related to the supply chain in the 2021 annual report, as compared to the 2018 reports. To examine this, I use NVIVO to search for key words related to SCM, sustainability and the circular economy.

The choice of keywords is based on Lockamy and McCormack (2004) who previously categorised SCM processes into (i) plan, (ii) source, (iii) make and (iv) deliver. These processes have subsequently been linked to the processes of (i) supply chain strategy, (ii) sourcing and procurement, (iii) production and (iv) logistics and distribution. Hence, I use these terminologies to investigate the content of SCM activities within the 2018 and 2021 annual reports. Keywords that cover broad aspects of the company, such as 'strategy' are disregarded. Moreover, words that have multiple meanings and/or refer to non-supply chain-related content are also excluded. These words include "production", which could refer to the production of the annual report, and "distribution", which could be in reference to the distribution of dividends, for example. Hence, keywords such as "sourcing" and "logistics" are used. Moreover, Mentzer et al. (2001) note that the supply chain is a network of organisations inclusive of suppliers and customers. As such, I also examine the frequency of keywords such as "supplier" and "customer". Further to this, Awaysheh and Klassen (2010), Green et al. (2012) and Farooque et al. (2019) note the importance of social, environmental and circular economic issues in the supply chain. Hence, I use keywords such as "human rights", "environmental", "circular economy" and "recycle".

Table 6-6 shows the frequency of the above-mentioned keywords across the 2018 and 2021 annual reports of the 80 sampled companies. The table shows the number of annual reports that have mentioned each keyword, along with the frequency of each keyword in the 2018 and 2021 annual reports. The last column shows the percentage increase from the 2018 to 2021 period.

Overall, there is an increase in all the keywords related to SCM, sustainability and the circular economy in the 2021 annual reports, as compared to the 2018 annual reports. Examining the increase in keywords pertaining to SCM, the keyword of "supply chain management" has increased by 24% in the 2021 FY, compared to the 2018 FY. Examining the keyword of "supply chain", the findings show a 126.18% increase from the 2018 financial year. This suggests that there is greater communication of the supply chain in the domain of company annual reports. However, while this shows a greater recognition of

Table 6-6: *Word Frequency Analysis of Supply Chain-related Keywords*

Keyword:	**2018 Annual Report**		**2021 Annual Report**		
	# of Annual Reports	**Word Count (#)**	**# of Annual Reports**	**Word Count (#)**	**% increase in Word Count:**
Supply Chain	75	1276	80	2886	126.18%
Supply Chain Management	26	50	32	62	24.00%
Supplier	80	2546	80	5403	112.22%
Sourcing; Procurement	74	902	79	1632	80.93%
Customer	80	8939	80	14374	60.80%
Logistics; Logistical	64	377	71	749	98.67%
Business Model	80	1246	80	1489	19.50%
Sustainability; Sustainable	78	4122	80	11926	189.33%
Environment; Environmental	80	4709	80	8491	80.31%
Human Rights; modern slavery; slavery	78	1033	80	1764	70.76%
Circular economy; circularity	15	55	49	380	590.91%
Recycle; recycling	66	516	78	2093	305.62%

the supply chain and SCM in annual reports, it does not indicate whether there is increased disclosure on the supply chain processes and dimensions.

Secondly, I examine whether there is greater communication of the dimensions of the company's supply chain in external, annual report communications. I find a 112% increase in the word frequency of keywords relating to "supplier" and a 81% increase in keywords relating to "sourcing" and/or "procurement". This is reflective of greater disclosure in reference to upstream supply chain and the sourcing and procurement processes. Keywords reflecting the downstream supply chain, such as "customer" and "logistics/ logistical", also exhibit significant increases in the word frequency. These keywords account for a 61% and 98% increase, respectively. This is reflective of greater disclosure referencing downstream supply chain dimensions and the logistics and distribution processes.

However, this does not translate to the growing use of the "business model" concept, which, as Norris et al. (2021) note, covers the entirety of the supply chain. The keyword of "business model" has only seen a 19.5% increase in the word frequency. This may be the case due to the mandatory disclosure of a company's business model coming into effect back in 2014. This may have led to the comparatively smaller growth of "business model" keywords from 2018 to 2021 (Simoni et al., 2022).

I also investigate the increase in disclosure relating to the environmental, social and circular economy dimensions of the supply chain. I investigated the increase in keywords such as "sustainability", "environment(al)", "human rights", "circular economy" and "recycling". I found that external disclosure pertaining to the environmental and social dimensions of the supply chain approximately doubled from the 2018 to the 2021 FYs. The keywords of "human rights" and "environmental" increased by 71% and 80% respectively. In comparison, the keyword of "sustainability", which is collectively used to refer to social and environmental dimensions, almost tripled. There was a 189% increase. A reason for the growing reference to sustainability is the increased awareness of environmental and social issues in the supply chain and its contribution to firm performance (Awaysheh & Klassen,

2010; Doorey, 2011; Green et al., 2012). Keywords related to human rights and modern slavery may also be due to a combination of the introduction of the modern slavery act in the UK (Stevenson & Cole, 2018).

Lastly, disclosure pertaining to circular economic dimensions was investigated. Keywords in reference to the circular economy sextupled across the four-year period. Keywords related to recycling practices, as a dimension of the circular economy, tripled across the same period. This is in line with Farooque et al. (2019) and Lahane et al. (2020) who conducted reviews of the circular economy literature, and found a greater uptake of circular economy dimensions in the supply chain.

Despite the growth in the above-mentioned keywords relating to the supply chain and SCM, the analysis does not provide insights as to keywords that are used together to communicate a message. As such, a factor analysis was performed on the 2018 and 2021 FYs separately. The results are shown in *Table 6-7* and *Table 6-8* for the 2018 FY. *Table 6-7* shows a total of 12 components, which is reflective of the 12 categories of keywords shown in *Table 6-6*. After the factor analysis was conducted, five factors were found to be significant with an eigenvalue above 1. *Table 6-8* provides a deeper analysis of these five factors, with each factor showing the components (keywords) that were used together in communicating a message.

The first factor shows that the keywords pertaining to (i) sourcing and procurement, (ii) human rights, (iii) environment and (iv) sustainability are most frequently used in combination to communicate a message. This suggests that the first factor communicates the environmental and social issues surrounding the purchase of products. *Panel A* shows that this comprises 29% of the variation in keywords among company annual reports. This is not surprising given the increasing importance of communicating the environmental and social

considerations in sourcing products (Deegan & Islam, 2010, 2014; Doorey, 2011; Grob & Benn, 2014).

The second factor shows that the keywords pertaining to (i) supply chain, (ii) SCM, (iii) sourcing and procurement, (iv) supplier, and (ii) customer are used in combination. This suggests that the second factor communicates the technical and operational aspects of the upstream as well as downstream supply chains. *Panel A* shows that this comprises approximately 14% of the variation in keywords among company annual reports.

The third factor shows that the keywords pertaining to (i) logistics and (ii) recycling are used in combination. This suggests that the communication of the logistical process of the supply chain mainly focusses on the recycling process. The communication of such disclosures emphasises the importance of reverse logistics in the supply chain (Srivastava, 2007). *Panel A* also shows the importance of communicating such resources, reporting 12% of the variation in keywords.

Table 6-7: *Factor Analysis on SCM Keywords – 2018 (Pre-Covid)*

	Initial Eigenvalues		
Component	Total	% of Variance	Cumulative %
1	3.530	29.419	29.419
2	1.671	13.929	43.348
3	1.470	12.252	55.600
4	1.101	9.172	64.772
5	1.013	8.442	73.214
6	0.740	6.164	79.378
7	0.698	5.813	85.191
8	0.452	3.770	88.961
9	0.439	3.657	92.618
10	0.357	2.974	95.593
11	0.313	2.606	98.198
12	0.216	1.802	100.000

Table 6-8: *Rotated Component Matrix of Factors – 2018 (Pre-Covid)*

	Component				
	1	2	3	4	5
SupplyChain_Text	0.019	0.561	-0.349	0.441	0.257
SupplyChainManagement_Text	0.272	0.405	-0.343	-0.228	0.530
BusinessModel_Text	0.204	-0.061	0.264	0.159	0.810
Sourcing_Text	0.567	0.498	-0.022	0.104	-0.415
Supplier_Text	0.260	0.804	0.161	0.024	-0.025
Logistics_Text	0.090	0.121	0.824	-0.123	0.078
Customer_Text	-0.117	0.707	0.296	0.133	-0.004
HumanRights_Text	0.783	0.098	-0.001	0.125	0.060
Environment_Text	0.824	-0.064	0.089	0.020	0.242
Sustainability_Text	0.695	0.175	0.037	0.512	0.144
CircularEconomy_Text	0.238	0.089	0.070	0.845	-0.010
Recycle_Text	0.014	0.244	0.726	0.438	0.123

The fourth and fifth factors account for less than 10% of the variation individually. The fourth factor communicates the environmental and circular economic dimensions of the supply chain with the keywords of (i) supply chain, (ii) sustainability and (iii) circular economy being disclosed together. Lastly, the fifth factor discusses SCM in the context of business model disclosures.

In sum, the factor analysis of keywords pertaining to the 2018 annual reports found that the following messages were disclosed most frequently.

Factor 1: Environmental and social aspects of sourcing products

Factor 2: Technical/Operational resources of the upstream and downstream supply chain

Factor 3: Reverse logistics process focusing on recycling.

Factor 4: Environmental/circular economic aspects of the Supply Chain

Factor 5: Discussion on SCM in the context of BM disclosures

Following this, another set of factor analysis was performed on the frequency of keywords in 2021 FY. *Table 6-9* and *Table 6-10* show the results. Similarly to *Table 6-7, Table 6-9* shows a total of 12 components, which is reflective of the 12 categories of keywords shown in *Table 6-6*. After the factor analysis was conducted, a total of four factors

were found to be significant with an eigenvalue above 1. *Table 6-10* provides a deeper analysis of these four factors, showing the components (keywords) that were used together in communicating a message.

The first factor shows that the keywords pertaining to (i) sourcing and procurement, (ii) supplier, and (iii) supply chain were most frequently used in combination to communicate supply chain messages. This suggests that the first factor communicates the upstream dimensions of the supply chain. As compared to the findings of the 2018 factor analysis, it shows that there is greater emphasis on communicating the technical and operational resources of the supply chain in the post-Covid period. This is empirically evidenced by the 2021 factor analysis showing 24% of the variation in company annual reports, as compared to 14% in the 2018 annual reports. A reason for this is likely to be that there is more emphasis from investors and stakeholders on the operational workings of the supply chain after the Covid-19 pandemic (Dai et al., 2020; Mickle & Kubota, 2020).

Table 6-9: *Factor Analysis on SCM Keywords - 2021 (Post-Covid)*

	Initial Eigenvalues		
Component	Total	% of Variance	Cumulative %
1	2.968	24.730	24.730
2	1.688	14.066	38.796
3	1.500	12.500	51.297
4	1.220	10.168	61.465
5	0.992	8.266	69.731
6	0.904	7.533	77.264
7	0.699	5.829	83.093
8	0.566	4.718	87.811
9	0.511	4.258	92.069
10	0.369	3.077	95.145
11	0.301	2.508	97.653
12	0.282	2.347	100.000

Table 6-10: *Rotated Component Matrix of Factors – 2021 (Post-Covid)*

	Component			
	1	2	3	4
SupplyChain_Text	0.677	-0.068	0.264	0.045
SupplyChainManagement_Text	0.045	-0.127	0.564	-0.014
BusinessModel_Text	-0.320	0.106	0.223	0.762
Sourcing_Text	0.736	0.314	0.148	-0.133
Supplier_Text	0.768	0.022	-0.092	0.365
Logistics_Text	0.210	-0.041	0.032	0.587
Customer_Text	0.396	0.139	-0.259	0.571
HumanRights_Text	0.403	0.264	0.536	0.143
Environment_Text	0.061	0.173	0.812	0.040
Sustainability_Text	0.089	0.649	0.449	-0.054
CircularEconomy_Text	-0.005	0.880	0.098	0.001
Recycle_Text	0.157	0.787	-0.244	0.181

The second factor shows that the keywords pertaining to (i) sustainability, (ii) circular economy, and (iii) recycling are used in combination. This suggests that the second factor specifically focusses on the communication of sustainability and circular economic resources. This finding provides insights into the greater emphasis on the circular economy and its playing an important role in sustainability, especially after the effects of the Covid-19 pandemic (Farooque et al., 2019). However, the discussion on the circular economy does not seem to be well integrated into the supply chain, and nor are the technical and operational dimensions of the supply chain.

The third factor shows that the keywords pertaining to (i) human rights, (ii) environment and (ii) SCM are used in combination. This suggests communication on the environmental and social dimensions in the context of SCM. However, this discussion is not integrated in the context of the upstream and downstream supply chains. As compared to the 2018 factor analysis, there is a reduced emphasis on such disclosures. This is evidenced by the 12% of variation in 2021 annual reports, as compared to 29% of the variation in 2018 annual reports.

The fourth factor shows that the keywords pertaining to (i) logistics, (ii) customer and (ii) BM are used in combination to communicate disclosures. This suggests that, while

communication on the upstream supply chain is linked with the supply chain, communication on the downstream supply chain is linked with the BM. This is surprising given that the BM encompasses the entirety of the supply chain. However, the definition of the BM by Shafer et al. (2005) focussing on creating and capturing value in a value network emphasises the downstream supply chain. Hence, this could be a reason as to why the downstream supply chain is linked more to the BM, than the upstream supply chain.

In sum, the factor analysis of keywords pertaining to the 2021 annual reports, and the post-Covid period found that the following messages were disclosed most frequently.

Factor 1: Discussion on the Upstream Supply Chain

Factor 2: Discussion on Sustainability and Circular Economy

Factor 3: Environmental and Social aspects of Supply Chain Management

Factor 4: Discussion on the Downstream Business Model

In summing up, this subsection has shown that there has been an increase in supply chain-related information from the 2018 to 2021 FYs. *Table 6-6* shows that this is not limited to a greater recognition of the supply chain and SCM in annual reports but is accompanied by greater external disclosure of the dimensions of the supply chain. This is evident through the increase in disclosure pertaining to the dimensions within the sourcing and procurement process and the logistics and distribution process, as well as environmental dimensions, social dimensions, and circular economic dimensions.

Further to this, based on a factor analysis, I analysed the keywords that were most frequently used in combination with other keywords to communicate supply chain messages . This was performed separately for the 2018 (pre-Covid) and 2021 (post-Covid) periods. It was found that in the post-Covid period there was a greater emphasis on communicating technical and operational dimensions of the supply chain. However, these dimensions and

resources were not well integrated with the social, environmental and circular economic dimensions.

That being said, this investigation is solely based on textual keywords and does not determine whether these keywords are accurately disclosed in a supply chain context. The next subsection looks at the extent of SCD and the four value elements of the BM in the pre-Covid (2018) and post-Covid (2021) periods.

B. *Supply chain disclosure of annual reports*

The previous section looked at the information content of annual reports in the context of supply chain information. This was performed by analysing the word frequency of key words related to the supply chain and SCM. In comparison, this section dives a bit deeper into the actual communication of supply chain information through SCD. From 2018 to 2021, there have been significant effects on the supply chain which have heightened the need to communicate supply chain information and the dimensions within. These effects include numerous supply chain disruptions such as the Covid-19 pandemic and climate-related disruptions, the introduction of the taskforce on climate-related financial disclosures, and the growing awareness of social and environmental issues in the supply chain (Deegan & Islam, 2010; Free & Hecimovic, 2020).

Therefore, I conducted a series of independent samples t-test on the disclosure score. Firstly, I conducted a t-test on the disclosure provided as per the four elements of the BM, before and after the pandemic. This analysis simply cuts through the surface and so I delved a bit deeper into how the communication of SCD before and after the pandemic varied between the five different industries. This is according to the five sampled industries: (i) healthcare, (ii) consumer staples, (iii) consumer discretionary, (iv) industrials and (v) basic materials, and the four elements of the BM: (i) value proposition, (ii) value creation, (iii) value delivery and

(iv) value capture. This analysis is shown in *Table 6-11* and closely investigates (i) the communication of the elements of the BM before and after the pandemic, and (ii) this pattern in each of the five industries. This analysis dives even further by looking at the specific information disclosures provided within each of the five industries and the trend of such information disclosures before and after the pandemic.

Firstly, as mentioned above, I conduct a simple t-test on the extent of SCD, and as divided into the four elements of the BM, before and after the pandemic. This analysis is seen in *Table 6*-11.

Table 6-11 shows that significant differences exist in the extent of SCD, before and after the pandemic. The overall increase in SCD, as reflected in *DSCORE(%),* from 2018 to 2021 is significant to the 1% level. This indicates that the dynamics of the SCD have changed from 2018 to 2021. Explaining this further, the significant increase in overall SCD is likely due to the significant increase in value creation disclosures and value capture disclosures. These categories of disclosure are also to the 1% significance level. This suggests greater communication of supply chain dimensions related to the sourcing and procurement process and the production process, and how value is created through the supply chain. Furthermore, there is increased communication in information pertaining to internal supply chain risks, external risks, firm performance and value.

Of less significance, but significant nevertheless, is the communication of value delivery disclosures. This category is significant to the 5% significance level, suggesting that the increase in communication of supply chain dimensions pertaining to the distribution and logistics process is moderately significant. While (i) overall disclosure, (ii) value creation disclosures, (iii) value delivery disclosures and (iv) value capture disclosure have significantly increased, the same cannot be said about value proposition disclosures. There

Table 6-11: *Supply Chain Disclosure – Pre- and Post-Covid*

		Means		Levene's Test for Equality of Variances		Significance	
		Pre-Covid (%)	Post-Covid (%)	F	Sig.	One-Sided p	Two-Sided p
DSCORE(%)	Equal variances assumed	51.727	57.460	0.679	0.411	< 0.001	< 0.001
ValueProposition_DSCORE(%)	Equal variances assumed	57.446	61.522	0.654	0.420	0.034	0.069
ValueCreation_DSCORE(%)	Equal variances assumed	45.622	49.992	0.034	0.854	0.005	0.009
ValueDelivery_DSCORE(%)	Equal variances assumed	52.194	56.365	0.638	0.426	0.012	0.025
ValueCapture_DSCORE(%)	Equal variances assumed	59.297	68.507	0.986	0.322	< 0.001	< 0.001

has been increased communication of supply chain dimensions relating to the strategy of the supply chain; however, this increase is not significant. Overall, these findings provide added support to the increased disclosure of keywords relating to the dimensions of the supply chain found in *Table 6-6*. Hence, it can confidently be claimed that the disclosure of supply chain information has increased from the 2018 to 2021 annual report.

There could be multiple reasons as to why the disclosure of supply chain dimensions has increased. Firstly, the growing importance of the supply chain in firm performance, as Sharifi et al. (2006) note, could be a motivating factor in the increase in disclosure of supply chain dimensions relating to sourcing and procurement processes, production processes and logistics and distribution processes. Secondly, the effects of the pandemic have called for greater disclosures on the supply chain (Moss Adams, 2020a, 2020b). This could have resulted in the greater disclosure of risk dimensions pertaining to the supply chain. However, *Table 6-11* showed that the difference in value proposition disclosures between the pre-pandemic and post-pandemic period shows no significance, or at the least very weak significance. This is to the 10% level. This suggests that supply chain dimensions pertaining to supply chain strategy have not seen a significant increase in disclosure from 2018 to 2021. This is possibly because disclosures pertaining to strategy and key performance indicators (KPIs) are mandatory disclosures in the UK and have been for a long time. Further to this, illustrative disclosures on the company's overall BM are mandatory disclosures in the UK (Simoni et al., 2022).

However, the overall disclosure score, as well as the four different types of disclosure, are a composite measure of all the companies across five industries. As the structure and design of the supply chain differ between each industry, the types of information disclosed between industries may also be different. Thus, I show the differences in means for the different types of disclosure scores for each of the five industries, before and after the Covid-19 pandemic.

This is reflective of the second group of t-tests, as mentioned above, and is shown in *Table 6-12*.

The columns of *Table 6-12* show each of the five industries along with their respective sample sizes. Comparing the disclosure score between the five industries, the basic materials industry has the highest overall disclosure score, while consumer discretionary companies have, on average, the lowest overall disclosure. This is likely because of the limited visibility that consumer discretionary companies, which are mainly retail companies, have over their upstream supply chain. This is reinforced by the lack of information disclosures pertaining to value creation, such as the identification and geographical location of suppliers. Because of this limited visibility, costs associated with collecting information on the upstream supply chain are likely to outweigh the benefits of disclosing such supply chain information. This aligns with previous research noting that cost is a big factor in influencing the extent of SCD (Kim & Davis, 2016; McCarthy et al., 2017).

Comparing the five industries, I recall that value creation disclosures comprise the supply chain processes of sourcing and procurement as well as production activities. These processes are most evident in upstream dominated supply chains such as in companies belonging to primary industries and manufacturing-dominated supply chains. This is reflected in the value creation disclosure scores of the following industries: Industrials (49.16%), Consumer Staples (50.95%), Healthcare (55.76%) and Basic Materials (60.23%). This is in contrast to a retail-dominated industry such as Consumer discretionary, which has a value creation disclosure score of 41.23%.

On the other hand, value delivery disclosures pertain to information on the distribution and logistics process. This process is most evident in downstream-dominated supply chains such as retail industries. This is reflected in the value delivery disclosure score of the consumer discretionary industry (58.33%) being the greatest of the five industries. This is in

Table 6-12: *Supply Chain Disclosure by Industry – Pre- and Post-Covid*

	Healthcare (5):	***Consumer Staples (18):***	***Consumer Discretionary (18):***	***Industrials (26):***	***Basic Materials (13):***
Overall Disclosure					
- ***2018***	52.81%	52.12%**	44.16%**	51.96%**	60.77%
- ***2021***	61.12%	57.89%**	50.62%**	57.75%**	64.35%
Value Proposition:					
- ***2018***	57.39%	52.90%	50.48%	61.71%	64.88%
- ***2021***	73.04%	57.25%	54.11%	64.21%	67.89%
Value Creation:					
- ***2018***	47.58%	48.44%	35.07%**	45.25%*	56.32%
- ***2021***	55.76%	50.95%	41.23%**	49.16%*	60.23%
Value Delivery:					
- ***2018***	54.44%	51.67%	53.61%	49.36%**	55.77%
- ***2021***	55.56%	57.22%	58.33%	55.34%**	54.81%
Value Capture:					
- ***2018***	59.38%	59.20%***	51.91%**	59.86%***	68.51%
- ***2021***	66.11%	70.99%***	61.11%**	70.09%***	73.08%

, **, * Significant at 0.10 level, 0.05 level and 0.01 levels, respectively*

contrast to manufacturing-dominated industries such as Industrials (55.34%) and Healthcare (55.56%).

Despite the above observations, industrial companies have the second-lowest overall SCD of the five industries. This is surprising given the upstream-dominated supply chain of industrial companies. In comparison to other upstream-dominated industries, industrial companies (55.75%) have a lower overall disclosure score than healthcare companies (61.12%) and companies in the basic materials industry (64.35%). This is likely to be because of the effect of proprietary costs on the extent to which supply chain information is disclosed (Ellis et al., 2012; Li et al., 2017). Ellis et al. (2012) find that companies are less likely to disclose major customer information if they have greater research and development (R&D) expenditures, and it is reasonable to assume that industrial companies engage in a lot of R&D. Further supporting the proprietary nature of such supply chain information is the low levels of disclosure pertaining to the number and geographic location of R&D facilities, statement on outsourcing and strategic alliances.

Another observation is that the highest overall disclosure scores belong to companies in the basic materials (64.35%) and healthcare (61.12%) industries. This is likely due to the complexities of company supply chains in both these industries. As Mullin (2020) noted, pharmaceutical supply chains are very complex and have global supply chains with manufacturing of drugs done in China and India. As for companies in the basic materials industry they are predominantly engaged in mining operations. These companies listed on the FTSE All-Share index have the majority of mining operations overseas with a big proportion of overseas customers. This adds to the complexities of the supply chain. In addition, environmental considerations are paramount in both these industries (Lauwo et al., 2016; Mullin, 2020). The association with greater SCD is likely due to the influence of information asymmetry (Cai et al., 2023), which suggests that greater supply chain structural complexities

will result in greater SCD. However, it is important to note that the healthcare industry comprises only 5 companies, so the high overall disclosure percentage is likely to be inflated.

In sum, the trends of the increased SCD among the five industries, before and after the pandemic, show that the extent of disclosure is influenced by the (i) visibility of the supply chain and the costs of collecting supply chain information, (ii) proprietary nature of supply chain information in some industries, and (iii) complexities of the structure of the supply chain and effects of information asymmetry. This provides support for the studies outlined in the literature review above.

I drill deeper into the types of SCD disclosed by companies. Firstly, I distinguish between mandatory disclosures and voluntary disclosures. The findings are not presented in the study. However, it is noted that the extent of both mandatory and voluntary disclosures has increased. Regarding mandatory disclosures, the extent of financial disclosures is likely to remain unchanged due to having been required by legislation for a long time. Having said this, it might be due to more comprehensive disclosures. For example, recent mandatory disclosures such as BM disclosures and modern slavery disclosures might have been disclosed more comprehensively in the 2021 annual report, as compared to 2018.

Regarding the voluntary disclosures, the extent of such disclosures has also increased. This is to the 1% level after having done a t-test. Further investigating this, I find that voluntary disclosures mainly comprise environmental disclosures, social disclosures, supply chain KPIs, and the number and geographic location of supply chain facilities. The observation of the changes in disclosures from the 2018 to the 2021 annual report of sampled companies shows that the extent of environmental disclosures, on average, has increased. This is strongly significant to the 1% level.

This is seen through the high level of environmental disclosures across all five industries. More specifically, scope 1 and scope 2 carbon emissions, along with energy consumption

information, were disclosed comprehensively in 2021 across all five industries. Disclosure of scope 2 carbon emissions, which are emissions released from purchased electricity and heat, along with comparisons made to previous years increased by a large quantity from 2018 to 2021. However, scope 3 carbon emissions, which are emissions released by a firm's supply chain operations, were lacking in disclosure, and this was universal across all five industries. This observation supports previous research that technology has enabled the collection of scope 2 carbon emissions (Marshall et al., 2016). On the other hand, scope 3 emissions, which involve collecting emissions data from supply chain members, are more costly to collect than scope 1 and 2 emissions. This poses a significant barrier in terms of cost (Kim & Davis, 2016). Of further significance is the increase in supply chain information pertaining to circular economic activities. This supports the increase in keywords relating to the circular economy, as found in the previous subsection, as well as the increasing relevance of such activities in the supply chain (Farooque et al., 2019; Lahane et al., 2020).

This significant increase in environmental disclosures in the supply chain is likely due to a combination of reasons. Firstly, companies are increasingly held accountable for the environmental practices of their supply chain, combined with a growing awareness from shareholders and customers as to the environmental practices of the supply chain (Deloitte, 2022). Studies also note the effect of environmental dimensions on firm performance and shareholder value (Green et al., 2012; Subir, 2009). Hence, communication of such environmental disclosures is a source of competitive advantage and could be used to signal the superiority of the company supply chains (Bateman & Bonanni, 2019). This increased demand from stakeholders could also lead to greenwashing or enhancing the legitimacy of company supply chains (Zharfpeykan, 2021). Upcoming legislation regarding the mandatory disclosure of scope 1, 2 and 3 greenhouse gas emissions and climate-related financial

disclosures regulated by the TCFD will also likely contribute to this increased environmental disclosure (Farrar, 2022).

However, while the extent of social disclosures has increased from 2018, this is not significant. In line with the high disclosure of mandatory information, the mention of a modern slavery statement being published was well disclosed. However, the content disclosed in such modern slavery statements is outside the scope of this study, and therefore, findings cannot be connected to previous research (Islam & Van Staden, 2021; Stevenson & Cole, 2018). However, with the exception of modern slavery disclosures, social disclosures, such as supplier code of conduct and supplier audits, were not disclosed comprehensively. The exception to this was in the consumer discretionary industry which are, in the majority, retail companies. This is likely a consequence of the pressure exerted from the media and other groups as to companies' social practices (Deegan & Islam, 2010; Doorey, 2011).

I further note that the voluntary disclosures also comprise supply chain risks, supply chain KPIs, and the number and geographical spread of supply chain facilities Further observations of the specific supply chain information disclosed in annual reports is the comprehensive disclosure of internal supply chain risks among companies in all five industries. This observation supports previous findings (Bayne et al., 2022). On the other hand, previous studies reported a lack of non-financial KPIs in SCM in the Australian and Swedish context (Arvidsson, 2011; Bayne et al., 2022; Bayne & Wee, 2019). In the current study, KPIs on R&D innovation, percentage of new products sold, and production volume indicators are considered to be supply chain KPIs. The lack of supply chain KPIs also applies in the current study of 80 sampled companies in the UK FTSE Index, with only 39% of companies reporting any sort of supply chain KPIs. The highest proportion was from companies in the basic materials sector with 62% of companies reporting such KPIs which mainly communicated the last five years of production volume growth.

Making further comparisons to previous studies, the current study observed that only disclosures relating to the number and/or geographic location of production facilities was well disclosed. The number and/or geographic location of production facilities was most disclosed across all industries with 70% of companies disclosing such disclosures. However, this was most disclosed by companies in healthcare, consumer staples and industrials. In the context of the basic material industry, the number and geographic location of open and development mines were well disclosed. In the context of the consumer discretionary industry, the number and geographic location of retail outlets were comprehensively disclosed. This is favourable and in line with preferred disclosures outlined by stakeholders (Bayne et al., 2022). However, disclosures pertaining to the number and/or geographic location of suppliers and information on supplier identities was not disclosed to a high degree. This is unfavourable towards the preferences of stakeholders (Bayne et al., 2022).

In summary, the findings show that the disclosure of supply chain information has increased from 2018 to 2021. This increase is significant for the overall disclosure, as well as in communicating value creation, value delivery and value capture. This increase is also applicable to all five industries sampled. A more in-depth look at these observations suggests the different factors that influence SCD including the (i) cost of collecting information, (ii) proprietary costs and (iii) complexities of the supply chain. The latter influence suggests that disclosing supply chain information can reduce information asymmetry between the company and stakeholders. This may also explain the increase in environmental disclosures pertaining to the supply chain. In conclusion, the observations note that a strong influence, albeit not the only one, on the extent of SCD is the complexities of supply chain structure. Hence, in the next few subsections, I look at the influence of different supply chain dimensions on SCD.

6.4.2 Effect of supply chain structure on SCD

A. *Descriptive statistics*

The previous subsections looked at the word frequency of keywords relating to SCM as well as the disclosure of supply chain information, both in annual reports. It was concluded that there was an increase in both the frequency of keywords and SCD between the 2018 and the 2021 periods. I reason that this is due to the growing complexities of the structure of the supply chain. Given this, I investigated the effect of supply chain structure on the extent of SCD, as illustrated through *Empirical Model II*. As such, I first outline the descriptive statistics and bivariate correlations of the empirical model. Subsequently, I move onto regressing the empirical model.

Table 6-13 shows the descriptive statistics for the dependent variable, explanatory variables, and control variables to be used in empirical model II above.

The dependent variable, disclosure score (DSCORE), varies from 20.98% to 73.88%. The mean disclosure score is 54.59%. This range, reflecting the comprehensiveness of disclosures, suggests the composition of the disclosure index is likely to comprise both mandatory and voluntary disclosures. Addressing the descriptive statistics of the explanatory variables, I note that the customer base of companies shows that the sample consists of firms that do not operate in the UK and have an international customer base (0%), as well as firms that solely have a regionalised or localised customer base (100%). In relation to the operating portfolio, there are firm-year observations that have a single operating segment within the company's portfolio as illustrated by the primary operating segment comprising 100% of total sales. The mean statistic of 66.110 indicates that the average company accounts for approximately 65% of sales as owing to its primary operating segment within its portfolio.

Thirdly, the environmental dimension (*Environmental*) reveals that some companies in the sample have very low environmental performance (indicated by the minimum statistic of

Table 6-13: *Descriptive Statistics*

						Skewness		Kurtosis	
	N	Mean	Std Dev	Min	Max	Statistic	Std Error	Statistic	Std Error
DSCORE(%)	160	54.593	8.707	20.980	73.880	-0.550	0.192	1.157	0.381
Customer Base	160	59.221	31.864	0.000	100.000	0.089	0.192	-1.494	0.381
Operating Portfolio	160	66.110	23.685	22.290	100.000	0.014	0.192	-1.395	0.381
Environmental	160	56.194	22.597	0.550	94.230	-0.225	0.192	-0.539	0.381
Social	160	65.278	18.881	16.590	97.210	-0.447	0.192	-0.345	0.381
Lev	160	56.106	16.823	12.446	90.234	-0.152	0.192	-0.617	0.381
Governance	160	68.983	16.910	17.670	97.670	-0.545	0.192	-0.069	0.381
Float Shares	160	78.800	18.723	25.000	100.000	-1.173	0.192	0.455	0.381
Foreign Ownership	160	10.225	14.039	0.000	62.000	2.047	0.192	4.033	0.381
Board Size	160	8.844	1.941	5.000	13.000	0.495	0.192	-0.383	0.381
Board Independence	160	61.777	14.081	7.690	85.710	-0.858	0.192	1.275	0.381
F_Size	160	21.743	1.655	18.457	25.709	0.642	0.192	-0.212	0.381
ROA	160	8.176	9.411	-11.877	58.003	2.411	0.192	8.810	0.381
Ln_M2B	160	1.025	0.716	-1.109	2.814	-0.046	0.192	-0.150	0.381
Analyst Following	160	12.294	6.900	0.000	34.000	0.291	0.192	-0.296	0.381

0.550) and very high environmental performance (maximum statistic of 95.810). Lastly, the social dimension indicates companies with very high social performance (97.210), while a bottom limit of 16.590 exists for companies with low societal performance in their supply chain. The skewness and kurtosis levels of all the explanatory variables show a normal distribution.

In the bottom 10 rows of *Table 6-13,* I show the descriptive statistics for the control variables. The results show that the sampled companies have slightly greater debt financing than equity financing. Further insights show that companies are, on average, 10% owned by overseas investors and have, on average, 12 analysts following each company. The majority of the 10 control variables showed a normal distribution. However, a logarithmic procedure was performed to make the distribution of the market-to-book ratio (M2B) more normalised.

B. *Bivariate analysis*

Table 6-14 addresses the bivariate relationships between the dependent, explanatory and control variables used in *Empirical Model II* above. *Table 6-14* shows that disclosure score (*DSCORE)* has negative bivariate correlations with customer base and operating portfolio. This suggests that as the proportion of domestic sales in the customer base increases, and as the proportion of the primary operating segment in the operating portfolio increases, SCD decreases. Based on these preliminary results, it might be suggested that, as the complexity of the supply chain decreases, the extent of SCD decreases. On the other hand, the environmental dimension and social dimension have positive relationships. This suggests that, as environmental and social practices are integrated more into the supply chain, the complexity of the supply chain will increase. This subsequently increases SCD.

Looking further into *Table 6-14*, there are several significant correlations. For example, one exists between (i) environmental dimensions and disclosure score ($0.420, p < 0.01$) and

Table 6-14: *Bivariate Correlations*

	DSCORE(%):	*Customer Base*	*Operating Portfolio*	*Environmental:*	*Social:*	*Lev:*	*Governance:*	*Float Shares*	*Foreign Ownership*	*Board Size*	*Board Independence*	*F_Size:*	*ROA:*	*Ln_MTB:*	*Analyst Following:*
DSCORE(%):	*1.00*														
Customer Base:	*-0.425***	*1.00*													
Operating Portfolio:	*-0.214***	*0.559***	*1.00*												
Environmental	*0.420***	*-0.219***	*-0.058*	*1.00*											
Social:	*0.404***	*-0.435***	*-0.257***	*0.723***	*1.00*										
Lev:	*-0.194**	*0.198**	*0.112*	*0.174**	*0.080*	*1.00*									
Governance:	*0.379***	*-0.347***	*-0.177**	*0.437***	*0.461***	*0.068*	*1.00*								
Float Shares	*-0.013*	*-0.034*	*-0.119*	*0.133*	*0.106*	*0.057*	*0.127*	*1.00*							
Foreign Ownership	*0.165**	*-0.089*	*-0.020*	*0.078*	*0.163**	*0.091*	*0.099*	*-0.517***	*1.00*						
Board Size	*0.374***	*-0.385***	*-0.240***	*0.449***	*0.545***	*0.033*	*0.407***	*-0.037*	*0.241***	*1.00*					
Board Independence	*0.195**	*-0.298***	*-0.200**	*0.401***	*0.333***	*0.050*	*0.528***	*0.415***	*-0.183**	*0.187**	*1.00*				
F_Size:	*0.402***	*-0.362***	*-0.141*	*0.639***	*0.657***	*0.214***	*0.501***	*0.075*	*0.221***	*0.655***	*0.410***	*1.00*			
ROA:	*-0.047*	*-0.053*	*0.006*	*-0.071*	*-0.097*	*-0.353***	*-0.143*	*-0.061*	*0.118*	*-0.049*	*-0.080*	*-0.124*	*1.00*		
Ln_MTB:	*-0.068*	*-0.164**	*-0.117*	*-0.053*	*-0.089*	*0.111*	*-0.070*	*0.138*	*-0.169**	*-0.005*	*-0.033*	*-0.254***	*0.325***	*1.00*	
Analyst Following:	*0.376***	*-0.311***	*-0.134*	*0.561***	*0.564***	*0.101*	*0.368***	*0.029*	*0.140*	*0.525***	*0.246***	*0.722***	*-0.016*	*0.035*	*1.00*

**, ** Significant at 0.05 level and 0.01 levels, respectively*

(ii) social dimensions and disclosure score (*0.404, $p < 0.01$*). In addition, the relationships between the explanatory variables show that customer base has significant bivariate relationships with operating portfolio *(0.559, $p < 0.01$)* and that environmental dimensions have significant bivariate relationships with social dimensions *(0.723, $p < 0.01$)*. These bivariate correlations suggests that there are significant multicollinearity issues which may cause endogeneity concerns.

The high levels of multicollinearity resulting from the bivariate relationships suggests there will be endogeneity concerns, which may be mitigated by the above-mentioned empirical model. This is through controlling for a number of variables in the multivariate regression such as the number of shares publicly floated, foreign ownership, board characteristics, firm size, profitability, market-to-book ratio and analyst following. This mitigates the concerns of having omitted variables bias. Secondly, reverse causality is unlikely to be an issue as SCD is unlikely to affect change in supply chain structural dimensions. This claim is supported by Gualandris et al. (2021) who note that supply chain transparency is unlikely to affect dimensions of the supply chain. Bateman and Bonanni (2019) further note that supply chains are not designed for the objective of transparency, but for operational efficiency and getting the product to the customer in a responsive manner. This further justifies the finding that SCD is unlikely to motivate supply chains to change their structure.

C. *Main regression*

Table 6-15 shows the results of the main empirical model investigating the effect of supply chain dimensions against SCD. Model A regresses the explanatory variables against SCD, controlling for the list of control variables, industry-fixed effects and the post-Covid

dummy variable. Model B regresses the same model, but with the interaction of the post-Covid dummy with the four explanatory variables.

Table 6-15, Model A shows that there is significant variation in the explanatory and control variables in explaining the variation in disclosure score. This is supported by an R-squared of 0.534 (53.4%) and an adjusted R-squared of 0.471 (47.1%). The validity of *Model A* is further supported in noting that the majority of the VIFs are under 4. This is apart from the relationship between firm size and disclosure score which has a VIF of above 5.

Next, I present the main findings of the effect of supply chain dimensions: (i) customer base, (ii) operating portfolio, (iii) environmental dimensions and (iv) social dimensions on SCD. The dimensions of customer base, environmental dimensions and social dimensions have significant effects on the extent of supply chain disclosure. In regard to a company's customer base, the significant negative coefficient ($\beta = -0.148, p < 0.10$) shows that, as the level of domestic sales increases, the complexity and uncertainty of the supply chain decreases, and as such less supply chain information is disclosed. Crawford et al. (2020) show that greater customer concentration is associated with fewer sales and management forecasts. They show that this is because greater customer concentration is associated with less complexity, and as such less monitoring is needed. Cahan et al. (2005) also show that as global diversification of operations increases, accounting disclosure increases due to complexity. The same reasoning can be applied to the significant negative coefficient for customer base. Hence, the information asymmetry hypothesis prevails. *Therefore, the coefficient lends support to $H2_A$ and as such the hypothesis is empirically supported and can be accepted.*

Regarding environmental dimensions of the supply chain, the significant positive coefficient ($\beta = 0.271, p < 0.01$) reveals that, as environmental performance of the supply chain increases, the extent of SCD also increases. This can be explained by the complexity

Table 6-15: *Supply Chain Dimensions and Supply Chain Disclosure (DSCORE)*

	Model A (DSCORE):	***Model B (DSCORE):***
Customer Base	*-0.148** *(-1.663)*	*-0.009* *(-0.286)*
*Customer Base*Post-Covid*		*-0.063* *(-1.504)*
Operating Portfolio	*0.056* *(0.757)*	*0.009* *(0.246)*
*Operating Portfolio*Post-Covid*		*0.033* *(0.637)*
Environmental:	*0.271**** *(2.608)*	*0.145**** *(2.889)*
*Environmental*Post-Covid*		*-0.100* *(-1.462)*
Social:	*-0.200*** *(-1.940)*	*-0.083* *(-1.303)*
*Social*Post-Covid*		*-0.016* *(-0.182)*
Lev:	*-0.155** *(-1.863)*	*-0.088*** *(-2.041)*
Governance:	*0.102* *(1.298)*	*0.041* *(1.009)*
Float Shares	*0.024* *(0.305)*	*0.016* *(0.446)*
Foreign Ownership	*0.026* *(0.326)*	*0.021* *(0.439)*
Board Size	*0.043* *(0.481)*	*0.206* *(0.520)*
Board Independence	*-0.105* *(-1.246)*	*-0.071* *(-1.358)*
F_Size:	*0.120* *(0.876)*	*0.819* *(1.129)*
ROA:	*-0.098* *(-1.263)*	*-0.121* *(-1.652)*
MTB:	*0.016* *(0.185)*	*0.427* *(0.410)*
Analyst_Following	*0.089* *(0.921)*	*0.085* *(0.684)*
Industry_Healthcare	*0.065* *(0.967)*	*-4.074* *(-1.571)*
Industry_ConsumerDiscretionary	*-0.237*** *(-2.591)*	*-11.206**** *(-5.165)*
Industry_ConsumerStaples	*-0.052* *(-0.649)*	*-7.425**** *(-3.898)*
Industry_Industrials		*-6.339**** *(-3.432)*
Industry_BasicMaterials	*0.262**** *(3.328)*	
Post-Covid	*0.248**** *(3.962)*	*12.653*** *(2.093)*

Observations:	*160*	*160*
R-Squared:	*0.534*	*0.554*
Adj. R-Squared	*0.471*	*0.479*
Industry FE	*Yes*	*Yes*
Year FE	*Yes*	*Yes*

, **, * Significant at 0.10 level, 0.05 level and 0.01 levels, respectively*

argument, as the incorporation and integration of environmental practices into the supply chain can increase the complexity of the supply chain, and as it does, will also increase the extent of SCD (Green et al., 2012; Macchion et al., 2020). Moreover, it can be reasoned that companies are motivated to signal the superiority of their supply chain as they incorporate more environmental dimensions into their supply chain. *The significantly positive effect lends support to $H2_C$, and as such can be accepted*.

Further to this, a significantly negative relationship between social dimensions of the supply chain and SCD is found *(β = -0.200, $p < 0.05$).* This suggests that, as the supply chain becomes more socially responsible, the extent of SCD reduces. This result does not provide support for the argument made Awaysheh and Klassen (2010) that socially responsible supply chains enhance brand reputation. However it does provide support for the argument made by Andersen and Skjoett-Larsen (2009) and Egels-Zandén et al. (2015). They make the argument that long-term collaboration with suppliers is key to becoming socially responsible. As such, to safeguard long-term collaborations with suppliers and maintain a socially responsible supply chain, companies will disclose less supply chain information. This is because disclosing supply chain practices can threaten such collaboration with suppliers. *Thus, it does lend support to $H2_D$ which hypothesised no relationship between social dimensions and SCD*.

However, the explanatory variable of operating portfolio (β = -0.012, $p > 0.10$) has an insignificant effect on the extent of SCD. This is possibly due to the contradictory arguments as to the effect of operating portfolio on SCD, respectively. *As such, $H2_B$ is not supported*.

Moving onto the control variables in *Model A*, the relationship between leverage and SCD is negatively significant to the 1% significance level. This result conforms to the fact that the greater the level of debt, the lower the disclosure level, and that equity financing drives disclosure (Bertomeu et al., 2011). None of the control variables have a significant effect on SCD. This suggests that company characteristics do not play a significant role in determining the extent of SCD, and that the extent of SCD may be determined largely by the dynamics of the industry and the positioning of the industry in the upstream or downstream supply chain, as indicated previously. Supporting this claim is the finding that the consumer discretionary and basic materials industries have a significantly negative and positive relationship respectively. This is because the former is positioned in the downstream supply chain, whereas the latter is positioned in the upstream supply chain.

Table 6-15 Model B shows the regression findings when the four supply chain dimensions are interacted with the post-Covid dummy variable. The findings reveal that, with the interaction of the post-Covid dummy variable, none of the supply chain dimensions are significant. However, the environmental dimension and leverage remain significant. In both *Model A* and *Model B*, the post-Covid sample is significantly positively associated with SCD. This positive coefficient suggests that SCD has increased in the post-Covid period, as compared to the pre-Covid period, which aligns with the findings of *Table 6-6 and Table 6-11*.

D. *Additional analysis*

I conduct further tests. Firstly, I regress the effect of supply chain dimensions on SCD for each industry separately. *Table 6-16* shows the regression results. *Model A* through to *Model E* show the results for the (i) healthcare, (ii) consumer staples, (iii) consumer discretionary, (iv) industrials and (v) basic materials industries, respectively.

In *Table 6-15,* I noted that the dimensions of customer base, environmental dimensions and social dimensions were significantly associated with SCD. However, *Table 6-16* shows that only customer base and environmental dimensions are significantly associated with SCD when each industry is regressed separately. This is consistent for all of the five industries. This suggests that, regardless of which industry the company is in, a more localised customer base is associated with reduced SCD. On the other hand, companies with a more environmentally-conscious supply chain signal the superiority of their supply chain through increased SCD. On the other side, *Table 6-16* reveals that the relationship between social dimensions and SCD is not significant when each industry is regressed separately. The fact that this is the case for all five industries suggests that the significance of such a relationship is only evident with a larger sample size.

Among the control variables, book leverage has a significant negative association with SCD in all five industries. This is not surprising as there is a general consensus that increased debt is associated with less disclosure (Bertomeu et al., 2011). However, there is a significant negative association between profitability, as measured by ROA, and SCD in the consumer staples, industrial and basic material industries. This suggests that, in these three industries, companies with greater profitability disclose less SCD. A reason for this might be because of greater proprietary information in companies within these industries. Such proprietary information may play an important role in the success and competitive advantage of such companies. This will increase profitability, but at the same time these firms will disclose fewer supply chain practices. Among the industry-fixed effects and post-Covid dummy variable, the results are the same as in *Table 6-15*.

The second set of additional tests examines the effect of the four supply chain dimensions on the value elements of the BM: (i) value proposition, (ii) value creation, (iii) value delivery and (iv) value capture. *Table 6-17* shows the findings with *Model A* to *Model*

Table 6-16: *Supply Chain Dimensions against Supply Chain Disclosure (DSCORE) – Controlling for Industry Effects*

	Model A: Healthcare	***Model B: Consumer Staples***	***Model C: Consumer Discretionary***	***Model D: Industrials***	***Model E: Basic Materials***
Customer Base	*-0.244*** (-2.633)*	*-0.176* (-1.901)*	*-0.245*** (-2.644)*	*-0.249*** (-2.66)*	*-0.210** (-2.382)*
Operating Portfolio	*-0.024 (-0.311)*	*0.012 (0.163)*	*-0.017 (-0.217)*	*-0.027 (-0.347)*	*0.023 (0.313)*
Environmental:	*0.272** (2.548)*	*0.189* (1.818)*	*0.269** (2.545)*	*0.271** (2.500)*	*0.311*** (3.109)*
Social	*-0.105 (-0.960)*	*-0.118 (-1.135)*	*-0.096 (-0.896)*	*-0.098 (-0.911)*	*-0.160 (-1.560)*
Lev:	*-0.276*** (-3.292)*	*-0.203** (-2.401)*	*-0.279*** (-3.352)*	*-0.289*** (-3.436)*	*-0.245*** (-3.089)*
Governance:	*0.115 (1.363)*	*0.098 (1.209)*	*0.112 (1.336)*	*0.109 (1.302)*	*0.095 (1.200)*
Float Shares:	*0.028 (0.348)*	*-0.027 (-0.340)*	*0.035 (0.428)*	*0.039 (0.468)*	*0.086 (1.109)*
Foreign Ownership	*0.124 (1.508)*	*0.077 (0.950)*	*0.130 (1.599)*	*0.130 (1.590)*	*0.081 (1.044)*
Board Size	*-0.010 (-0.103)*	*-0.045 (-0.501)*	*-0.002 (-0.017)*	*-0.003 (-0.037)*	*0.076 (0.847)*
Board Independence	*-0.116 (-1.336)*	*-0.080 (-0.947)*	*-0.128 (-1.417)*	*-0.108 (-1.226)*	*-0.111 (-1.351)*
F_Size:	*0.174 (1.195)*	*0.182 (1.293)*	*0.177 (1.220)*	*0.164 (1.110)*	*0.098 (0.710)*
ROA:	*-0.120 (-1.483)*	*-0.079 (-1.010)*	*-0.133* (-1.702)*	*-0.135* (-1.714)*	*-0.169** (-2.261)*
MTB:	*0.022 (0.235)*	*0.039 (0.455)*	*0.030 (0.330)*	*0.032 (0.363)*	*0.040 (0.468)*
Analyst_Following:	*0.050 (0.500)*	*0.121 (1.220)*	*0.051 (0.513)*	*0.044 (0.427)*	*0.030 (0.320)*
Industry_Healthcare:	*0.039*				

	(0.564)				
Industry_ConsumerStaples		*-0.042* *(-0.592)*			
Industry_ConsumerDiscretionary			*-0.256**** *(-3.150)*		
Industry_Industrials				*-0.030* *(-0.386)*	
Industry_BasicMaterials					*0.292**** *(4.095)*
Post-Covid	*0.238**** *(3.558)*	*0.262**** *(4.013)*	*0.238**** *(3.551)*	*0.237**** *(3.525)*	*0.231**** *(3.642)*
Observations:	*160*	*160*	*160*	*160*	*160*
R-Squared:	*0.446*	*0.481*	*0.446*	*0.446*	*0.503*
Adj. R-Squared	*0.384*	*0.423*	*0.384*	*0.384*	*0.448*
Industry FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Year FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*

, **, * Significant at 0.10 level, 0.05 level and 0.01 levels, respectively*

D showing the results for the four value elements, respectively.

The findings show that the supply chain dimensions of customer base, environmental dimensions and social dimensions, that had a significant effect on overall SCD, is owing to the communication of value creation resources. *Model B* shows that a more localised customer base and a more socially conscious supply chain is associated with less communication of how value is created. Firstly, this suggests that the communication of how value is created is disclosed less for a less complex customer base. Secondly, it also supports the argument by Andersen and Skjoett-Larsen (2009) and Egels-Zandén et al. (2015). This is because supplier practices are disclosed as part of the sourcing and procurement process which communicates value creation. Thus, to protect collaborations with suppliers, firms will communicate less about supplier practices. This is given that the communication of supplier practices is predominantly through the channel how value is created through the supply chain. On the other side, environmental dimensions have a positive and significant association with the communication of value creation. This is owing to the fact that much of the environmental and green operations of the supply chain set out by Green et al. (2012) are communicated through how products are sourced (*Table 6-2*) and produced (*Table 6-3*). This confirms that the positive association between environmental dimensions and SCD is due to the signalling argument.

Moving onto *Model D* and the communication of how supply chain resources translate to value capture, the findings show that operating portfolio, which was not significantly associated with SCD, is positively associated with value capture. This suggests that the narrower the product offerings of the supply chain, the greater the disclosure of how this affects the company's bottom line. This may be suggestive that the lack of diversification may reflect a need to disclose more on how this affects performance (Cai et al., 2023). However, a more likely explanation is that a narrower scope of product offerings makes

Table 6-17: *Supply Chain Dimensions against Types of Supply Chain Disclosure (DSCORE)*

	Model A (Value Proposition DSCORE):	***Model B (Value Creation DSCORE):***	***Model C (Value Delivery DSCORE):***	***Model D (Value Capture DSCORE):***
Customer Base	*-0.144* *(-1.298)*	*-0.182*** *(-2.061)*	*0.104* *(0.869)*	*-0.095* *(-1.008)*
Operating Portfolio	*0.035* *(0.383)*	*-0.031* *(-0.415)*	*0.133* *(1.328)*	*0.131** *(1.671)*
Environmental:	*0.138* *(1.064)*	*0.265*** *(2.578)*	*0.159* *(1.139)*	*0.183** *(1.669)*
Social	*-0.193* *(-1.505)*	*-0.219*** *(-2.141)*	*-0.079* *(-0.568)*	*-0.039* *(-0.359)*
Lev:	*-0.155* *(-1.489)*	*-0.064* *(-0.769)*	*-0.171* *(-1.526)*	*-0.146** *(-1.656)*
Governance:	*0.077* *(0.787)*	*0.106* *(1.365)*	*0.056* *(0.534)*	*0.025* *(0.297)*
Float Shares:	*0.131* *(1.321)*	*-0.020* *(-0.253)*	*0.021* *(0.201)*	*-0.010* *(-0.119)*
Foreign Ownership	*0.141* *(1.444)*	*-0.126* *(-1.611)*	*0.131* *(1.244)*	*0.117* *(1.413)*
Board Size	*0.052* *(0.466)*	*-0.035* *(-0.402)*	*-0.042* *(-0.350)*	*0.159** *(1.693)*
Board Independence	*-0.063* *(-0.599)*	*-0.135* *(-1.618)*	*-0.116* *(-1.021)*	*0.036* *(0.402)*
F_Size:	*0.064* *(0.377)*	*0.133* *(0.977)*	*0.316** *(1.715)*	*-0.074* *(-0.512)*
ROA:	*-0.276**** *(-2.866)*	*0.032* *(0.421)*	*-0.007* *(-0.069)*	*-0.129* *(-1.579)*
MTB:	*0.103* *(0.967)*	*-0.060* *(-0.703)*	*0.247*** *(2.154)*	*-0.080* *(-0.888)*
Analyst_Following:	*0.078* *(0.653)*	*0.147* *(1.544)*	*-0.326*** *(-2.524)*	*0.140* *(1.378)*
Industry_Healthcare:	*0.000*	*0.134***	*0.071*	*-0.060*

	(-0.004)	*(2.003)*	*(0.790)*	*(-0.851)*
Industry_ConsumerDiscretionary	*-0.172* *(-1.507)*	*-0.262**** *(-2.887)*	*0.105* *(0.858)*	*-0.207*** *(-2.145)*
Industry_ConsumerStaples	*-0.245*** *(-2.471)*	*0.059* *(0.745)*	*0.033* *(0.310)*	*-0.080* *(-0.950)*
Industry_Industrials				
Industry_BasicMaterials	*0.084* *(0.853)*	*0.311**** *(3.979)*	*0.108* *(1.019)*	*0.108* *(1.298)*
Post-Covid	*0.086* *(1.103)*	*0.143*** *(2.302)*	*0.169*** *(2.016)*	*0.319**** *(4.835)*
Observations:	*160*	*160*	*160*	*160*
R-Squared:	*0.278*	*0.543*	*0.161*	*0.482*
Adj. R-Squared	*0.180*	*0.481*	*0.047*	*0.412*
Industry FE	*Yes*	*Yes*	*Yes*	*Yes*
Year FE	*Yes*	*Yes*	*Yes*	*Yes*

, **, * Significant at 0.10 level, 0.05 level and 0.01 levels, respectively*

it easier to disclosure information on the future outlook of product and operating segments. Further to this, *Model D* also shows a positive association between environmental dimensions and the communication of firm performance and value captured. This is likely because of companies not only signalling their environmentally conscious supply chain but also how the incorporation of environmental practices in their supply chain translates to performance and value (Subir, 2009).

However, the findings show that none of the four supply chain dimensions have a significant effect on the communication of supply chain strategy (value proposition) in *Model A*. The same goes for the communication of logistics and distribution resources (value delivery) in *Model C*. Summing the findings up thus far shows that only the dimensions of customer base, environmental dimensions and social dimensions are significantly associated with overall SCD. However, all four dimensions are significantly associated with different value elements of the BM.

I then examine the determinants of these four supply chain dimensions against mandatory and voluntary disclosures. For brevity, these findings are not shown. The findings show that environmental dimensions are a significant determinant of both mandatory disclosures and voluntary disclosures. As regards mandatory disclosures, this might be slightly surprising as mandatory disclosures are, for the most part, determined by legislation and regulations. In regard to voluntary disclosures, customer base, environmental dimensions and social dimensions are significant determinants.

I further pinpoint the supply chain dimensions that play a role in determining SCD by investigating the determinants of environmental and social SCDs. Firstly, this is because voluntary supply chain disclosures heavily comprise environmental and social disclosures. Secondly, it was noted in *Section 5.3* that environmental and social disclosures were the main disclosures that increased from 2018 to 2021. Hence, it is important to determine the

dimensions that motivated and drove these disclosures. The findings, which are not presented, showed that environmental dimension was the only significant determinant of both environmental and social SCDs. Overall, it is concluded that environmental dimension is the single most important determinant of the four dimensions that drove SCD.

The first set of further analysis subdivided the overall disclosure score (*DSCORE*) into (i) examining each industry individually, (ii) the four elements of the BM, (iii) mandatory and voluntary disclosures, and (iv) environmental and social disclosures. This was examined to identify which of the four dimensions was the most prominent in determining the extent of SCD. However, I also conducted additional analyses on the effect of the supply chain dimensions against an alternative dependent variable to SCD. This was the frequency of SCM keywords in annual reports. This was previously investigated in *Section 6.4.1*. In order to perform this test, I combined the total frequency of the keywords, as noted in *Table 6-6*, for each company's 2018 and 2021 annual reports. *Table 6-18* presents the results of this regression.

Table 6-18 Model A shows the results of the four supply chain dimensions against SCM Keywords while controlling for industry-fixed effect and the post-Covid dummy variable. *Model B* interacts these dimensions with the post-Covid dummy variable. In both models, the R-squared is sufficiently strong, predicting 59.0% (*Model A*) and 59.6% (*Model B*). In *Model A*, there is a significant positive association between customer base ($\beta = 0.143, p < 0.10$) and the word frequency of SCM keywords. However, none of the other dimensions were found to have a significant effect on the frequency of SCM keywords. Among the control variables, board size was a significant determinant on the frequency of SCM keywords. This suggests that the frequency of the disclosure of SCM keywords is greater for companies with a larger board size. This may be owing to the fact that, as the size of the board increases, the expertise of the board widens and as such the disclosure of SCM keywords increases. However, in

Model B, none of the dimensions have significant associations when interacted with the post-Covid dummy variable.

6.4.3 Summary

These findings examine the effect of supply chain dimensions on SCD. From the word frequency analysis of SCM-related keywords and the independent sample t-test, I find that there is an increase in the disclosure related to supply chain information, comparing the 2018 and 2021 FYs. Further analysis finds that this increase is across all four types of SCD: value proposition, value creation, value delivery and value capture, and across all five industries: healthcare, consumer discretionary, consumer staples, industrials and basic materials. Overall, these findings show comprehensive support for SCD having increased from 2018 to 2021.

The findings of the main regression reveal that the supply chain dimensions of customer base, environmental dimensions and social dimensions significantly affect the extent of SCD. However, only customer base and environmental dimensions are significant when each industry is regressed separately. Further examination finds that the dimensions of customer base, environmental dimensions and social dimensions are more specifically associated with the communication of how value is created through the supply chain. However, the primary dimension that is found to drive SCD is the environmental dimension which has a significant association in driving value creation and value capture disclosures. It further drives mandatory and voluntary SCDs, as well as environmental and social SCDs

Table 6.18: *Supply Chain Dimensions and SCM Keywords*

	Model A (SCM_Keywords):	***Model B (SCM_Keywords):***
CustomerBase	*0.143**	*1.450*
	(1.717)	*(1.641)*
*Customer Base*Post-Covid*		*-0.594*
		(-0.521)
OperatingPortfolio	*-0.054*	*-0.693*
	(-0.773)	*(-0.692)*
*Operating Portfolio*Post-Covid*		*0.149*
		(0.104)
Environmental	*0.125*	*0.575*
	(1.280)	*(0.420)*
*Environmental*Post-Covid*		*1.960*
		(1.047)
Social	*-0.019*	*0.151*
	(-0.197)	*(0.086)*
*Social*Post-Covid*		*-0.761*
		(-0.320)
Lev	*-0.027*	*-0.439*
	(-0.346)	*(-0.373)*
Governance	*0.113*	*1.780*
	(1.529)	*(1.612)*
FloatShares	*0.085*	*1.148*
	(1.139)	*(1.142)*
ForeignOwnership	*0.095*	*1.767*
	(1.284)	*(1.331)*
BoardSize	*0.145**	*18.856**
	(1.730)	*(1.741)*
BoardIndependence	*0.004*	*0.123*
	(0.053)	*(0.086)*
F_Size	*0.049*	*5.973*
	(0.380)	*(0.302)*
ROA:	*-0.079*	*-2.153*
	(-1.085)	*(-1.081)*
Ln_M2B	*0.071*	*25.629*
	(0.878)	*(0.901)*
AnalystFollowing	*0.053*	*1.822*
	(0.582)	*(0.536)*
Industry_Healthcare	*-0.196****	*-182.709***
	(-3.095)	*(-2.580)*
Industry_ConsumerDiscretionary	*-0.135*	*-58.449*
	(-1.575)	*(-0.987)*
Industry_ConsumerStaples	*-0.189***	*-91.093**
	(-2.538)	*(-1.752)*
Industry_Industrials		*20.924*
		(0.415)
Industry_BasicMaterials	*-0.032*	
	(-0.435)	
PostCovid	*0.559****	*240.331*
	(9.522)	*(1.456)*
Observations	*160*	*160*

R-Squared	*0.590*	*0.596*
Adj. R-Squared	*0.534*	*0.528*
Industry FE	*Yes*	*Yes*
Year FE	*Yes*	*Yes*

, **, * Significant at 0.10 level, 0.05 level and 0.01 levels, respectively*

6.5 Discussion

This section discusses the findings of the effect of the four supply chain dimensions: (i) customer base, (ii) operating portfolio, (iii) environmental dimensions and (iv) social dimensions, against the extent of SCD disclosed in annual reports. In discussing the findings, I initially studied the types of supply chain information provided in company annual reports, across the pre-Covid (2018) and post-Covid (2021) periods. This was done through conducting a word frequency analysis of supply chain keywords, and investigating the keywords that were communicated together to understand the supply chain messages communicated. Based on an exploratory analysis, it was found that there was an increase in supply chain keywords relating to the upstream and downstream supply chains. This was more so the case for keywords relating to environmental information, social information and circularity information. Together with this, there was change in emphasis of supply chain messages communicated.

The annual reports in the post-Covid period placed a greater emphasis on communicating the technical and operational aspects of the supply chain. This was in contrast to the greater emphasis placed on the environmental and social aspects of sourcing products in the pre-Covid period. This suggests the growing importance of considering environmental and social factors in the upstream supply chain prior to when the pandemic hit (Deegan & Islam, 2010, 2014; Doorey, 2011; Grob & Benn, 2014). However, the Covid-19 pandemic and other supply chain disruptions shifted the focus of annual reports more centrally towards communicating supply chain operations. This is likely because of the greater emphasis from

investors and stakeholders on the operational workings of the supply chain after the Covid-19 pandemic (Dai et al., 2020; Mickle & Kubota, 2020).

Further to this, an independent samples t-test analysing the changes in the types of information disclosed between the 2018 and 2021 annual reports was performed. The findings provided support for the increase in keywords pertaining to the supply chain. This increase was in the most part due to the increase in value creation disclosures, communicating resources within the processes of (i) sourcing and procurement and (ii) production. This provided support for the increase in keywords reflecting the upstream supply chain, supply chain sustainability and the circular economy within supply chains. In line with this, the value creation SCDs increased significantly to the 1% level between the 2018 and 2021 annual reports. Value capture SCDs (1% level) and value delivery SCDs (5% level) also played a significant role in the overall increase in SCD. This may be due to the increasing importance of the supply chain in firm performance, value creation and in maintaining a competitive advantage (Li et al., 2006; Sharifi et al., 2006). Alternatively, this may be due to the increasing frequency and magnitude of supply chain disruptions, such as that of the Covid-19 pandemic (Dai et al., 2020).

Apart from investigating whether the increase in communication of supply chain resources was consistent over the value elements of the BM, I also tested whether this was industry specific or across all industries. This increase was across all industries. However, a closer inspection of the SCDs across the five industries and the four value elements of the BM show the numerous factors that affect the extent of SCD. Previous studies have shown that the extent of SCD is influenced by (i) internal visibility, (ii) technology, (iii) cost, (iv) proprietary information, (v) supply chain signalling, (vi) greenwashing and (vii) supply chain complexities and information asymmetry among other factors.

Firstly, Montecchi et al. (2021) noted that internal visibility is the process of collecting and analysing information about supply chain operations and processes from upstream suppliers and downstream customers. The role internal visibility plays in external transparency of SCD can be illustrated through the consumer discretionary industry. As shown, the consumer discretionary industry had the lowest SCD score belonging to value creation and the highest SCD score belonging to value delivery. This shows the lack of internal visibility that companies in the consumer discretionary industry have over their upstream supply chain resources, and the processes of (i) sourcing and procurement and (ii) production. This in turn makes it more difficult to collect and subsequently communicate informational resources on such processes. On the other hand, the high value delivery score shows the high visibility that such companies have over their downstream supply chain resources, and the process of logistics and distribution.

Secondly, the influence that proprietary information has on the extent of SCD can be traced back to the relatively low value creation SCDs of industrial companies. Industrial companies, having manufacturing-oriented supply chains, have high visibility over their upstream supply chain. However, industrial companies operate in highly competitive markets, as reflected in numerous companies on the FTSE All-Share index operating in industries such as (i) aerospace and defence, and (ii) packaging. Given this, there are incentives for not disclosing upstream supply chain resources, that can be used by competitors.

This will outweigh the high visibility that such companies have over their upstream supply chain. The influence of proprietary information on SCD is in line with the findings of previous literature (Ellis et al., 2012). Interviewee #2, who works for a manufacturing company, stated, *The people that actually invest and developing their supply chains would just get ripped off,"* in reference to the disclosing of proprietary supply chain information.

However, as mentioned by Glaeser (2018), companies with trade secrets and more proprietary information disclose more non-proprietary information. This may provide a reason why industrial companies, on average, have high value proposition SCD and value capture SCD scores, which consist of more non-sensitive information.

Thirdly, the opposing influences of technology (enabling SCD) and cost, which is a disincentive to SCD, can be seen through the comprehensive disclosure of scope 2 carbon emissions and the lack of disclosure of scope 3 carbon emissions. Marshall et al. (2016) and Saberi et al. (2019) noted that technology can enhance traceability through company and supply chain activities. This can explain why scope 2 emissions, which are emissions that the company indirectly affects, have increased. However, this is only to the extent to which cost is not a major barrier. However, cost may outweigh the traceability benefits of technology in disclosing scope 3 emissions, which are emissions incurred up and down the company's supply chain. The added costs of tracing scope 3 emissions can be similarly looked at from the point of view of the added cost in tracing the source of conflict materials (Kim & Davis, 2016)

Fourthly, much of the increase in SCD from 2018 to 2021 was due to the increase in the communication of environmental and social dimensions of the supply chain. A significant increase, to the 1% level, was reported for environmental disclosures. However, the increase in social disclosures was not significant. The significant increase in the communication of environmental dimensions is likely due to the increase in environmental awareness and the impacts on the supply chain (Deloitte, 2022). This would go a long way in supporting the information asymmetry hypothesis. Moreover, Green et al. (2012) noted the effect of environmental dimensions on firm performance, and so it would be plausible that the increase in environmental disclosures will be used to signal the superiority of the supply chain. This would support Bateman and Bonanni (2019) who noted that signalling can be used to

motivate SCD. An alternative explanation would also be as provided by Interviewee #4 who notes the following about sustainability disclosure.

> *So, I think it's wanting to make sure that people understand what it is that we really do, and you know where it's an important issue like waterways that that's, you know, very much a transparent presentation of, rather than, you know, impressions that may have been developed by, you know, mediatised since incidents or whatever has sort of been picked up externally.*

On the other hand, the extent to which social and environmental resources are disclosed could be due to greenwashing. In alignment with this, Tost et al. (2018) note that sustainable development in mining companies is aligned with the expectations from society. Combined with negative media surrounding the environmental impacts of mining operations such as Adani's open-cut coal mine in Australia (Cox, 2019), it is a plausible explanation that the growth in disclosing environmental and circular economic resources within SCD is a platform for greenwashing and meeting societal expectations.

Furthermore, the influence that supply chain complexities have on SCD is illustrated through the high overall SCD scores of the healthcare and basic materials industries. (Mullin, 2020) and (Lauwo et al., 2016) explained that both these industries are characterised by the globality of their supply chains. Further to this, companies in the basic materials industry have significant environmental concerns in their supply chain that are addressed in their reporting (Lauwo et al., 2016). Hence, such complexity and high overall SCD scores can be interpreted as information asymmetry having a significant role in the extent of SCD (Cai et al., 2023). Overall, this highlighted the numerous influences and determinants of SCD.

Further insights from the comparative analyses between the 2018 and 2021 results revealed findings in line with previous studies. In line with (Bayne et al., 2022), the findings revealed comprehensive supply chain risk disclosures, reflected in all, apart from four, companies disclosing supply chain risks. Similarly to the study, the findings reported disclosures of how these risks were addressed. The comparative findings also revealed a lack of supply chain KPIs in line with previous studies (Arvidsson, 2011; Bayne et al., 2022; Bayne & Wee, 2019). However, the content of annual reports was found to be slowly moving to the content preferences of shareholders noted in Bayne et al. (2022), with increased disclosure of geographical locations in regard to production facilities. There is, however, still a long way to go to meet stakeholder preferences with disclosure lacking around supplier identities. Bayne et al. (2022) also noted stakeholders value in triangulating various sources of supply chain information. This highlights a limitation of this study in only looking at supply chain information contained in annual reports.

The comprehensiveness of disclosure around internal supply chain risks, supporting Bayne et al. (2022), and the importance of disclosing such information in light of the pandemic (Moss Adams, 2020a), suggests it will be of importance to equity markets. However, alongside a lack of disclosure around supply chain KPIs, disclosure is lacking in the provision of the supply chain impacts on strategic and product outlook. Disclosure of supply chain impacts on strategic and product outlook is especially important given the effects of the Covid-19 pandemic and other disruptions on the future outlook of companies and their going concerns (Moss Adams, 2020b). This lack of disclosure on supply chain KPIs communicating past performance, and on strategy and product outlook communicating future outlook hinders the connections between past, present and future. Hence, this may affect the information usefulness to equity markets.

In regard to the usefulness of such information to debt markets, loan contract terms and debt covenant structures rely on information pertaining to firm value creation and growth opportunities (Bradley & Roberts, 2015; Campello & Gao, 2017). This can be thought of as information relating to the tangible and intellectual performance drivers of value creation (Marr et al., 2004). In the context of the supply chain, it is the processes of (i) sourcing and procurement and (ii) production, and the resources within these processes that drive value creation. As such the significant increase in value creation SCDs will be beneficial to debt markets. For example, information on R&D expenditure and product innovation, as intellectual performance drivers, will help drive value creation. Given this, the comprehensiveness of disclosure around R&D expenditure and product innovation will be useful to debt markets. Hence, the greater communication of these drivers will help debt markets better understand how the firm creates value to repay debt.

Overall, the exploratory analysis revealed increased SCD from the 2018 to the 2021 annual reports, and this was supported by the increase in frequency of keywords. Despite this, the findings highlighted similar conclusions made in previous studies. However, the patterns in disclosure among different industries showed (i) the various influences that determine the extent of SCD and (ii) the rich role that supply chain structures have on SCD. The study responded to these insights by regressing the effect of supply chain structure on SCD. In the context of the RBV theory, it provided a vehicle to explain the role of resources within supply chain structure.

Despite the numerous factors that affect the extent to which supply chain resources are communicated, this study investigated the role that supply chain structures have on SCD. The findings revealed that customer base, environmental dimensions and social dimensions significantly affected the extent to which resources were communicated. The reasoning behind this is due to the different dynamics that affect SCD. Firstly, in explaining the reason

behind customer base negatively affecting SCD, I note that this is due to the complexity dynamic. I recall Cahan et al. (2005) and Crawford et al. (2020) who noted that increased (decreased) complexity of firm/supply chain operations leads to increased (decreased) disclosure. This supports the information asymmetry explanation (Cai et al., 2023).

Secondly, in explaining the reason behind environmental dimensions positively affecting SCD, I note that this is due to the benefits of signalling. As Bateman and Bonanni (2019) noted, companies disclose more supply chain information when they want to signal the superiority of their supply chain. This also applies to signalling to investors that they are environmentally conscious and that this is consistent throughout their supply chain. To support this reasoning, environmental dimensions were a significant determinant in the increase in value creation disclosures and value capture disclosures. Environmental dimensions were also a significant determinant of voluntary disclosures, and also environmental and social disclosures. This suggests that environmental dimensions are the primary determinant towards the increase in disclosure of supply chain resources. This provides evidence to show the importance of environmental dimensions in the supply chain and their contribution to firm performance and value creation. This also strengthens the argument towards signalling the superiority and/or enhancing the legitimacy of the supply chain (Bateman & Bonanni, 2019).

Thirdly, in explaining the reason behind social dimensions negatively affecting SCD, I note that this is due to the relational costs of disclosing SCD. This is because disclosing SCD that is inclusive of disclosing supplier practices jeopardises long-term collaborations with those suppliers. Given that long-term collaborations with suppliers are key to NPD and developing new capabilities, jeopardising such collaborations is disadvantageous to firm sustainability efforts (Kaipainen et al., 2022; Koufteros et al., 2007).

Fourthly, while the supply chain dimension reflecting a firm's operating portfolio does not significantly affect SCD, it positively affects the communication of value capture resources. This is likely because of the complexity and/or uncertainty dynamic. From a complexity perspective, a greater proportion of sales owing to the primary operating segment results in a less complex supply chain. This reduces the costs associated with disclosing the future outlook of fewer product/distribution segments. Alternatively, a greater proportion of sales owing to the primary operating segment causes a lack of diversification. This lack of diversification may impact firm profitability and the sustainability of supply chain operations in the future (DeCampos et al., 2022). As such, firms may disclose more supply chain information to reduce this uncertainty

In summary, the investigation of the effect of supply chain dimensions on SCD has provided a wealth of observations. Firstly, the disclosure of supply chain information has increased from the pre-Covid to post-Covid period. This pertains to the frequency of supply chain keywords and the extent of SCD. Secondly, the emphasis of such disclosure has shifted to focus on the technical and operational aspects of the supply chain. Thirdly, there are multiple reasons and dynamics behind the disclosure or lack thereof of supply chain information which have affected how a firm's supply chain structure affects SCD.

Chapter Seven: Consequences of Supply Chain Disclosure

7.1 Introduction

In the recent past, company supply chains have been heavily affected by disruptions such as the Covid-19 pandemic, the Suez canal blockage, growing global tensions such as the US-China trade war and the Russia-Ukraine conflict, and climate-related disruptions such as floods (Free & Hecimovic, 2020). These disruptions subsequently affect the operating performance and equity risk of the firm as well as stock price performance and shareholder wealth (Hendricks & Singhal, 2003, 2005a, 2005b, 2008). This has seen growing calls for the disclosure of supply chain information (Bayne et al., 2022). While there have been calls for greater disclosure of supply chain information, there arises the issue of whether the disclosure of such information affects the decision-making of shareholders and debtholders. In this study, I examine the effect of SCD on the cost of equity and cost of debt. This follows on from the previous study which examined the extent of SCD in company annual reports. Thus, I use the same sample of 80 companies (160 firm-year observations) listed on the FTSE All-Share index across the 2018 and 2021 annual reports.

Previous studies have examined the capital market consequences of disclosure across various settings, such as accounting disclosure (Botosan, 1997), ESG disclosure (Eliwa et al., 2021), carbon disclosure (Bui et al., 2020) and intellectual capital disclosure (Mangena et al., 2016). There has also been a growing research presence in regard to integrated reporting disclosure (Raimo et al., 2021; Vitolla et al., 2020). However, the role of supply chains in company performance has been emphasised as of late. In regard to the supply chain, studies have examined the effect of supply chain structural dimensions, such as supplier concentration and customer concentration on the cost of equity and cost of debt (Campello &

Gao, 2017; Cen et al., 2015; Upson & Wei, 2024). That being said, the effect of SCD in reducing risk, through the cost of equity and cost of debt, has not been previously studied.

In investigating the capital market consequences of SCD, this study is outlined as follows. Section 2 will explain the previous literature on the capital market consequences in different disclosure settings and subsequently narrowed to studies investigating the market reaction of SCM disruptions and consequences of supply chain dimensions. Following this in Section 3 will be a brief overview of the sample and variable definitions. This has already been explained in detail in the previous chapters so will not be repeated. Section 4 will explain the findings of the main regression and additional analyses. Lastly, Section 5 will provide a discussion of the findings in the context of the RBV theory, previous literature, and interview findings.

7.2 Prior literature and hypothesis development

7.2.1 Capital market consequences

The literature on the effects of disclosure on the capital market consequences, especially on the effects on the cost of equity and the cost of debt, is one of the largest strands of research in accounting. What commenced as research investigating the effects of accounting disclosure (Botosan, 1997, 2006; Souissi & Khlif, 2012) spread to other strands of disclosure as mentioned above.

Taking the agency theory and the problem of information asymmetry, it is widely accepted that disclosure results in a lower cost of equity and cost of debt. This is because of the reduction of the moral hazard and information asymmetry problems (Botosan, 2006; Healy & Palepu, 2001). Botosan (2006) notes that previous studies have concluded that increased levels of disclosures are associated with less information asymmetry and lower transaction costs, which will suggest a lower cost-of-equity capital. This is further

corroborated by studies such as Lang and Lundholm (2000), who note that firms increase their disclosure prior to a stock offering. Francis et al. (2005) also find that firms in industries with greater external financing needs have higher voluntary disclosure levels. However, Athanasakou et al. (2020) find a U-shaped relationship when investigating the extent of disclosure. They note that there is an optimal level of disclosure and that, when there is too much information, or uninformative information, a positive relationship with the cost-of-equity may emerge. In regard to the cost of debt, Botosan (2006) reveals that previous studies have found a negative association between the level of disclosure and the cost of debt.

Previous studies have also researched the effect of corporate social responsibility (CSR), Environmental, Social and Governance (ESG) and carbon disclosures on the cost of equity and cost of debt. In research pertaining to CSR disclosures, Dhaliwal et al. (2011) unsurprisingly found a negative relationship with the cost of equity. From the cost of debt perspective, similar results were found, with ESG disclosure weakening the relationship between ESG performance and the dependent variable, albeit only for firms with low ESG performance (Eliwa et al., 2021). Gao et al. (2016) noted a negative relationship between CSR disclosures and the cost of debt, but only for firms with strong CSR performance. The combination of these results may mean that disclosure has the ability to reduce the magnitude of the positive relationship between low CSR/ESG performance and the cost of debt but the relationship between disclosure and the cost of debt is only negative when there is high CSR/ESG performance. The moderating effect of CSR/ESG disclosure will also likely depend on the symbolic or substantive nature of the disclosures in relation to the CSR/ESG performance.

Recent studies have also examined the effects of carbon emissions intensity and carbon disclosure on cost of equity and cost of debt. Bui et al. (2020) find that carbon emission intensity has a positive association with cost of equity and cost of debt. However, Bui et al.

(2020) and Jung et al. (2018) find that this relationship becomes negative and significant when the relationship is moderated by carbon disclosure and carbon reporting. These findings, along with the fact that greater carbon emissions is a negative for the company, may explain why Gerged et al. (2021) find a U-shaped relationship. The negative relationship at lower levels of carbon disclosure can be explained by previous relationships. In contrast the positive relationship after a certain point can be explained by the fact that providing higher disclosure levels of carbon emissions information, albeit more transparent, can be a negative for a company's reputation.

Further to this, researchers have also studied the effects of intellectual capital and the individual dimensions that comprise intellectual capital: human capital, structural capital, and relational capital. Mangena et al. (2016) find a significantly negative relationship between intellectual capital disclosure and the cost of capital. Boujelbene and Affes (2013) reveal that, in regard to human capital and structural capital individually, the significant negative relationship remains. However, the relationship between relational capital and the cost of equity is negative, albeit insignificant. This may mean that relational capital, which is the disclosure of market channels, customer and supplier relationships and supply chain information, while informative may not be important in shareholders' decision-making.

The latest stream of research has been on integrated reporting disclosure and the capital market consequences. In short, Isabel-Maria and Ligia (2017) and Vitolla et al. (2020) report a negative and significant relationship with the cost of equity, and Gerwanski (2020) and Raimo et al. (2021) find the same negative and significant relationship with the cost of debt. The integrated thinking of all sources of capital in the creation of value shares many similarities with SCM in that they both subscribe to the RBV. As such, IR disclosure will share many similarities with SCD. Hence, it can be logically explained that the capital market consequences of SCD can have the same effect as the capital market consequences of IR

disclosure, which is studied by numerous previous researchers. The next section also discusses the previous research investigating the capital market consequences of SCM.

7.2.2 Market reaction of SCM competency and supply chain disruptions

There have been numerous streams of literature on the market effects of SCM and capital market consequences of SCM dimensions. The first stream of literature pertains to the market effects of SCM competency and SCM disruptions. Investigating the former, Ellinger et al. (2012) study the effect of SCM competency on customer satisfaction (as measured by the American Customer Satisfaction Index) and on shareholder value (economic value added). The study notes a positive relationship with customer satisfaction suggesting that firms with the best supply chain practices (most competent) have higher customer satisfaction. The findings also reveal greater shareholder value.

However, there are more studies that investigate the effect of negative news media about organisations' supply chains and, more broadly, supply chain disruptions on stock price performance and shareholder value. Jacobs and Singhal (2017) studied this effect in the context of the Rana Plaza disaster that happened in Bangladesh in April 2013. The findings revealed that there was a significant negative stock market reaction of retailers who sourced from factories located in the Rana Plaza at the time. Another example is Apple's drop in share price because of product delays during the Covid-19 pandemic, with Wu (2021) reporting delays over the supply of mobile chip components from the company's majority suppliers, Broadcom Inc and Texas Instruments. Mickle and Kubota (2020) also noted concerns from analysts and investors over Apple's reliance on its outsourcing partner, Foxconn, during the growing tensions between US and China. This goes to show that supply chain disruptions will have a negative market reaction, but the extent of this effect will reflect

the structure of the firm's supply chain as well as the coverage of the external forces creating those disruptions.

Further studies also noted a negative market reaction to supply chain disruptions. Hendricks and Singhal (2005a) found that firms that suffered from supply chain glitches suffered from a decrease in operating income, return on sales and return on assets, from which firms do not quickly recover. Furthermore, Hendricks and Singhal (2003, 2005b, 2008) all noted that supply chain disruptions reflected a -40% average abnormal stock returns and a 10.28% decrease in shareholder value. This gives a little insight into the consequences of such disruptions caused by the Covid-19 pandemic.

Studies have also investigated the market consequences of ethical and environmental SCD. Swift et al. (2019) study the market consequences of conflict mineral disclosures and find a positive association between a firm's conflict mineral disclosures and profitability, sales growth, and market valuations. Longoni and Cagliano (2018) also find an indirect positive association between inclusive environmental disclosure practices and financial performance through the effect on the presence of green supply chain management (GSCM) practices.

While the previous two studies look at the effect of disclosure practices on operating performance, Birkey et al. (2018) and Griffin et al. (2014) study the market reactions from shareholders and investors. Following the mandatory legislation of the California Transparency in Supply Chains Act (CTSCA), Birkey et al. (2018) find a significant negative market reaction of -2.29%. This is due to the social and political costs associated with having to report ethical discrepancies. The negative market reaction is stronger for firms facing greater risks in their supply chain, suggesting that investors negatively react to exposing legitimacy threats. The study also finds that disclosures made in response to the CTSCA are more symbolic than substantive (Birkey et al., 2018). This gives fuel to the argument that the

negative market reaction may also be due to shareholders being able to interpret the symbolic nature of disclosures unfavourably.

Griffin et al. (2014) note that the market reaction to disclosures can have either a positive effect (transparency), as suggestive by the findings of Swift et al. (2019) and Longoni and Cagliano (2018), Alternatively, market reaction to disclosures can have a negative effect (costs of implementation) as referred to by Birkey et al. (2018). Griffin et al. (2014) find a negative association with conflict mineral disclosure, which is likely because of the costs associated with tracking the use of conflict minerals throughout the supply chain. Conforming to the transparency explanation, the negative market response is stronger (weaker) for firms with less (more) publicly available information. The study by Griffin et al. (2014) present the reality in that the costs of making these disclosures may outweigh the benefits, and in the short run will lead to losses to shareholder value. To support this argument, the study was based on the first wave of companies making conflict mineral disclosures. Overall, the studies suggest that ethical and environmental disclosures have a positive effect on performance and firm valuation, which serves as an argument that in the long-term these disclosures will positively influence the market.

7.2.3 Capital market consequences of supply chain dimensions.

In addition to previous literature investigating the market reaction to SCM competency, supply chain disruptions, and ethical and environmental SCD, researchers have also investigated the effect of SCM dimensions on the cost-of-equity capital and cost of debt. Patatoukas (2012), Dhaliwal et al. (2016) and Campello and Gao (2017) study the capital market consequence of customer concentration. Patatoukas (2012) found that the efficiencies associated with greater customer concentration outweighed the inefficiencies. While the study found lower gross margins for firms with greater customer concentration, benefits

accrued included lower selling, general and admin expenses, less inventory required on-hand owing to closer relationships, higher turnover rates, and a shorter cash conversion cycle. These findings are expected when companies have a smaller customer base and closer relationships with these customers.

However, Dhaliwal et al. (2016) and Campello and Gao (2017) suggest that shareholders and debtholders do not look at customer concentration favourably. The former study found a positive relationship between customer concentration and the cost of equity capital. This suggests that a greater customer concentration (smaller customer base) brings greater downstream risks and uncertainties, for which investors need to be compensated more highly. Along this same inference, the study found that this relationship was stronger for companies more likely to lose a major customer and for those that suffer more financially from such losses. Campello and Gao (2017) studied the effect on the cost of debt and found that greater customer concentration is associated with larger bid-ask spreads and tougher loan covenants, suggesting a greater cost-of-debt capital (positive association). The results from the two studies reveal that higher cost of financing for both debt and equity is as a result of greater risk and uncertainty associated with greater customer concentration and a smaller customer base. This conclusion is supported by Cen et al. (2015). However, as compared to previous research, Cen et al. (2015) look at the effect of long-term principal customers on loan spreads. It has to be noted that the presence of long-term customers helps reduce the uncertainty associated with greater customer concentration, and as such, Cen et al. (2015) found that the presence of long-term customers is associated with a reduction in loan spreads.

Upson and Wei (2024) conducted a study on the effect of supplier concentration of the cost of equity and cost of debt. Regarding the cost of equity, the study found a negative relationship, which implies that a lower supplier concentration (greater supply base) is reflected in a greater cost of equity. Along the same reasoning, the study found that a lower

supplier concentration is associated with a greater cost of debt financing. The result from the study reveals that higher cost of financing, for both debt and equity, results from the greater complexity, and subsequently greater monitoring costs of a lower supplier concentration and a greater supply base (Upson & Wei, 2024).

7.2.4 Hypothesis development

Previous studies on financial disclosure, ESG and CSR disclosure, carbon disclosure, intellectual capital disclosure and IR disclosure have documented negative relationships with the cost of equity and the cost of debt. This is owing to the reduction in information asymmetry. Furthermore, findings have documented that SCM dimensions, such as customer concentration and supplier concentration, have the above relationships with the two dependent variables because of the effect of uncertainty in and complexity of the supply chain, respectively. The independent variable in the following study, SCD, will help communicate the uncertainty and complexity of the firms' supply chain as well as reduce information asymmetry with investors and debtholders, by providing supply chain-relevant disclosures. Hence, the following hypotheses are formed.

H_3 (Alternate): *A negative relationship exists between the extent of supply chain disclosure (SCD) and the Cost-of-Equity Capital.*

H_4 (Alternate): *A negative relationship exists between the extent of supply chain disclosure (SCD) and the Cost of Debt.*

7.3 Sample selection and variable definitions

7.3.1 Data and sample selection

The sample used in this study is the same as in the study performed in *Chapter Six* on SCD, which comprises 80 companies listed on the FTSE All-Share index across the 2018 and

2021 FYs. Hence, the sample consists of 160 firm-year observations. Regarding the dependent variables — (i) cost of equity and (ii) cost of debt — secondary data were collected from Refinitiv workspace. On the other side, content analysis of company annual reports was used to develop company disclosure scores (*DSCORE*). This has been explained in detail in the previous chapter.

7.3.2 Empirical model

In examining the effect of SCD on the cost of equity and cost of debt, I regress the following two regression models.

$$Costof Equity = \alpha + \beta_1 DSCORE + \gamma Control\ Variables + \delta_i + n_t + \varepsilon$$

(*Empirical Model III*)

$$Costof Debt = \alpha + \beta_1 DSCORE + \gamma Control\ Variables + \delta_i + n_t + \varepsilon$$

(*Empirical Model IV*)

In the two empirical models above, the dependent variables are the cost of equity and the cost of debt, respectively. These variables measure the risk premium required by shareholders and debtholders, respectively. The cost of equity is measured via the WACC cost of equity calculated by Refinitiv workspace. The measure is based on the capital asset pricing model (CAPM) formula. On the other hand, the cost of debt is operationalised through the WACC cost of debt which is calculated by Refinitiv workspace. The measure is calculated, adding the weighted cost of short-term and long-term debt based on the 1-year and 10-year points of the company's credit curve. This is regressed against the explanatory variable comprising the disclosure score of supply chain information (*DSCORE*) which has been defined in *Chapter Six*.

In regard to control variables, previous studies on the consequences of disclosure on the cost of equity have controlled for firm size (*F_Size*), leverage (*Lev*), profitability (*ROA*), growth (*MTB*) and the return of equity (*ROE*) (Bui et al., 2020; Francis et al., 2005; Isabel-Maria & Ligia, 2017; Mangena et al., 2016). Thus, these variables are controlled for in examining the effect of SCD on the cost of equity. Previous studies on the consequences of disclosure on the cost of debt have controlled for firm size, leverage, tangibility (*Tangibility*) and the interest coverage ratio (*ICR*) (Gerwanski, 2020; Jung et al., 2018; Raimo et al., 2021). Thus, the study controls firm size, leverage, tangibility, and interest coverage ratio in examining the effect of SCD on the cost of debt. Following this, the findings are examined.

7.4 Results

This section presents the findings of whether SCD helps in reducing risk and information asymmetries for shareholders and debtholders through the effect on cost of equity and cost of debt. Prior to that, I outline the supply chain dimensions communicated through the four value elements of SCD. This includes outlining the dimensions that were disclosed most frequently and the dimensions that lacked disclosure. This will subsequently aid the discussion on the effects of SCD on the cost of equity and cost of debt. After laying this foundation, I outline the descriptive statistics and bivariate correlations of the variables as illustrated in *Empirical Model III and Empirical Model IV*. This is followed by conducting an independent sample t-test of the cost of equity and cost of debt before and after the effects of the Covid-19 pandemic. I subsequently examine the effect of SCD on the cost of equity and cost of debt, and thereby address the hypotheses developed in *Section 7.2.4*. The findings of the main regression subsequently motivate us to conduct additional analyses.

7.4.1 Descriptive analysis

In investigating the effect of SCD on the (i) cost of equity and (ii) cost of debt, I firstly outline the composition of SCD. This is shown in *Table 7-1* providing (i) the four value elements of SCD, (ii) the supply chain dimensions they communicate and (iii) an overview of the most and least frequently disclosed dimensions according to the content analysis conducted in the previous chapter.

As shown in *Table 7-1*, the SCD comprises the four value elements of the BM: (i) value proposition, (ii) value creation, (iii) value delivery and (iv) value capture. These elements communicate dimensions of the supply chain and the BM from supply chain strategy to the outcomes resulting from the integration of material, information and financing flows. These dimensions are shown in the second column of *Table 7-1*. Subsequently, a content analysis from 160 annual reports was conducted and the third and fourth columns show the most and least frequently disclosed dimensions as of the 2021 annual report. To make *Table 7-1* as relevant as possible, I only consider the dimensions that are communicated on a voluntary basis, and not a mandatory basis. For example, the table does not show modern slavery as one of the most disclosed dimensions as such dimensions are communicated on a mandatory basis through disclosures on the preparation of a modern slavery statements. It is important to note that only *Table 7-1* contains voluntary disclosure items, and all the subsequent tables contain mandatory and voluntary disclosure items.

Table 7-1 shows that in communicating supply chain strategy, through value proposition, companies mainly disclose voluntary information on external market dimensions (specifically industry opportunities and challenges) as well as on internal company dimensions that influence strategy. However, they disclose the least on external market dimensions, specifically industry competition, as well as performance dimensions (supply chain KPIs). The lack of disclosure on performance dimensions, and specifically supply chain

Table 7-1: *Supply Chain Dimensions communicated via SCD*

SCD Elements:	Supply Chain dimensions:	Most/Least Disclosed Dimensions	
		Most Disclosed	**Least Disclosed**
Value Proposition *(Communicates dimensions of supply chain strategy)*	• Strategy • Core Capabilities • Internal Company Dimensions • Upstream and Downstream Supply Chain Dimensions • External Market Dimensions • Performance Dimensions (i.e. KPIs)	• External Market Dimensions (Industry Opportunities and Challenges) • Internal Company Dimensions (Sustainability Development Goals)	• External Market Dimensions (Industry Competition) • Performance Dimensions (Supply Chain KPIs)
Value Creation *(Communicates dimensions of the sourcing and procurement Process, and production Process)*	• Supply Base • Strategic Supplier Collaboration (i.e., R&D expenses; Product innovation; R&D facilities; Strategic Alliances) • Production Base (i.e. Production Facilities) • Outsourcing • Environmental Considerations (i.e. Environmental Certification; Responsible Procurement; Eco-Design; Carbon Emissions; Energy Use; Water Use; Waste) • Social Considerations (i.e. Code of Conduct, Audits; Human Rights, Modern Slavery) • Supply Chain Finance • Circular Economic Practices	• Production Base • Strategic Supplier Collaboration (R&D Expenses; Product Innovation; Strategic Alliances) • Environmental Considerations (Scope 1 & 2 Carbon Emissions; Energy Consumption • Social Considerations (Human Rights) • Circular Economic Practices	• Supply Base • Outsourcing • Supply Chain Finance
Value Delivery *(Communicates dimensions of the Logistics and Distribution Process)*	• Demand Management (i.e. Customer Segmentation; Operating Segmentation) • Warehouse Management (i.e. Distribution Facilities, Distribution Channels) • Retail Management • Transport Management • Environmental Considerations (e.g. Recycling, Packaging)	• Environmental Considerations (Packaging; Recycling)	• Warehouse Management • Transport Management
Value Capture *(Communicates the integration of material, information and financing flows)*	• Supply Chain Risks (i.e. Internal Risks) • Value (i.e. Engagement with Stakeholders; Value Created for Stakeholders, Future Strategy Outlook, Future Product Outlook)	• Supply Chain Risks • Value (Engagement with Stakeholders; Value Created for Stakeholders)	• Value (Future Strategy Outlook; Future Product Outlook)

KPIs, may suggest that shareholders lack information on supply chain performance measures to make informed decisions.

Moving onto the communication of value creation through (i) sourcing and procurement and (ii) production reveals that the most disclosed dimensions include communicating strategic supplier collaboration, and especially product innovation and strategic alliance partnerships. Disclosure of circular economic dimensions have largely improved from 2018 to one of the most disclosed dimensions in 2021. The communication of strategic supplier collaboration and circular economic dimensions suggests an increased emphasis on communicating how the supply chain creates value through supply chain relationships and circular supply chain innovations. However, the dimension of SCF lacks disclosure. The consequent lack of disclosure around how financing of the supply chain is conducted may reflect the largely ignored literature on integrating SCF with the physical supply chain (Silvestro & Lustrato, 2014). Nonetheless, the lack of communication pertaining to this dimension may mean that shareholders are not as well informed as they may want to be as they will want to know how funds are utilised in the internal supply chain.

The third element of SCD communicates the delivery of value through the logistics and distribution process. As in *Table 7-1*, the most disclosed dimensions comprise environmental practices, which include recycling practices and packaging. On the other side, the least communicated dimensions pertain to warehouse management and the geographic locations of distribution facilities, as well as downstream transport management. Despite the Covid-19 pandemic and other supply chain disruptions emphasising dimensions in the downstream supply chain such as alternative transportation routes (Fisher and Paykel Fisher and Paykel Healthcare, 2020; Renwick, 2023), such information is irrelevant to shareholders and debtholders. Such incremental information, beyond mandatory information already required by law, will unlikely impact shareholders decision-making markedly.

The last element, value capture, communicates the financial performance and value outcomes of the integration of information, material and financing flows. From *Table 7-1*, the most disclosed dimensions are internal supply chain risk dimensions and value dimensions: (i) engagement with stakeholders and (ii) value created for stakeholders. This being said, the least disclosed dimensions are value dimensions communicating the future: (i) future strategic outlook and (ii) future product outlook. This contrast suggests that, while the communication of present value, reflecting the engagement with and value created for shareholders/stakeholders, is comprehensively disclosed, it is not linked to the communication of future value. Despite the communication of present value being informative to shareholders, the absence of the link to future value suggests information used for shareholders' decision-making is limited.

Concluding this subsection, the supply chain dimensions that were most disclosed and least disclosed through SCD can lay a foundation to how informative SCD is to the decision-making of shareholders and debtholders. The lack of resources communicating past performance (i.e. supply chain KPIs) and future value (i.e. future strategic outlook, future product outlook) suggest limited supply chain resources are communicated that are informative to shareholders decision-making. On the other hand, the comprehensiveness of resources communicating value creation through strategic supplier collaboration and circular economic dimensions suggest SCD is informative to debtholders' decision-making. Despite providing primary evidence that SCD may not be informative to shareholders but informative to debtholders, I conduct a regression analysis to investigate whether SCD is informative in influencing the cost of equity and cost of debt.

7.4.2 Descriptive statistics

Prior to conducting a regression analysis on whether SCD is informative in influencing the cost of equity and cost of debt, I outline the descriptive statistics. *Table 7-2* shows the descriptives for the list of dependent, explanatory and control variables used in the empirical model above.

Firstly, I discuss the descriptives for the dependent variables: (i) cost of equity and (ii) cost of debt. *Table 7-2* shows that the cost of equity has a minimum statistic of -2.149% and a maximum statistic of 39.725%. The mean value is 10.492%. As the sample includes the cost of equity of companies for the 2021 period, the maximum statistic of 39% is explainable, as the Covid-19 pandemic has created uncertainties across supply chains and companies which may have prompted investors to increase the required premium on their investment. However, the minimum statistic of -2.149% is surprising as this means that investors are paying the company as opposed to requiring a premium on equity. The standard deviation is sufficient, and the skewness shows a normal distribution.

In regard to the cost of debt, the mean value is low at 2.335% with a maximum of 5.589%. The low cost of debt, on average, could reflect the size of the companies on the FTSE All-Share index, as larger companies will likely be able to repay debt much more easily than smaller companies. Thus, debtors would require a lower return on their debt financing. It is also important to note that the minimum statistic is 0.000% which will likely mean that companies either do not have any debt financing, or the debt is to be repaid without interest. The former is unlikely as the descriptives for book leverage have a minimum statistic of 12.446% meaning that all companies have some debt financing. Hence, some companies may have debt that do not need to be repaid with interest.

The explanatory variable — overall disclosure score (*DSCORE*) — has been previously discussed in the *Chapter Six*. Thus, it will not be discussed further. However, *Table 7-2* has

Table 7-2: *Descriptive Statistics*

						Skewness		Kurtosis	
	N	Mean	Std Dev	Min	Max	Statistic	Std Error	Statistic	Std Error
Cost_of_Equity	160	10.492	5.423	-2.149	39.725	1.653	0.192	5.927	0.381
Cost_of_Debt	160	2.335	1.195	0.000	5.589	0.704	0.192	0.135	0.381
DSCORE(%)	160	54.593	8.707	20.980	73.880	-0.550	0.192	1.157	0.381
Value Proposition DSCORE(%)	160	59.484	14.178	8.696	100.000	-0.661	0.192	1.284	0.381
Value Creation DSCORE(%)	160	47.807	10.648	23.438	74.576	0.304	0.192	-0.246	0.381
Value Delivery DSCORE(%)	160	54.280	11.776	25.000	94.444	0.441	0.192	0.767	0.381
Value Capture DSCORE(%)	160	63.902	11.222	22.222	86.111	-0.902	0.192	1.667	0.381
Mandatory DSCORE(%)	160	82.946	8.465	40.476	97.619	-1.394	0.192	4.290	0.381
Voluntary DSCORE(%)	160	42.355	10.131	12.371	67.045	-0.125	0.192	0.058	0.381
Lev	160	56.106	16.823	12.446	90.234	-0.152	0.192	-0.617	0.381
Float Shares	160	78.800	18.723	25.000	100.000	-1.173	0.192	0.455	0.381
Foreign Ownership	160	10.225	14.039	0.000	62.000	2.047	0.192	4.033	0.381
Board Size	160	8.844	1.941	5.000	13.000	0.495	0.192	-0.383	0.381
Board Independence	160	61.777	14.081	7.690	85.710	-0.858	0.192	1.275	0.381
F_Size	160	21.743	1.655	18.457	25.709	0.642	0.192	-0.212	0.381
ROA	160	8.176	9.411	-11.877	58.003	2.411	0.192	8.810	0.381
Tangibility	160	31.908	20.015	3.530	94.656	0.908	0.192	0.640	0.381
Ln_M2B	160	1.025	0.716	-1.109	2.814	-0.046	0.192	-0.150	0.381
Beta	160	1.037	0.558	-0.319	2.930	0.516	0.192	1.011	0.381
ROE	160	18.314	29.632	-141.330	223.462	1.672	0.192	20.301	0.381
ICR	160	33.568	78.678	-29.000	534.669	4.337	0.192	20.367	0.381

also further categorised the disclosure score into the four different elements of BM reporting. These elements, which comprise the different types of SCD, are (i) value proposition, (ii) value creation, (iii) value delivery and (iv) value capture. The mean score for value proposition is 59.48%, value creation 47.81%, value delivery 54.28% and value capture 63.90%.

Digging more deeply, the mean value of value proposition and value capture is comparatively greater than that of value creation and value delivery. This reflects the greater extent of mandatory disclosures communicating supply chain strategy dimensions (value proposition) and financial performance and risk dimensions (value capture). The low standard deviations reported for the value proposition and value capture variables relative to their means also show the higher average disclosures. This is in alignment with the greater extent of mandatory disclosures. This is also reflective of lower variability in these variables compared to value creation and value delivery. This trend is also seen in the mean value of mandatory disclosure as compared to voluntary disclosure. To further support this trend, mandatory disclosures reveal low variability, reflective of the low standard deviation relative to its mean. This is as compared to voluntary disclosures which reveal a greater standard deviation and a lower mean value suggesting greater variability. Overall, this is expected as mandatory disclosures are expected to be disclosed by the large majority of companies as compared to voluntary disclosures and hence have lower variability.

Moving onto the control variables, many of them have been discussed in *Chapter Five* and *Chapter Six*. They are not discussed further. The new control variables not discussed previously include return on equity (*ROE*) and the interest coverage ratio (*ICR*). The control variables of ROE and ICR show a leptokurtic distribution. Hence, the same logarithmic procedure performed previously is conducted on ROE and ICR. However, the logarithmic procedure for ROE (*Ln_ROE*) and ICR (*Ln_ICR*) reveal a similarly leptokurtic distribution.

Hence, the unchanged control variables of ROE and ICR will be used in the multivariate regression analyses.

7.4.3 Bivariate analysis

This subsection addresses the bivariate analysis which comprises the bivariate correlations and independent sample T-test. *Table 7-3* addresses the correlations between the dependent, explanatory and control variables used in the above empirical model.

Table 7-3 shows some interesting results. It shows a positive correlation between the overall disclosure score and the cost of equity (*0.070, p > 0.10*), which suggests that as the extent of SCD increases, so does the cost of equity. Hence, this does not align with the concept of information asymmetry which notes that, as disclosure increases, cost of equity should decrease (Botosan, 2006). This suggests that the information within the communication of supply chain dimensions might not be of value to shareholders. Despite this, the p-value is not significant. On the other hand, there is a negative correlation between the overall disclosure score and cost of debt of *(-0.157, p = 0.05)*. This latter result makes sense, as when disclosure increases, the cost of debt should decrease. This may suggest that information within the communication of supply chain dimensions might be of value to debtholders.

I also subdivide the overall disclosure score into the four elements of the BM. The correlation for these four variables are not shown in *Table 7-3*. However, it is noted that the overall disclosure score has high correlations with the four elements of the BM: value proposition disclosures (*0.695, p = 0.01*), value creation disclosures (*0.877, p = 0.01*), value delivery disclosures (*0.381, p = 0.01*) and value capture disclosures (*0.784, p = 0.01*). To prevent endogeneity concerns, these variables will not be regressed in the same empirical

Table 7-3: *Bivariate Correlations*

	Cost of Equity:	*Cost of Debt:*	*DSCORE*	*Lev:*	*Float Shares*	*Foreign Ownership*	*Board Size*	*Board Independence*	*F_Size*	*ROA:*	*Tangibility:*	*Ln_MTB:*	*Beta*	*ROE:*	*ICR:*
Cost of Equity:	*1.00*														
Cost of Debt:	*0.318***	*1.00*													
DSCORE(%):	*0.070*	*-0.157**	*1.00*												
Lev:	*0.147*	*0.331***	*-0.194**	*1.00*											
Float Shares	*-0.179**	*-0.255***	*-0.013*	*0.057*	*1.00*										
Foreign Ownership	*0.127*	*0.330***	*0.165**	*0.091*	*-0.517***	*1.00*									
Board Size	*-0.066*	*-0.089*	*0.374***	*0.033*	*-0.037*	*0.241***	*1.00*								
Board Independence	*0.021*	*-0.145*	*0.195**	*0.050*	*0.415***	*-0.183**	*0.187**	*1.00*							
F_Size:	*0.067*	*0.018*	*0.402***	*0.214***	*0.075*	*0.221***	*0.655***	*0.410***	*1.00*						
ROA:	*-0.089*	*-0.240***	*-0.047*	*-0.353***	*-0.061*	*0.118*	*-0.049*	*-0.080*	*-0.124*	*1.00*					
Tangibility:	*0.204***	*0.146*	*-0.118*	*0.042*	*-0.354***	*0.101*	*-0.070*	*-0.073*	*0.022*	*0.018*	*1.00*				
Ln_M2B:	*-0.117*	*-0.130*	*-0.068*	*0.111*	*0.138*	*-0.169**	*-0.005*	*-0.033*	*-0.254***	*0.325***	*-0.169**	*1.00*			
Beta	*0.871***	*0.281***	*0.103*	*0.143*	*-0.097*	*0.170**	*-0.047*	*0.038*	*0.116*	*-0.134*	*0.202**	*-0.231***	*1.00*		
ROE:	*-0.051*	*-0.124*	*0.058*	*0.034*	*-0.130*	*0.226***	*0.057*	*-0.045*	*-0.007*	*0.698***	*-0.064*	*0.313***	*-0.137*	*1.00*	
ICR:	*-0.085*	*-0.294***	*-0.123*	*-0.484***	*-0.067*	*-0.071*	*-0.096*	*-0.190**	*-0.203***	*0.562***	*-0.005*	*0.168**	*-0.074*	*0.192**	*1.00*

**, ** Significant at 0.05 level and 0.01 levels, respectively*

model. I also subdivide the overall disclosure score into mandatory disclosures and voluntary disclosures. The overall disclosure score has significant correlations with both mandatory disclosures (*0.748, p = 0.01*) and voluntary disclosures (*0.959, p = 0.01*). These are not shown either in *Table 7-3*. The remaining 11 rows in *Table 7-3* present the correlations for the control variables.

In addressing the endogeneity concerns of the empirical model, the bivariate relationships show no significant multicollinearity issues. Concerns around omitted variable bias are also reduced by controlling for a number of variables including leverage, the number of shares publicly floated, foreign ownership, board characteristics, firm size, profitability, market-to-book ratio, beta and the interest coverage ratio. These variables are, as appropriate, controlled for across both models.

However, there remain endogeneity concerns around the issue of reverse causality. It is well known from previous literature that, while disclosure affects the cost of equity and cost of debt, the reverse is also apparent (Eliwa et al., 2021; Eugster, 2020). The cost of equity and cost of debt reflect the premium on firm equity and firm debt, and in an attempt to reduce this premium, the firm may reduce information asymmetry by disclosing more information. Hence, reverse causality is a very pertinent issue. While this may not be as critical in SCD due to the factors against such disclosure, I account for reverse causality by examining the effect of supply chain messages identified in *Section 6.4.1 (A)* on the cost of debt and cost of equity. This is because supply chain messages, which are based on supply chain keywords, are a consequence of annual report preparation and have no effect from the cost of equity and cost of debt.

After examining the bivariate correlations between the variables, I perform further bivariate analysis in the form of an independent sample T-test. As mentioned previously in *Section 3.2.5,* numerous internal and external risks and uncertainties affect the supply chain.

Christopher et al. (2011) note that internal supply chain risks include (i) supply risks, (ii) production/manufacturing risks and (iii) demand risks, all of which have been affected by the Covid-19 pandemic. As a result of the effects of the pandemic on these risks, there have been supply chain disruptions. Previous studies have noted that such supply chain disruptions have a negative effect on stock price performance and shareholder value (Hendricks & Singhal, 2005b, 2008). Hence, shareholders and debtholders may want to be compensated for the risks and uncertainties that the pandemic brought on companies and their supply chains. *Table 7-4* shows the findings of the independent samples t-test performed on the cost of equity and cost of debt, respectively.

The findings in *Table 7-4* show that the variance (standard deviation) between the pre-and post-pandemic periods is approximately equal for both the cost of equity and cost of debt. The main results of the test show that there is no significant difference in the pre- and post-pandemic samples for the cost of equity. This is surprising due to the effects of the Covid-19 pandemic on company risk. Despite this insignificant difference, the cost of equity has increased from pre-pandemic levels by 1.28%. This might well be because of the increased supply chain disruptions that the Covid-19 pandemic has caused, which have subsequently led to increased company risk. This argument is founded upon the finding that beta has increased from 0.93 during the pre-pandemic period to 1.14 during the post-pandemic period. The means are significantly different for beta to the 5% significance level. Addressing the cost of debt, *Table 7-4* notes that there is a significant difference in the means prior to the pandemic, compared to after the pandemic. The finding is significant to the 1% level. However, the cost of debt has decreased by 0.64%, which does not reflect the increased company risk resulting from the Covid-19 pandemic.

Table 7-4: *Cost-of-Equity and Cost-of-Debt - Pre- and Post-Covid*

		Means		Levene's Test for Equality of Variances		Significance	
		Pre-Covid (%)	Post-Covid (%)	F	Sig.	One-Sided p	Two-Sided p
Cost_of_Equity	Equal variances assumed	9.853	11.131	3.488	0.064	0.068	0.137
Cost_of_Debt	Equal variances assumed	2.656	2.014	0.011	0.917	0.000	0.001

7.4.4 Main regression

A. SCD and the Cost-of-Equity

After conducting a t-test on the cost of equity and cost of debt respectively, the main multivariate analysis was conducted. *Table 7-5* shows the findings of the effect of SCD on the cost of equity. This pertains to *Empirical Model V* above. *Model A* shows the regression coefficients of the main disclosure score (*DSCORE*) with the inclusion of control variables, industry-fixed effects and the post-Covid dummy variable. *Model B* subsequently examines the relationship between SCD and the cost of equity after the effects of the Covid pandemic. This is done by interacting the four supply chain dimensions with the post-Covid dummy variable. This is followed by *Model C* through to *Model F* which regress each value element of the BM against the cost of equity.

The study notes that *Model A* predicts 79.3% of the variation in the cost of equity. *Model B* shows a similar prediction power of 79.5%. In the findings in *Table 7-5, Model A* reveals a positive and non-significant relationship with the cost of equity *($\beta = 0.010$, $p > 0.10$)*. *Model B* reveals a similar non-significant relationship when the interaction term of SCD and the post-Covid dummy variable is regressed *($\beta = 0.038$, $p > 0.10$).* In all of these models, the VIFs are mostly within the range of 1 to 3. As such, it is unlikely that multicollinearity will affect the results.

Overall, it suggests that the communication of supply chain dimensions through SCD does not assist investors in their decision-making. Specifically, the external communication of SCDs does not help in reducing information asymmetry for investors. In fact, the positive (albeit insignificant) relationship suggests that SCD may increase the cost of equity. This finding is in contrast with previous literature in regard to the consequences of accounting disclosure, which mainly find a significant negative association due to the reduction in information asymmetry (Botosan, 2006). *As such, the hypothesis, H_3 is not supported*. In

Table 7-5: *Supply Chain Disclosure and the Cost of Equity*

	Model A (Cost_of_Equity):	***Model B (Cost_of_Equity):***	***Model C (Cost_of_Equity):***	***Model D (Cost_of_Equity):***	***Model E (Cost_of_Equity):***	***Model G (Cost_of_Equity):***
DSCORE(%):	*0.010* *(0.189)*	*0.038* *(0.893)*				
*DSCORE*Post-Covid*		*-0.066* *(-1.209)*				
ValueProposition_DSCORE(%):			*0.052* *(1.147)*			
ValueCreation_DSCORE(%):				*0.014* *(0.262)*		
ValueDelivery_DSCORE(%):					*-0.065* *(-1.651)*	
ValueCapture_DSCORE(%):						*0.016* *(0.314)*
Lev:	*-0.018* *(-0.303)*	*-0.004* *(-0.184)*	*-0.006* *(-0.109)*	*-0.018* *(-0.307)*	*-0.031* *(-0.544)*	*-0.018* *(-0.304)*
Float Shares	*-0.131**** *(-2.650)*	*-0.039**** *(-2.697)*	*-0.138**** *(-2.771)*	*-0.131**** *(-2.633)*	*-0.130**** *(-2.639)*	*-0.131**** *(-2.639)*
Foreign Ownership	*-0.096** *(-1.894)*	*-0.039*** *(-1.992)*	*-0.105*** *(-2.043)*	*-0.094** *(-1.826)*	*-0.088** *(-1.742)*	*-0.098** *(-1.915)*
F_Size	*0.019* *(0.394)*	*0.048* *(0.301)*	*0.012* *(0.260)*	*0.018* *(0.364)*	*0.022* *(0.489)*	*0.018* *(0.374)*
ROA:	*-0.079* *(-1.082)*	*-0.040* *(-0.939)*	*-0.055* *(-0.735)*	*-0.081* *(-1.120)*	*-0.088* *(-1.243)*	*-0.079* *(-1.093)*
MTB:	*0.090** *(1.858)*	*0.597* *(1.608)*	*0.082** *(1.712)*	*0.090** *(1.864)*	*0.098*** *(2.068)*	*0.091** *(1.899)*
Beta	*0.897**** *(20.511)*	*8.565**** *(19.312)*	*0.905**** *(20.595)*	*0.895**** *(20.069)*	*0.903**** *(20.796)*	*0.899**** *(20.425)*
ROE:	*0.094* *(1.478)*	*0.018* *(1.548)*	*0.083* *(1.306)*	*0.094* *(1.482)*	*0.107** *(1.717)*	*0.095* *(1.521)*
Industry_Healthcare:	*0.006* *(0.147)*	*-0.319* *(-0.294)*	*0.010* *(0.230)*	*0.005* *(0.109)*	*0.009* *(0.222)*	*0.008* *(0.192)*

Industry_ConsumerDiscretionary:	*0.065* *(1.226)*	*0.307* *(0.350)*	*0.070* *(1.355)*	*0.067* *(1.241)*	*0.074* *(1.435)*	*0.066* *(1.255)*
Industry_ConsumerStaples:	*-0.012* *(-0.253)*	*-0.688* *(-0.910)*	*0.001* *(0.015)*	*-0.014* *(-0.286)*	*-0.005* *(-0.109)*	*-0.011* *(-0.227)*
Industry_Industrials		*-0.495* *(-0.677)*				
Industry_BasicMaterials	*0.034* *(0.682)*		*0.033* *(0.676)*	*0.032* *(0.631)*	*0.038* *(0.802)*	*0.035* *(0.724)*
Post-Covid	*-0.053* *(-1.253)*	*3.069* *(1.008)*	*-0.057* *(-1.444)*	*-0.052* *(-1.303)*	*-0.039* *(-0.996)*	*-0.056* *(-1.275)*
Observations:	*160*	*160*	*160*	*160*	*160*	*160*
R_Squared:	*0.793*	*0.795*	*0.795*	*0.793*	*0.797*	*0.793*
Adj. R-Squared:	*0.773*	*0.774*	*0.775*	*0.773*	*0.777*	*0.773*
Industry FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Year FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*

, **, * Significant at 0.10 level, 0.05 level and 0.01 levels, respectively*

terms of economic significance, a 1 standard deviation increase in SCD (*8.71%)* increases the cost of equity by 0.087%. This is not of economic significance as a 0.087% increase in the cost of equity is less than 1 standard deviation (5.423). As such, the relationship between SCD and the cost of equity is statistically not significant, and also economically not significant.

Moving to the control variables, the number of shares publicly available and the extent of foreign ownership have a significant negative association with the cost of equity. On the other hand, firm growth (as measured by the market-to-book ratio) and the riskiness of the firm (as measured by beta) have a significantly positive association with the cost of equity. The remaining control variables are not significantly associated with the cost of equity. Among the industry-fixed effects, none of the industries show a significant association. Lastly, it is important to note that the post-Covid sample is not significantly associated with the cost of equity. This confirms the non-significant difference of the cost of equity post-Covid in *Table 7-4*.

As mentioned previously, *Model C* to *Model F* show the regression findings for the different types of SCDs, namely (i) value proposition, (ii) value creation, (iii) value delivery and (iv) value capture. The prediction levels of Model C to Model F range from 79.3% in *Model D* to 79.7% in *Model E*. In all the respective models, there are no significant results. Hence, the communication of supply chain resources pertaining to all value elements of the BM do not help in reducing risk or information asymmetries for shareholders. This may suggest that the disclosure of supply chain information in its entirety is too much information. The control variables reveal similar findings as to *Model A* and *Model B*.

B. SCD and the Cost of Debt

Examining the relationship between SCD and the cost of debt, in addressing the fourth hypothesis, *Table 7-6* shows the findings of the effect of SCD on the cost of debt. This pertains to *Empirical Model VI* above. *Model A* shows the regression coefficients of the main disclosure score (*DSCORE*) with the inclusion of control variables, industry-fixed effects and the post-Covid dummy variable. *Model B* subsequently examines the relationship between SCD and the cost of debt after the effects of the Covid-19 pandemic. This is done by interacting the overall disclosure score with the post-Covid dummy variable. This is followed by *Model C* through to *Model F* which regress each value element of the BM against the cost of debt.

The results show that the explanatory and control variables predict 43.1% (*Model A*) and 46.0% (*Model B*) of the variation in the cost of debt. Further to this, the adjusted R-squared is 38% (*Model A*) and 40.8% (*Model* B). The main findings in *Model A* shows a significantly negative relationship *(β = -0.182, p = < 0.05)* between the overall disclosure score and the cost of debt. This suggests that the communication of supply chain resources is informative in reducing information asymmetry for debtholders. Hence, the hypothesis, H_5, *which hypothesises a negative relationship between SCD, and the cost of debt is supported.* In terms of economic significance, a 1 standard deviation increase in SCD (*8.71%*), manages to decrease the cost of debt by 1.59%. This is of economic significance as a 1.59% decrease in the cost of debt is more than 1 standard deviation (1.195). As such, the relationship between SCD and the cost of debt is statistically and economically significant.

A reason for this is the use of debt financing in the operations of the supply chain. This is more specifically the case for short-term debt financing amid the rise in short-term SCF and the use of trade credit, prepayments and reverse factoring (Banerjee et al., 2004; Gelosmino et al., 2016; Liebl et al., 2016). This in turn suggests that debtholders will be

Table 7-6: *Supply Chain Disclosure and the Cost of Debt*

	Model A (Cost_of_Debt)):	***Model B (Cost_of_Debt):***	***Model C (Cost_of_Debt):***	***Model D (Cost_of_Debt):***	***Model E (Cost_of_Debt):***	***Model F (Cost_of_Debt):***
DSCORE(%)	*-0.182***	*0.000*				
	(-2.029)	*(-0.016)*				
*DSCORE*Post-Covid*		*-0.053****				
		(-2.816)				
ValueProposition_DSCORE(%)			*-0.037*			
			(-0.511)			
ValueCreation_DSCORE(%)				*-0.220***		
				(-2.480)		
ValueDelivery_DSCORE(%)					*-0.091*	
					(-1.393)	
ValueCapture_DSCORE(%)						*-0.041*
						(-0.475)
Lev	*0.186***	*0.014***	*0.218***	*0.186***	*0.210***	*0.209***
	(2.198)	*(2.427)*	*(2.588)*	*(2.222)*	*(2.508)*	*(2.416)*
Board Size	*-0.005*	*-0.001*	*-0.014*	*-0.017*	*-0.017*	*-0.010*
	(-0.058)	*(-0.024)*	*(-0.153)*	*(-0.195)*	*(-0.188)*	*(-0.109)*
Board Independence	*-0.107*	*-0.010*	*-0.100*	*-0.105*	*-0.108*	*-0.100*
	(-1.375)	*(-1.506)*	*(-1.271)*	*(-1.358)*	*(-1.380)*	*(-1.265)*
F_Size	*-0.052*	*-0.042*	*-0.096*	*-0.035*	*-0.100*	*-0.093*
	(-0.490)	*(-0.558)*	*(-0.913)*	*(-0.334)*	*(-0.970)*	*(-0.886)*
Tangibility	*-0.003*	*-0.001*	*0.022*	*-0.011*	*0.016*	*0.027*
	(-0.041)	*(-0.284)*	*(0.312)*	*(-0.148)*	*(0.225)*	*(0.385)*
Beta	*0.308****	*0.533****	*0.298****	*0.330****	*0.307****	*0.300****
	(4.397)	*(3.478)*	*(4.169)*	*(4.684)*	*(4.355)*	*(4.228)*
ICR	*-0.246****	*-0.003****	*-0.229****	*-0.231****	*-0.231****	*-0.236****
	(-3.214)	*(-2.951)*	*(-2.971)*	*(-3.064)*	*(-3.026)*	*(-2.976)*
Industry_Healthcare	*0.207****	*-0.171*	*0.199****	*0.225****	*0.204****	*0.196****
	(2.999)	*(-0.447)*	*(2.853)*	*(3.253)*	*(2.937)*	*(2.790)*
Industry_ConsumerDiscretionary	*0.057*	*-1.006****	*0.087*	*0.044*	*0.112*	*0.089*
	(0.653)	*(-3.293)*	*(0.998)*	*(0.509)*	*(1.300)*	*(1.020)*

Industry_ConsumerStaples	*0.093* *(1.104)*	*-0.924**** *(-3.291)*	*0.087* *(0.992)*	*0.115* *(1.372)*	*0.105* *(1.241)*	*0.097* *(1.137)*
Industry_Industrials		*-1.158**** *(-4.371)*				
Industry_BasicMaterials	*0.347**** *(4.139)*		*0.298**** *(3.675)*	*0.369**** *(4.355)*	*0.305**** *(3.779)*	*0.299**** *(3.673)*
Post-Covid	*-0.272**** *(-3.805)*	*-0.053*** *(-2.816)*	*-0.322**** *(-4.739)*	*-0.289**** *(-4.282)*	*-0.311**** *(-4.604)*	*-0.313**** *(-4.225)*
Observations	*160*	*160*	*160*	*160*	*160*	*160*
R_Squared	*0.431*	*0.460*	*0.416*	*0.439*	*0.423*	*0.416*
Adj. R-Squared	*0.380*	*0.408*	*0.364*	*0.389*	*0.371*	*0.364*
Industry FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Year FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*

, **, * Significant at 0.10 level, 0.05 level and 0.01 levels, respectively*

interested in the operations of the supply chain and that such information disclosures will have the ability to reduce the cost of debt.

The findings in *Model B*, during the post-Covid period, show a similar negative and significant relationship between SCD and the cost of debt *(β = -0.053, p = < 0.01)*. This relationship is stronger at the 1% level. This may suggest that the effects of the Covid-19 pandemic increased the reliance of short-term debt financing to maintain supply chain operations. Liebl et al. (2016) showed that SCF tools such as reverse factoring came into greater prominence after the GFC of 2007/08. In turn, combined with the increased risks of the pandemic, creditors' reliance on publicly-disclosed supply chain information increased in decision-making.

Addressing the control variables, leverage and beta both have a significant positive relationship with the cost of debt in both *Model A* and *Model B*. This is expected as book leverage and beta both increase the riskiness of the firm and thereby increase information asymmetry. On the other hand, ICR has a negative and significant relationship with the cost of debt. This suggests that, as the ability to cover interest payments improves, the premium required by debtholders reduces, which is expected. Overall, the relationships between these control variables and the cost of debt is supported by previous studies (Eliwa et al., 2021; Gerwanski, 2020; Raimo et al., 2021). Looking at the industry-fixed effects, only companies in the healthcare industry and basic materials industry have significantly positive coefficients with the cost of debt. This is likely due to the complexities of the structure of the supply chain in these industries, as reported in *Chapter Six*. As for the post-Covid dummy variable, it is also negatively significant suggesting that the post-Covid sample is significantly different from the pre-Covid sample in relation to the cost of debt. This reinforces the findings of the t-test in *Table 7-4* which shows a significant difference in the two subsamples.

Model C through to *Model F* show negative relationships between (i) value proposition SCDs, (ii) value creation SCDs, (iii) value delivery SCDs and (iv) value capture SCDs and the cost of debt. However, only the coefficient between the communication of value creation disclosures (*-0.220, $p < 0.05$*) and the cost of debt is significant. In regard to economic significance, a 1 standard deviation increase in value creation (*10.648%*) will decrease the cost of debt by 2.34%. This is more than 1 standard deviation in the cost of debt (*1.195%*). This shows that the significance of SCD in reducing the cost of debt is owing to the communication of value creation disclosures, as the result between value creation disclosures and SCD is both statistically and economically significant.

Lastly, as for the control variables, industry-fixed effects and the post-Covid dummy variable, the coefficients are the same as when the overall disclosure score was regressed against the cost of debt.

7.4.5 Additional analysis

The previous section found that the relationship between SCD and the cost of equity was not significant either statistically or economically. This was the case, whereas the relationship between SCD and the cost of debt was both statistically and economically significant. This section conducts additional analysis to investigate whether, individually, mandatory and voluntary disclosures have an effect on the two measures of the cost of equity and cost of debt.

This is similar to Cheung et al. (2010) who divide their transparency disclosure index into mandatory and voluntary disclosures in examining the effect on market valuation. As such, I subdivide the SCD index, illustrated throughout *Chapter Six,* into mandatory (M) disclosures and voluntary (V) disclosures. These mandatory and voluntary disclosure items are illustrated in the disclosure index in *Table 6-1* through to *Table 6-5*. The mandatory

disclosures mainly consist of financial disclosures, alongside recently legislated disclosures such as those of business model disclosures (Simoni et al., 2022) and modern slavery disclosures (Christ et al., 2018). Such disclosures are mandatory across all companies and will likely not affect the cost of equity and cost of debt. On the other hand, voluntary disclosures consist of mostly operational and location-type supply chain disclosures, and environmental and social supply chain disclosures. Such disclosures will exhibit variation and, therefore, should affect the cost of equity and cost of debt.

Table 7-7 shows the findings of the relationship between (i) mandatory and (ii) voluntary disclosures on the cost of equity. Despite the inclusion of both mandatory and voluntary disclosures in the same regressions, the VIFs are below 3, indicating that the results are not heavily affected by multicollinearity concerns. *Model A* shows that the effect of mandatory ($\beta = -0.027, p > 0.05$), as well as voluntary disclosures ($\beta = 0.023, p > 0.05$), on the cost of equity are not significant. The results when mandatory disclosures and voluntary disclosures are regressed separately, although not shown, remain the same. This suggests that the disclosure of voluntary supply chain resources leads to the lack of informative disclosures for shareholders. Moreover, this disclosure of voluntary information may be the cause of too much information being disclosed, as a result crowding out the useful information used in shareholders' decision-making. Among the control variables, the number of shares publicly floated, the extent of foreign ownership, the market-to-book ratio and beta remain significantly associated with the cost of equity. Similarly, in *Model B*, the findings show no significant impact for mandatory and voluntary disclosures when interacted with the post-Covid dummy variable, and the cost of equity.

Table 7-8 shows the findings of the relationship between mandatory and voluntary disclosures on the cost of debt. *Model A* shows that, similarly to the cost of equity, the effect of mandatory disclosures ($\beta = 0.000, p > 0.05$) on the cost of debt is not significant and does

Table 7-7: *Mandatory & Voluntary Disclosure and the Cost of Equity*

	Model A (Cost_of_Equity):	***Model B (Cost_of_Equity):***
Mandatory_DSCORE:	*-0.027* *(-0.520)*	*0.033* *(0.716)*
*Mandatory_DSCORE*Post-Covid*		*-0.094* *(-1.573)*
Voluntary_DSCORE:	*0.023* *(0.405)*	*0.009* *(0.237)*
*Voluntary_DSCORE*Post-Covid*		*0.003* *(0.055)*
Lev:	*-0.019* *(-0.307)*	*-0.004* *(-0.214)*
Float Shares	*-0.134**** *(-2.687)*	*-0.040**** *(-2.769)*
Foreign Ownership	*-0.095** *(-1.852)*	*-0.038** *(-1.944)*
F_Size	*0.021* *(0.432)*	*0.054* *(0.336)*
ROA:	*-0.081* *(-1.098)*	*-0.045* *(-1.055)*
MTB:	*0.087** *(1.783)*	*0.593* *(1.590)*
Beta	*0.893**** *(20.043)*	*8.517**** *(19.014)*
ROE:	*0.094* *(1.469)*	*0.019* *(1.592)*
Industry_Healthcare:	*-0.002* *(-0.041)*	*-0.497* *(-0.445)*
Industry_ConsumerDiscretionary:	*0.056* *(1.016)*	*0.200* *(0.229)*
Industry_ConsumerStaples:	*-0.016* *(-0.317)*	*-0.710* *(-0.945)*
Industry_Industrials		*-0.454* *(-0.623)*
Industry_BasicMaterials	*0.034* *(0.675)*	
Post-Covid	*-0.051* *(-1.184)*	*7.151* *(1.639)*
Observations:	*160*	*160*
R_Squared:	*0.794*	*0.798*
Adj. R-Squared:	*0.772*	*0.774*
Industry FE	*Yes*	*Yes*
Year FE	*Yes*	*Yes*

, **, * Significant at 0.10 level, 0.05 level and 0.01 levels, respectively*

not indicate any relationship. However, *Model A* shows that the relationship between voluntary disclosures and the cost of debt is negative and significant ($\beta = -0.185, p < 0.05$). This reinforces the notion that, due to greater short-term debt financing in supply chain operations, creditors find the disclosure of supply chain operations, as well as environmental and social resources to be useful in decision-making. Furthermore, a one standard deviation increase in voluntary disclosure (10.131%) decreases the cost of debt by 1.87%. This is economically significant, given it is more than one standard deviation of the cost of debt. Lastly, similarly to *Table 7-6*, beta has a significantly positive association. Addressing the other control variables, book leverage and ICR have a significantly positive and negative effect on the cost of debt, respectively.

Moving onto *Model B*, the story is the same with the interaction between voluntary disclosures and the post-Covid dummy variable having a significant negative relationship with the cost of debt. This supports the theory that, with the increased use of SCF tools post supply chain disruptions, creditors found information on supply chain operations even more useful.

Apart from conducting additional analyses on the effect of mandatory and voluntary disclosures on the cost of debt and cost of equity, I conduct further tests. Previously, in *Section 6.4.1 (A),* two sets of factor analyses were conducted on the frequency of SCM keywords in 2018 and 2021. The purpose of this was to investigate the supply chain resources that were disclosed together to communicate a message. The findings found five factors in the pre-pandemic period and four factors in the post-pandemic period. Additional regression analyses were conducted on the effect of these (i) five factors pre-Covid and (ii) four factors post-Covid, against the cost of equity and cost of debt. For brevity, the results are not shown.

Table 7-8: *Mandatory & Voluntary Disclosure and the Cost of Debt*

	Model A (Cost_of_Debt):	***Model B (Cost_of_Debt):***
Mandatory_DSCORE:	*0.000* *(0.003)*	*-0.004* *(-0.244)*
*Mandatory_DSCORE * Post-Covid*		*0.009* *(0.438)*
Voluntary_DSCORE:	*-0.185*** *(-1.989)*	*0.003* *(0.213)*
*Voluntary_DSCORE * Post-Covid*		*-0.053**** *(-2.846)*
Lev:	*0.187*** *(2.197)*	*0.014*** *(2.317)*
Board Size	*-0.014* *(-0.153)*	*-0.006* *(-0.112)*
Board Independence	*-0.112* *(-1.427)*	*-0.009* *(-1.398)*
F_Size:	*-0.042* *(-0.395)*	*-0.038* *(-0.506)*
Tangibility:	*-0.004* *(-0.062)*	*-0.001* *(-0.300)*
Beta	*0.312**** *(4.430)*	*0.557**** *(3.632)*
ICR:	*-0.240**** *(-3.133)*	*-0.003**** *(-2.934)*
Industry_Healthcare:	*0.223**** *(3.060)*	*-0.058* *(-0.146)*
Industry_ConsumerDiscretionary:	*0.068* *(0.771)*	*-0.935**** *(-3.087)*
Industry_ConsumerStaples:	*0.094* *(1.113)*	*-0.901**** *(-3.244)*
Industry_Industrials		*-1.164**** *(-4.424)*
Industry_BasicMaterials	*0.343**** *(4.124)*	
Post-Covid	*-0.265**** *(-3.666)*	
Observations:	*160*	*160*
R_Squared:	*0.433*	*0.468*
Adj. R-Squared:	*0.378*	*0.408*
Industry FE	*Yes*	*Yes*
Year FE	*Yes*	*Yes*

, **, * Significant at 0.10 level, 0.05 level and 0.01 levels, respectively*

Firstly, the findings of the effect of the five factors identified prior to the pandemic against the cost of equity are mentioned. The findings show that none of the five factors have a significant association with the cost of equity. This further supports the notion that there is a lack of relevant information in the 2018 annual reports, concerning the supply chain, that is useful to shareholders' decision-making. The same consensus is found when the four factors identified in the post-pandemic period are regressed against the cost of equity. None of the four factors have significant coefficients with the cost of equity. This further shows that the difference in emphasis in communicating supply chain messages in the post-Covid period had no significant effect on shareholders' decision-making.

Secondly, the findings on the effect of these factors identified against the cost of debt is mentioned. The findings show that three of the five factors identified pre-Covid had an effect on the cost of debt. The second factor focussing on the communication of technical/ operational resources in the supply chain and SCM was significant and negative to the 1%. This shows that creditors find information on the technical and operational aspects of the supply chain useful. This further confirms that creditors find such information useful because supply chain operations are predominantly financed using short-term debt (Banerjee et al., 2004; Gelosmino et al., 2016).

Further to this, the fourth most frequently occurring factor, communicating the environmental and circular economic resources of the supply chain, was also significantly negative to the 1% level. This may suggest that creditors are also concerned with the environmental reputation and sustainability of the supply chain. This confirms the findings of Fernández-Cuesta et al. (2019) and Caragnano et al. (2020). They studied the effect of environmental SCDs in the context of greenhouse gas (GHG) emissions, in which both studies reported a positive relationship between GHG emissions and debt financing. As such communication of environmental and circular economic resources will affect debt financing.

On the other hand, the communication of downstream logistical resources focussing on recycling has a significantly positive association with the cost of debt. This shows that creditors do not find information on the reverse logistics as useful in making decisions. Such information will lack relevance to the types of decisions that creditors make, focussing on loan contracts.

Lastly, I regress the four factors identified in the post-Covid period against the cost of debt. The findings show that discussions concerning upstream supply chain resources, as well as communication of supply chain resources that promote sustainability and the circular economy, have significantly negative associations with the cost of debt. These are the two most frequently occurring factors. Similarly to the pre-Covid period, the findings show that supply chain messages concerning the operational supply chain, and the sustainability of the supply chain are meeting the needs of creditors. This aligns with the explanation provided above on the supply chain messages in the pre-pandemic period. On the other hand, and similarly to the pre-Covid (2018) findings, communicated resources on the downstream supply chain have a significantly positive association with the cost of debt. This shows that such information lacks relevance to the decision-making of creditors. This is surprising because as (Campello & Gao, 2017) mention the downstream supply chain (i.e., customer concentration) affect loan contract terms.

7.4.6 Summary

To sum the findings up, the communication of supply chain resources and dimensions through SCD is not effective in reducing risk and information asymmetries for shareholders but is effective towards debtholders' decision-making. The non-significant relationship between SCD and the cost of equity is interesting given that previous studies have reported importance of disclosure in reducing information asymmetries for shareholders, thereby

facilitating decision-making. However, the finding is likely due to the lack of relevant disclosures.

On the other hand, the findings show that debtholders find the disclosure of supply chain information, particularly value creation SCDs, as useful in reducing risks and information asymmetries, facilitating debtholders' decision-making. Further insights provide evidence that this is due to the voluntary communication of how value is created through the (i) sourcing and procurement and (ii) production processes. The finding is also significant for companies in the (i) healthcare and (ii) basic materials industries, which, as reported in *Chapter Six,* have more complex supply chain structures. Additional analyses also reported that information communicating supply chain operations and environmental, sustainability and circular economic dimensions are relevant to creditors' decision-making.

7.5 Discussion

This chapter discusses the findings of the effect of SCD on the cost of equity and cost of debt. *Chapter Six* mentioned that SCD is the external communication of supply chain resources used to create, deliver and capture value in the company's BM. Hence, in this chapter, I sought to understand whether the communication of such supply chain resources/ dimensions were relevant to reducing information asymmetry between the company and its (i) shareholders and (ii) debtholders.

7.5.1 Cost of equity

Firstly, I examined whether the communication of supply chain resources, through SCD, affected the information asymmetry of shareholders. This was examined by investigating the effect of SCD on the cost of equity. Previous literature noted that different

disclosure content, such as accounting disclosure, ESG disclosure, GHG disclosure and integrated reporting disclosure, reported negative relationships, thereby reducing information asymmetry and cost of equity (Botosan, 1997; Bui et al., 2020; Dhaliwal et al., 2011; Vitolla et al., 2020). This study predicted the same negative relationship because SCD comprises the communication of accounting dimensions, environmental and social dimensions, and GHG dimensions, in addition to supply chain dimensions. However, a positive relationship was found, albeit not significant.

In discussing the findings of the relationship between SCD and the cost of equity, this could be for several reasons. Firstly, the communication of supply chain dimensions through the annual report could overload the annual report with too much information, so that the sea of information could crowd out the relevant information. In Athanasakou et al. (2020), they reported a U-shaped relationship owing the positive relationship to the disclosure of too much information. This supports the argument made by interviewees that the extent of SCD depends on the materiality and value-relevance of information. As Interviewee #7 quotes, *"I mean the bottom line if they are delivering growth and a good return year after year, quarter after quarter that is important."* As such, the financials are the most important factors to the decision-making of shareholders, and the communication of other supply chain-relevant resources and dimensions may not be.

Alternatively, as opposed to too much information, it is likely that there is a lack of SCDs. As mentioned in *Chapter Six*, there was a lack of disclosures around supply chain KPIs and around the impact of the supply chain on future strategic and product outlook. Firstly, much like financial and environmental KPIs that communicate past financial and environmental performance, supply chain KPIs communicate the efficiency and effectiveness of the supply chain in meeting customer needs. A lack of such information will limit the links between the supply chain and past performance. Secondly, strategic and future outlook

communicates the effect of past and present performance on the future. The lack of such information will limit the links between the supply chain in driving future performance.

This is especially concerning given the effects of the Covid-19 pandemic and other supply chain disruptions on the supply chain in affecting future performance. Moss Adams (2020a) note that, with the effects of the pandemic, going concern disclosures have increased in importance. That being so, disclosures concerning the supply chain and the impact on the company's strategic outlook and future outlook have become more important in evaluating the risk and going concerns of the company. The lack of such disclosures means that shareholders will not find supply chain information useful in decision-making. Furthermore, the lack of supply chain KPIs as well means there is a disconnect between the integration of past, present and future supply chain performance and the effect on company performance.

This leads the discussion onto the integration of supply chain information with company disclosures. *Chapter Four* mentioned the importance of integrating supply chain practices and resources. Interviewee #2 further mentioned that the supply chain does not operate in silos, but rather in a continuous process. Given this, supply chain information on resources must be well integrated into how it will affect company performance. In the context of the study, it was previously reported that environmental disclosures increased significantly from the 2018 to 2021 annual reports. This was most notable in the increase in keywords and disclosures relating to circular economic activities and resources. However, such disclosures were mostly communicated as standalone and not linked to performance. To shareholders, disclosures on circular economic resources would not mean much, unless such resources were linked to how it reduced firm risk and enhanced firm performance. I conclude that the communication of supply chain resources through SCD is not sufficient. It has to be tightly integrated in how such resources affect firm competitive advantage and firm performance.

This subsequent integration of past, present and future supply chain performance, and integration of supply chain resources with company performance, supports the transition of financial reporting towards integrated reporting. Further to this, such integration will likely be more useful to shareholders given that previous studies have found negative relationships between integrated reporting and SCD (Isabel-Maria & Ligia, 2017; Vitolla et al., 2020).

Another reason is very likely to be because there are numerous other sources of information where information on supply chain dimensions is provided such as sustainability reports, company websites and the directors' reports. As Bayne et al. (2022) mentioned, users found value in triangulating different sources of supply chain information through management discussions, media, and NGOs, as well as annual reports and sustainability reports. Hence, only looking at SCDs in the annual report may not be a good indicator of the relevance of supply chain information. Linked to this is the fact that shareholders may view SCDs in the annual report as biased towards the company. As the supply chain is a competitive advantage tool, the company may only provide supply chain information that is favourable. As such, they rely on other sources of information to provide a more balanced opinion. This explanation, therefore, provides a limitation to solely investigating SCDs in annual reports.

Moreover, the supply chain is very dynamic in nature. However, the annual report provides information on the supply chain at a static point in time, once a year. Within this period, a lot can change in the dynamics of the supply chain. Hence, the annual report may not provide as timely information on the supply chain as other sources, such as directors' reports. To make matters worse, the increasing frequency and magnitude of supply chain disruptions further heighten the dynamic nature of the supply chain. By the time the annual report provides supply chain information, the information might be outdated and not as relevant to shareholders. This will limit the impact of SCD in reducing information

asymmetries, and in turn provides support for growing research on continuous disclosure (Russell, 2015).

In conclusion, it is plausible that the non-significant relationship between SCD and the cost of equity is owing to a combination of all these reasons. This is because the non-significant relationship is uniform across all four value elements of the BM, mandatory and voluntary disclosures.

7.5.2 Cost of debt

Secondly, I examined whether the communication of supply chain resources, through SCD, affected the information asymmetry of debtholders. This was examined by investigating the effect of SCD on the cost of debt. Similarly to the cost of equity, previous literature noted that different disclosure content such as accounting disclosure, ESG disclosure, GHG disclosure and integrated reporting disclosure reported negative relationships (Botosan, 2006; Eliwa et al., 2021; Jung et al., 2018; Raimo et al., 2021). Given this, I hypothesised a negative relationship between SCD and the cost of debt.

The reported findings of this study showed a negative, and significant relationship between SCD and the cost of debt. Hence, the finding suggests that unlike against the cost of equity, the communication of resources and dimensions of the supply chain is value-relevant to debtholders' decision-making. Further to this, it is pinpointed that such resources that are value-relevant are made voluntarily and communicate resources of the (i) sourcing and procurement, and (ii) production processes To add to this significant result, the main regression finding, and additional findings are economically significant.

The main reason debtholders may find supply chain information useful is that supply chain operations are mainly financed using short-term debt financing (Banerjee et al., 2004; Gelosmino et al., 2016). This reasoning is supported by the finding that supply chain

messages communicating the technical and operational aspects of the supply chain are relevant in reducing the cost of debt.

A second reason is likely that creditors find supply chain information useful in structuring loan contract terms and debt covenants (Bradley & Roberts, 2015). As Campello and Gao (2017) noted, dimensions of the supply chain such as customer concentration are useful in structuring loan contract terms and debt covenants. As such, the ability of the company to create value through the (i) sourcing and procurement process and (ii) production process will provide useful information on the resources used to create value. Moreover, it is found that supply chain messages communicating environmental and circularity dimensions are also relevant in reducing the cost of debt. Thus, information on value creation resources, and environmental and circularity resources are beneficial in evaluating the sustainability of the firm's value creation activities. This will be useful in evaluating whether the company can repay debt.

However, while the findings show that SCD reduces the cost of debt, several studies have shown that it may not promote increased short-term debt financing through (i) SCF and/or (ii) bank loans. Wang et al. (2023) find that reduced supply chain transparency facilitates financing using trade credit. This is because disclosure of supplier practices can jeopardise relationships with suppliers and endanger financing from such suppliers. In support of this, Shi et al. (2024) noted that increased supply chain transparency inhibits SCF but promotes financing through bank loans. That being said, both studies measured supply chain transparency in the context of disclosing supplier lists. These studies provide further support for the finding that SCD reduces the cost of debt and encourages short-term debt financing such as bank loans. However, short-term debt financing through SCF depends on the extent of SCD and whether such disclosure exposes suppliers.

In concluding this chapter, it is revealed the communication of supply chain resources through SCD is not of value-relevance to shareholders but assists in reducing information asymmetry for debtholders. The former result is likely because of a combination of factors. These include (i) disclosing too much information, (ii) a lack of SCD on supply chain KPIs and links to future outlook, and (iii) ineffective integration of environmental and circular economic resources. Further to this, this finding may be because of the design of the study. Shareholders may prefer using multiple sources of information to provide balanced information on the supply chain and prefer timely disclosure of supply chain information which annual reports do not provide. The latter result with regard to the cost of debt suggests that creditors find supply chain information useful because short-term debt financing is the primary source of financing for supply chain operations. Alternatively, value creation SCDs are informative of the ability of the company to create value and repay debt, and thereby useful in loan contract terms and debt repayments. Overall, the results show that ***H4*** is not supported while ***H5*** is supported.

Together, the three preceding chapters (*Chapter Five, Chapter Six and Chapter Seven*) have investigated the three separate but interlinked research questions, identified in *Chapter One*. These pertain to investigating the supply chain structural dimensions and the effect on capital structure and SCD, and the subsequent consequences of SCD on information asymmetry. The following chapter (*Chapter Eight*) summarises the thesis, outlining the primary findings, the contribution and research implication of the study, and the limitations of the study and avenues for future research.

Chapter Eight: Conclusion

This final chapter presents the study's conclusions on the overall research problem. It begins by presenting a summary of the research findings. Subsequently, it outlines the contributions of the study, along with implications for the firm, shareholders, creditors and standard setters. The thesis concludes with the limitations of the study and areas for future research.

8.1 Research summary

This thesis documents the nature of financing for the structure of the supply chain, as well as determinants and consequences of SCD. The thesis addresses three interrelated research questions. The first research question addresses the determinants of supply chain dimensions on a company's capital structure. The second research question investigates the determinants of supply chain dimensions on the extent of SCD provided in company annual reports. The third and final research question follows on from the second research question and examines the consequences of SCD on the cost of equity and cost of debt.

The three research questions are very pertinent in the current supply chain environment, given the importance of supply chains in sustaining a company's competitive advantage (Sharifi et al., 2006). This has been emphasised with the effects of the Covid-19 pandemic, geopolitical tensions and climate-related disruptions (Dai et al., 2020; Free & Hecimovic, 2020). These disruptions have shaped the structure and operations of the supply chain and have created many risks, exposed liquidity problems and brought to light the lack of visibility and transparency.

These disruptions have exposed the structure of supply chains, and especially global supply chains (Free & Hecimovic, 2020). The Economist (2020) and Chatterjee et al. (2020) have noted that companies, such as Apple, are considering diversifying the production out of

China as well as moving production regionally. Secondly, Mefford (2009) noted that disruptions such as the GFC have created liquidity problems for companies, and their supply chains. Liebl et al. (2016) noted that late payments were the cause of many supplier bankruptcies. Such problems heightened the need to investigate the effects of supply chain dimensions on capital structure (***RQ1***).

In addition to these problems, Dai et al. (2020) also noted that the Covid-19 pandemic exposed the visibility and transparency of supply chains. In response, Moss Adams (2020b) highlighted the importance of financial reporting and disclosure amidst the pandemic. Subsequently, this problem of a lack of supply chain transparency, combined with the importance of financial reporting, prompted the investigation into the effect of supply chain dimensions on SCD (***RQ2***).

Lastly, the impact of supply chain disruptions affected stock price performance and shareholder value (Hendricks & Singhal, 2005b, 2008). This has been further highlighted through the recent pandemic with the example of Apple, as mentioned above (Wu, 2021). These effects combined with the lack of supply chain transparency have hampered dialogue with shareholders and debtholders regarding the communication of supply chain dimensions. This problem is addressed through the investigation into the effects of SCD on the cost of equity and cost of debt (***RQ3***).

In addressing the three research questions, I first used the RBV in identifying the dimensions of the supply chain that helped in providing the firm a competitive advantage. Using the RBV, the study narrowed down the supply chain as comprising three supply chain flows: (i) material flows, (ii) information flows and (iii) financing flows. The material flows were further narrowed into four processes. They include (i) plan, referred to as supply chain strategy, (ii) source, referred to as the sourcing and procurement process, (iii) make, referred to as the production process and (iv) deliver, referred to as the logistics and distribution

process. Based on the RBV, a supply chain framework was developed identifying the structure, processes and dimensions of the structure of the supply chain. Based on a combination of previous literature and interviews, four dimensions were examined as measures of supply chain structure. These were (i) customer base, (ii) operating portfolio, (iii) environmental dimensions and (iv) social dimensions. These dimensions reflect the dynamic and operational nature of the supply chain

The first research question examined the effect of the four supply chain dimensions, against capital structure. Previous studies noted that the relationship between supply chain dimensions and book leverage was influenced through the channels of complexity and uncertainty. Expanding on the complexity mechanism, supply chain dimensions that increase the complexity of the supply chain are more favourable towards equity financing. This is the same for the uncertainty mechanism: supply chain dimensions that increase the susceptibility of the supply chain to disruptions are more favourable to equity financing. This was found to be the case in the positive and significant relationship between customer base and book leverage. A more localised customer base will result in reduced complexity and reduced uncertainty of supply chain operations.

However, the relationship between (i) operating portfolio, (ii) environmental dimensions and (iii) social dimension on book leverage was not significant. This is because of conflicting arguments between the decrease in complexity of operating portfolio which necessitates debt financing, while the increase in uncertainty of operating portfolio necessitates equity financing. As for the environmental and social dimensions, environmentally and socially responsible firms (and supply chains) enhance their reputation and future cash flows, facilitating debt financing. However, this involves incorporating complex environmental and social practices into the supply chain which facilitates equity financing.

Further to this, previous studies noted the importance of integrating environmental and social dimensions in the flow of materials through the supply chain (Awaysheh & Klassen, 2010; Jr et al., 2012). Thus, I examined the interaction between the flow of materials with (i) environmental dimensions and (ii) social dimensions. I examined the moderating effects of (i) customer base and (ii) operating portfolio on the relationship between (a) environmental dimensions and (b) social dimensions, and book leverage. The study found significant relationship for all four moderation effects. Further studies have also demonstrated the importance of integrating the flow of materials with the flow of financing (Pfohl & Gomm, 2009). As such, the thesis also conducted the moderating effects of (i) asset turnover, (ii) inventory turnover and (iii) CCC on the relationship between (a) customer base and (b) operating portfolio, and book leverage. The findings revealed some evidence of the integration between the flow of materials and flow of financing in affecting book leverage.

Further to this, I also performed robustness tests on an alternative measure of capital structure. This was the proportion of short-term financing to total assets. In line with the main regression analysis, the study found significant results for the association between customer base and short-term financing. The findings of the robustness tests further found that environmental dimensions had a significant positive association with short-term financing. This is unlike the non-significant association between environmental dimensions and book leverage. In addition, operating portfolio showed limited significance to short-term financing.

Overall, the findings provided a few insights. Firstly, the findings showed that the structure of the supply chain is more inclined towards debt financing. This is due to the nature of supply chain activities primarily involving day-to-day activities and being operational in nature. This is the case, with the exception being when the structure of the supply chain becomes more complex. Furthermore, equity financing may be preferred when the supply chain is faced with greater risks and uncertainties. This is either internally from the

supply chain structure or externally from supply chain disruptions, such as the Covid-19 pandemic.

I further add onto the finding that the operational nature of the supply chain necessitates debt financing. Supply chain dimensions, such as customer base and environmental dimensions, necessitate short-term financing, and there's evidence of limited significance that operating portfolio necessitates short-term financing. Combined with the fact that customer base necessitates debt financing, the findings provide some evidence that the operational nature of the supply chain requires short-term debt financing. This is supported by recent research, and the growing importance of SCF (Banerjee et al., 2004; Gelosmino et al., 2016; Gomm, 2010; Liebl et al., 2016).

The second research question examined the effects of the same four supply chain dimensions on SCD. To measure the extent of SCD, an index was developed in the context of the BM and the four value elements that characterise the BM. These were (i) value proposition, (ii) value creation, (iii) value delivery and (iv) value capture. As such, a theoretical framework combining the RBV, and the identification of supply chain dimensions, with the corporate reporting of BMs to communicate these dimensions, was developed. The final index comprised the information communicating these supply chain dimensions as categorised into the four value elements of the BM.

Prior to examining the second research question, exploratory analyses were conducted on the frequency of supply chain-related keywords and on the extent of SCD. The findings revealed an increase in supply chain information reported in company annual reports. This was both in terms of the increase in supply chain-related keywords and the extent of overall SCD. Firstly, I found that, while there was an increase in supply chain-related keywords, the emphasis in reporting changed from pre-Covid to post-Covid. The pre-Covid period was dominated by supply chain messages communicating the environmental and social

consideration behind the sourcing of products. The post-Covid era saw supply chain messages communicating the technical and operational aspects of the supply chain to a greater extent than in the pre-Covid era. This coincided with the effects of the Covid-19 pandemic on the supply chain which resulted in severe disruptions throughout the supply chain. This brought greater awareness to the various flows of the supply chains and the operational side of the supply chain became the focus.

Secondly, I found an increase in the extent of SCD, which measured the communication of information in a supply chain context. What was evident was the significant increase in three of the four elements of BMs, specifically value creation, value delivery and value capture. This was universal across the five industries. Upon further discussion, these trends were explained as likely due to a multitude of factors affecting the external disclosure of supply chain dimensions. External disclosure of the supply chain heavily depends on the internal visibility of the focal company on its upstream and downstream supply chain. Other factors include (i) the role of technology, (ii) the costs of collecting supply chain information, (iii) proprietary information, (iv) signalling, (vi) legitimacy, (vii) greenwashing and (viii) information asymmetry.

Testing these factors that affect the extent of SCD, I found that the supply chain dimensions of (i) customer base, (ii) environmental dimensions and (iii) social dimensions significantly affected SCD. Firstly, a negative association between customer base and SCD was found. This supports the notion that information asymmetry affects SCD. This is because in the first research question a positive association was found between customer base and book leverage. This suggests that with greater debt financing, a less expansive disclosure policy is required (Bertomeu et al., 2011). According to this notion, customer base would be expected to negatively affect SCD.

Secondly, a positive association between environmental dimensions and SCD was found. This suggests that environmental dimensions are disclosed to signal the superiority of the firm's supply chain. In confirming this, additional tests found that environmental dimensions were the main determinant of SCD. This was through the effects on (i) value creation SCDs, (ii) value capture SCDs, (iii) voluntary SCDs, (iv) environmental SCDs and (iv) social SCDs. Thirdly, a negative association between social dimensions and SCD was found. A reason for this is that social dimensions are enhanced through long-term collaborations with suppliers and SCD can threaten these collaborations through the disclosure of socially sensitive information (Egels-Zandén et al., 2015). This suggests that relational costs and long-term collaborations with suppliers affect the extent of SCD.

The third and final research question examined the effect of SCD on the cost of equity and cost of debt. This was to investigate whether the communication of supply chain dimensions through SCD is relevant to shareholders and creditors. Previous studies found that external disclosure of information (e.g. accounting, CSR, greenhouse gas emissions, integrated reporting, etc.) reduced the cost of equity and as such was of value to shareholders' decision-making. However, this was not the case for information communicating supply chain dimensions with there being no significant effect between SCD and the cost of equity. This result was robust when subdividing SCD into the four elements of the BM: (i) value proposition, (ii) value creation, (iii) value delivery and (iv) value capture, and also into mandatory and voluntary disclosure.

Such a result is likely to be the case because of several issues including (i) a lack of supply chain information communicating past performance and future value and (ii) a lack of integration between supply chain information and how it creates value for the company. Moreover, shareholders are likely to triangulate supply chain information from multiple sources, and not only annual reports to inform their decision-making. Further to this, supply

chain information disclosure in annual reports is likely to lack timeliness due to the dynamic nature of the supply chain.

On the other hand, the relationship between SCD and the cost of debt was significant. However, this was only due to the informativeness of supply chain dimensions communicating value creation. This was also supported by the significant association between voluntary disclosures and SCD. A reason for this is likely that supply chain operations are predominantly being financed with short-term debt financing (Banerjee et al., 2004; Liebl et al., 2016). In addition to the literature on SCF, the first research question finds that operational aspects of the supply chain, such as customer base, are financed through debt financing and more specifically short-term debt financing. The second research question also showed primary emphasis on communicating operational and technical aspects of the supply chain in the post-Covid period. Such supply chain messages were very significant in reducing the cost of debt.

A second reason SCD is relevant in reducing the cost of debt is due to creditors' priority on whether the firm is able to repay debt. Firstly, it was found that the communication of value-creating resources is informative to creditors. Given that value -creating resources communicate how the firm creates value through the supply chain through (i) sourcing and procurement and (ii) production, it is likely to help creditors set loan contract terms and debt covenants (Bradley & Roberts, 2015; Campello & Gao, 2017). Further to this, the findings to the second part of the thesis revealed a high emphasis on communicating sustainability and circularity messages in the post-Covid period. Such supply chain messages are likely to communicate the sustainability of the supply chain in the future, in which case such messages are likely to communicate the future viability of the firm. This will further help in creditors' decision-making on whether to provide bank loans and SCF.

The three respective studies examined in this thesis provide an abundance of insightful findings. Given this, there are many contributions and implications of the study, as well as huge scope for future research.

8.2 Contributions

This thesis makes numerous contributions, including theoretical contributions, methodological contributions as well as contributions to previous literature on (i) supply chain structure, (ii) capital structure, (iii) SCD, (iv) cost of equity and (v) cost of debt.

Firstly, this thesis make an important theoretical contribution. Previous studies have used the RBV to identify and explain the resources of the company and its supply chain (Chahal et al., 2020; Rungtusanatham et al., 2003). Further to this, previous studies have linked the supply chain with the corporate reporting of business models (Nielsen & Roslender, 2015; Norris et al., 2021). This shows that the supply chain is a common link between the RBV and BMs. As such, this thesis explicitly combines the RBV with the corporate reporting of BMs. The RBV allows the thesis to identify the resources of the supply chain, while the corporate reporting of BMs allows for the reporting and disclosure of a company's BM, which is inclusive of the extended supply chain. Therefore, the combination of these two theories allows the thesis to explain the communication of supply chain resources through SCD.

Secondly, this thesis makes an important methodological contribution. Previous studies have based the supply chain dimensions which they have examined on preceding studies (Chahal et al., 2020; Kadapakkam & Oliveira, 2021; Kale & Shahrur, 2007). However, in this thesis, I first identified the supply chain dimensions based on interviews and previous literature. This allowed the thesis a practice-oriented exploration of the dimensions of the supply chain and to merge this with previous literature. This provided a more accurate picture

given the quickly changing dynamics of the supply chain and the effects of the Covid-19 pandemic.

Further to the above-mentioned theoretical and methodological contributions, this study contributes to examining the relationship between supply chain structural dimensions and capital structure. There have been numerous studies on the relationship between supply chain dimensions and book leverage (Chu & Wang, 2017; Huang & Kim, 2019; Kadapakkam & Oliveira, 2021; Kale & Shahrur, 2007). However, these studies use theories such as the PAT and the relational view to look at supply chain dimensions, which account for supply chain dimensions within specific networks of the supply chain. These networks include the buyer-supplier relationship. However, the RBV accounts for the supply chain dimensions across the entirety of the supply chain, as opposed to specific networks in the supply chain. In this way, the use of the RBV allowed the thesis to capture multiple dimensions of the supply chain across multiple networks. The identification of multiple dimensions across multiple networks aided in the construction of a supply chain framework, which is a major contribution of this thesis.

Further to this, the development of the supply chain framework allowed the thesis to capture the integration of environmental and social dimensions with the flow of materials, as well as the integration of the flow of materials with the flow of financing. This allowed the thesis to conduct additional tests examining the moderation effects between supply chain dimensions, against book leverage. This is unlike previous studies which only examined the effect of a single supply chain dimension on book leverage, without moderation effects (Kadapakkam & Oliveira, 2021; Kale & Shahrur, 2007). This led to a further contribution of the thesis.

Moreover, many studies have emphasised the importance of short-term financing in the supply chain (Gelosmino et al., 2016; Liebl et al., 2016). However, previous studies have

mostly examined the effect of supply chain dimensions on book leverage. The first part of the thesis contributes by examining not only the effect on book leverage but also on short-term financing. The latter measure isolates short-term financing which comprises debt financing from short-term bank loans and trade credit. Using measures of (i) book leverage and (ii) short-term financing provides a more comprehensive picture on the nature of financing on supply chain dimensions. Explaining this further, the examination on book leverage revealed an inclination of supply chain dimensions to be financed with debt. The examination on short-term financing further revealed an inclination towards short-term debt financing.

Moving onto the second part of the thesis, numerous studies have investigated the supply chain determinants of accounting disclosure (Cho et al., 2020; Crawford et al., 2020; Dai et al., 2021). Further to this, studies have looked at the effect of supply chain dimensions on supply chain transparency (Cai et al., 2023; Gualandris et al., 2021). However, these studies measure supply chain transparency by solely looking at a limited number of disclosure items, such as supplier lists and customer lists. As opposed to this, the second part of the thesis looks at a comprehensive range of disclosure items. This extensive list is based on the exhaustive mapping of the supply chain framework.

This leads me to the next contribution, and the construction of the SCD index. Previous research has studied the disclosure of supply chain information (Bayne et al., 2022), modern slavery disclosures in the supply chain (Christ et al., 2018; Stevenson & Cole, 2018) and conflict minerals disclosures in the supply chain (Swift et al., 2019). McCarthy et al. (2017) also develop an SCD radar. The study by McCarthy et al. (2017) broadly covers the supply chain information that should look to be disclosed in noting four areas of supply chain disclosures. However, this study draws upon a combination of previous literature and interview findings in the development of a comprehensive SCD index covering multiple types of information. These types of information cover (i) membership information, (ii)

provenance information, (iii) environmental information, (iv) social information, (v) supply chain KPIs and (vi) supply chain risk disclosures. In addition, I include information not highlighted in Bayne and Wee (2019) or Bayne et al. (2022) nor accounted for in the SCD radar developed by Marshall et al. (2016). This includes information concerning the BM as well as accounting disclosures (i.e. accounts receivable) that have supply chain implications.

The development of the SCD index also contributes to the abundance of research that has developed disclosure indices. Previous studies have developed disclosure indices in examining the extent of financial and accounting disclosures (Botosan, 1997; Hossain et al., 1995), intellectual capital disclosures (Mangena et al., 2016) and integrated reporting quality disclosures (Raimo et al., 2021; Vitolla et al., 2020). This study, being in the context of supply chain, develops a disclosure index measuring the extent of SCD. Further to this, the disclosure index is developed in the context of the BM which focusses on the entirety of the supply chain. This focus on the BM, in tandem with the development of a comprehensive supply chain framework, allows for the development of a comprehensive SCD index.

The third part of the thesis contributes to investigating the consequences of SCD. Previous studies have investigated the consequences of different types of disclosure in relation to the cost of equity and cost of debt. These include accounting disclosure, ESG disclosure, carbon emissions disclosure, intellectual capital disclosure and integrated reporting disclosure (Botosan, 2006; Bui et al., 2020; Eliwa et al., 2021; Mangena et al., 2016; Vitolla et al., 2020). While studies have investigated the market reaction of ethical and environmental SCD (Longoni & Cagliano, 2018; Swift et al., 2019), there haven't been any studies on the capital market consequences of SCD.

This thesis makes several contributions including theoretical and methodological contributions, as well as adding to previous literature This includes (i) the development of a theoretical framework combining RBV with the corporate reporting of BMs and (ii) the use

of interviews alongside previous literature to explore the dimensions of the supply chain. In sum, the major contributions of the thesis include (i) the development of a supply chain framework and (ii) the construction on a SCD index. That being said, the study also has multiple implications for future research, as well as in practice. This will be addressed in the next section.

8.3 Implications

The findings of the three research questions provide a multitude of implications for firms, shareholders, creditors and standard setters. The first research question found that the complexity of the supply chain structure and the risk (uncertainty) exposure of this structure to supply chain disruptions are the main mechanisms by which capital structure is affected. This will have implications for companies given the increasingly complex nature of supply chain operations, and the increased uncertainties associated with this. The implications of this can already be seen in practice in the regionalisation and localisation of supply chains to reduce supply chain complexity (Chatterjee et al., 2020). In the context of risk and uncertainty, investors have raised concerns over Apple's dependence on China (Mickle & Kubota, 2020). However, in regard to a lot of supply chain dimensions, such as operating portfolio, there is a fine balance to be reached between reducing complexities that facilitate debt financing and increased uncertainties which facilitate equity financing. This is even more pertinent in the midst of increased supply chain disruptions where balancing the capital structure of the firm is evermore important.

Secondly, the first part of the thesis found that, due to the nature of supply chain operations, the firm is frequently financed by short-term debt financing. This is for operations that are comparatively uncomplex and have greater certainty. However, Liebl et al. (2016) noted that during the GFC late payments by firms led to supplier bankruptcies, which

subsequently led to increased vulnerabilities and disruptions in the supply chain. Dai et al. (2020) also noted that the Covid-19 pandemic exposed a lack of preparedness and supply chain planning, and in responding to this, Remko (2020) noted the need to have greater supply chain resiliency. Given the increasing frequency and magnitude of supply chain disruptions, firms may consider incorporating greater equity financing in becoming more resilient to disruptions.

The second part of the thesis found that the provision of supply chain information in annual reports increased from the pre-pandemic to the post-pandemic period. This was both in terms of references made to supply chain keywords and the extent of SCD. Further to this, the emphasis of supply chain messages communicated through the annual report focussed more on the operational supply chain. This has important implications for the firm as it shows that companies are paying more attention to their supply chain and the importance of disclosing supply chain information. However, the findings showed that the integration of operational supply chain information with environmental and social supply chain information is not as good as it ought to be.

The lack of integration of operational supply chain information with environmental and social supply chain information will have implications for how useful SCD will be for shareholders. Firstly, shareholders may perceive information disclosures that are not well integrated as a sign that the operational supply chain and environmental and social supply chain is disjointed. Secondly, the resource recombinations element of the RBV showed the importance of integrating resources in providing dynamic capabilities for the company. Given that SCD reflects the resources and dimensions of the supply chain, the lack of integration in information disclosures may limit the communication of a firm's dynamic capabilities to shareholders. Thirdly, the supply chain is an integration of multiple dynamics, between the different processes, flows and entities. As such, the provision of supply chain information

should be integrated to be useful, and more or less adopt the concept of integrated reporting. Despite the increase in the provision of supply chain information, the findings will have implications for how useful such information will be.

The second part of the thesis also provided implications for firms in deciding and weighing up the benefits and costs of disclosing SCD. The findings shed light on the various reasons and tensions between disclosing and not disclosing SCD. These various reasons include (i) information asymmetry, (ii) signalling, (iii) legitimacy, (iv) proprietary costs, (v) costs of collecting such information and (vi) greenwashing, among others. As such, there are different dynamics to consider when disclosing supply chain information. It is not as simple as disclosing or not disclosing, but also to what extent the firm should disclose supply chain information.

The findings will also have implications for the standard setters. Legislated disclosures such as modern slavery and conflict minerals disclosures (Islam & Van Staden, 2021; Swift et al., 2019) in the UK are only the beginning of further regulations relating to the supply chain. Australia and New Zealand, among other countries, have already legislated or are beginning to legislate climate-related disclosures and modern slavery disclosures, to name a few (CAANZ, 2024; Pilley, 2024; Price Waterhouse Coopers, 2024). Further to this, the effects of the Covid-19 pandemic, the greater demand for supply chain transparency and the greater extent of SCD may lead standard setters to further regulate supply chain disclosures. While further mandatory disclosures may come about regarding environmental disclosures in the supply chain, supply chain-centric disclosures, such as membership information, are likely to remain voluntary given that the supply chain is a competitive advantage tool.

The third part of the thesis will further provide implications for the firm, shareholders and creditors. Bayne and Wee (2019) previously found a lack of non-financial KPIs including performance indicators measuring supply chain aspects. On the other hand, Bayne et al.

(2022) found shareholder preferences for supply chain-focussed KPIs. The results of the second part of the thesis also found a lack of supply chain KPIs. This has implications for firms as they are clearly not responding to the needs of shareholders in regard to SCD. This is clearly the case as shareholders do not find SCD relevant for decision-making. These implications for firms are further emphasised across the board with all four value elements of the BM. The findings of a non-significant effect of SCD on the cost of equity further emphasises previous implications that SCD should reflect the concept of integrated reporting to be informative to shareholders.

Further to this, the third part of the thesis showed that SCD is relevant for creditors in their decision-making. This finding will have implications for creditors. This will fuel creditors' appetite for information concerning the supply chain in their decision-making, and as such the demand for SCD will grow. This is given that supply chain information, both in terms of supply chain messages communicated and SCD, reduces the cost of debt. On the other hand, the findings will have implications for firms. In the first part of the thesis, findings found that supply chain dimensions are predominantly financed using short-term debt financing. This is due to the operational nature of the supply chain. Given this, firms will be more likely to voluntarily disclose supply chain information to enhance accessibility to short-term debt financing. This will also depend on how much voluntary supply chain information is provided as too much disclosure will be a detriment to trade credit and financing from the internal supply chain (Shi et al., 2024).

8.4 Limitations

Despite the richness of the findings, the numerous contributions to previous research and the implications for the firm, shareholders, creditors and standard setters, there are limitations

to this research and areas for future research. This subsection will address such limitations and avenues for future research.

The first limitation relates to the composition of sampled companies. Previous literature and interview findings noted that the supply chain is a product of the external business environment, including country factors. This suggests that country factors affect the structure of the supply chain (Ivanov et al., 2019). However, it is unfeasible to control for country factors, many of which may be difficult to identify and measure. Therefore, the sample here was limited to a single country, comprising companies solely in the UK and on the FTSE All-Share Index. A UK context was chosen due to the number of publicly listed companies, the requirement to prepare annual reports, and the advancement of the supply chain disclosure environment. However, while the context of the study is justified, the generalisability of findings is limited to the UK and possibly to similar external business environments with similar characteristics.

A second limitation is that the sample size of 80 companies comprised companies in the manufacturing, retail and primary industries. These sampled industries included (i) healthcare, (ii) consumer discretionary, (iii) consumer staples, (iv) industrials and (v) basic materials. Hence, the exclusion of service-dominant companies is a limitation of this study. Firstly, this is because firms in the service industry are likely to have more dynamic and more complex supply chains. This may, therefore, influence the effect on capital structure and SCD, differently from companies in the manufacturing/retail industry. Secondly, companies in service-related industries comprise the majority of firms on the UK FTSE All-Share Index and many global indices. The exclusion of service industries was made because of the major differences in the supply chains of service companies, as compared to manufacturing and retail companies, as alluded to by Ivanov et al. (2019). This major exclusion, therefore, limits the generalisability of findings to manufacturing and retail companies.

A third limitation of this study is in regard to the analysis of SCD limited to company annual reports. As pointed out by previous studies, supply chain information is communicated through multiple communication channels such as sustainability reports, company websites, directors' reports and other sources (Bateman & Bonanni, 2019; Bayne et al., 2022; Doorey, 2011). A combination of all these sources provides a more comprehensive picture of SCD. Despite the annual report being the main source of information for shareholders and investors and many early accounting disclosure studies using annual reports to analyse disclosure (Botosan, 1997; Hossain et al., 1995), other sources are more frequented than before. Further to this, Bayne et al. (2022) mentioned the importance of triangulating supply chain information from annual reports, sustainability reports as well as external information from NGOs and newspapers. Hence, the use of solely the annual report in analysing the extent of SCD is a significant limitation.

8.5 Suggestions for future research

As a result of such limitations, there are numerous promising avenues for future research. Due to the relative infancy of research in the disclosure of supply chain information, future studies can investigate the extent of SCD in different contexts. Further research can be conducted in different countries or in a cross-country analysis, provided that the countries have similar external and business environments. This is to investigate whether and to what extent country differences may affect SCD. Further to this, research can examine SCD among service companies. However, this is more difficult to examine due to the difficulties in identifying the resources, operations, processes and activities in service-related supply chains. Moreover, disclosure indices that are specific to service supply chains will have to be constructed.

The second broad area of future research lies in the analysis of SCD in other communication channels, such as sustainability reports, company websites and directors reports. The focus of future analyses can be on any one of these communication channels or on a combination of a few. This will more accurately provide an overall picture of the extent of SCD in companies, as well as help examine the types of supply chain information that are disclosed in different reports and communication methods.

Furthermore, this study sheds light on the dynamic nature of the supply chain which has been emphasised by the effects of the Covid-19 pandemic and other supply chain disruptions. However, the annual report provides information on the supply chain at a static point in time, once a year. Within this period, a lot can change in the dynamics of the supply chain. This adds further fuel to previous research that has investigated continuous disclosure (Russell, 2015). Hence, future research can add to the growing literature on continuous disclosure, supported by the disclosure of supply chain information, and the increasingly dynamic supply chain environment.

Further to this, SCD research needs to be complemented with qualitative research using interview methodologies regarding supply chain information demanded by shareholders and creditors. This will capture the changing information needs of shareholders and creditors regarding the supply chain amidst the significant effects of the pandemic, and the increasing magnitude and frequency of supply chain disruptions. In the current literature, only a few studies examine the lack of SCD and shareholder preferences towards such disclosures (Arvidsson, 2011; Bayne et al., 2022; Bayne & Wee, 2019). This needs to be supplemented with future studies.

Lastly, the linking of the RBV with (i) value proposition, (ii) value creation, (iii) value delivery and (iv) value capture in the communication of supply chain resources lends itself to the growing literature in the corporate reporting of BMs. This will allow future research to

study SCD in the context of the corporate reporting of BMs. Further to this, the integrated nature of the supply chain and the importance of communicating supply chain resources, operations and processes in an integrative manner, lends itself to the growing literature in integrated thinking and integrated reporting (IR). Given the infancy of research in the corporate reporting of BMs and growing research on the operationalisation of IR, future studies can link SCD with IR and also in the context of BM reporting.

In conclusion, I have positioned this study in the context of previous literature by outlining the contributions that this study has made and the practical and research implications to a host of stakeholders. Nevertheless, this study has numerous limitations which future studies can address and build upon, given the growing body of knowledge in SCD.

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Appendices

Appendix A: AUTEC Letter of Approval

1 March 2022

Asheq Rahman
Faculty of Business Economics and Law

Dear Asheq

Re Ethics Application: **22/5 Supply Chain Structure, Nature of Financing and the Determinants and the Consequences of Supply Chain Disclosure – A Resource-Based View**

Thank you for providing evidence as requested, which satisfies the points raised by the Auckland University of Technology Ethics Committee (AUTEC).

Your ethics application has been approved for three years until 1 March 2025.

Standard Conditions of Approval

1. The research is to be undertaken in accordance with the Auckland University of Technology Code of Conduct for Research and as approved by AUTEC in this application.
2. A progress report is due annually on the anniversary of the approval date, using the EA2 form.
3. A final report is due at the expiration of the approval period, or, upon completion of project, using the EA3 form.
4. Any amendments to the project must be approved by AUTEC prior to being implemented. Amendments can be requested using the EA2 form.
5. Any serious or unexpected adverse events must be reported to AUTEC Secretariat as a matter of priority.
6. Any unforeseen events that might affect continued ethical acceptability of the project should also be reported to the AUTEC Secretariat as a matter of priority.
7. It is your responsibility to ensure that the spelling and grammar of documents being provided to participants or external organisations is of a high standard and that all the dates on the documents are updated.
8. AUTEC grants ethical approval only. You are responsible for obtaining management approval for access for your research from any institution or organisation at which your research is being conducted and you need to meet all ethical, legal, public health, and locality obligations or requirements for the jurisdictions in which the research is being undertaken.

Please quote the application number and title on all future correspondence related to this project.

For any enquiries, please contact ethics@aut.ac.nz. The forms mentioned above are available online through http://www.aut.ac.nz/research/researchethics

(This is a computer-generated letter for which no signature is required)

The AUTEC Secretariat
Auckland University of Technology Ethics Committee

Cc: ajantha.velayutham@aut.ac.nz; ad.narayan@aut.ac.nz

Appendix B: *Variable definitions and data sources*

Code	Label	Research Question	Definition	Source
Dependent Variables:				
Lev	Book Leverage	Dependent Variable (RQ 1) Control Variable (RQ 2 & 3)	The proportion of debt financing to total assets	Refinitiv Workspace
ST_Finance	Short-Term Financing	RQ 1	The proportion of short-term financing, comprising of current liabilities, to total assets	Hand-collected
DSCORE	Supply Chain Disclosure Score	Dependent Variable (RQ 2) Explanatory Variable (RQ 3)	The extent of supply chain disclosure provided in company annual reports	Hand-collected
SCM_Keywords	Supply Chain Management Keywords	Dependent Variable (RQ 2) Explanatory Variable (RQ 3)	The word frequency of supply chain management-related keywords in company annual reports	NVIVO generated
ValueProposition_DSCORE	Value Proposition Disclosure	Dependent Variable (RQ 2) Explanatory Variable (RQ 3)	A subdivision measure of DSCORE reflecting the extent of supply chain disclosure pertaining to the supply chain strategic activities of the supply chain	Hand-collected
ValueCreation_DSCORE	Value Creation Disclosure	Dependent Variable (RQ 2) Explanatory Variable (RQ 3)	A subdivision measure of DSCORE reflecting the extent of supply chain disclosure pertaining to the sourcing and procurement and production processes of the supply chain	Hand-collected
ValueDelivery_DSCORE	Value Delivery Disclosure	Dependent Variable (RQ 2) Explanatory Variable (RQ 3)	A subdivision measure of DSCORE reflecting the extent of supply chain disclosure pertaining to the logistics and distribution processes of the supply chain	Hand-collected

ValueCapture_DSCORE	Value Capture Disclosure	Dependent Variable (RQ 2) Explanatory Variable (RQ 3)	A subdivision measure of DSCORE reflecting the extent of supply chain disclosure pertaining to firm performance, value creation and risk factors of the supply chain and the company	Hand-collected
Mandatory_DSCORE	Mandatory Disclosure	Dependent Variable (RQ 2) Explanatory Variable (RQ 3)	A subdivision measure of DSCORE reflecting the extent of mandatory supply chain disclosure required by legislation	Hand-collected
Voluntary_DSCORE	Voluntary Disclosure	Dependent Variable (RQ 2) Explanatory Variable (RQ 3)	A subdivision measure of DSCORE reflecting the extent of voluntarily disclosed supply chain information	Hand-collected
Environmental_DSCORE	Environmental Disclosure	Dependent Variable (RQ 2)	A subdivision measure of DSCORE reflecting the extent of supply chain disclosure pertaining to environmental dimensions	Hand-collected
Social_DSCORE	Social Disclosure	Dependent Variable (RQ 2)	A subdivision measure of DSCORE reflecting the extent of supply chain disclosure pertaining to social dimensions	Hand-collected
Cost_of_Equity	Cost of Equity	RQ 3	The return a firm pays its shareholders (theoretically). Calculated using CAPM model	
Cost_of_Debt	Cost of Debt	RQ 3	The marginal cost to the company of issuing new debt. Calculated by adding weighted cost of short-term and long-term debt based on 1-year and 10-year credit curve	
Explanatory Variables:				
CustomerBase	Customer Base	RQ 1 & 2	The proportion of domestic sales (within the UK and Europe) to total sales	Hand-collected
OperatingPortfolio	Operating Portfolio	RQ 1 & 2	The proportion of the largest operating segment (in dollar amount) to total sales	Hand-collected

Environmental	Environmental Dimensions	RQ 1 & 2	A composite measure comprising (i) emissions, (ii) resource use and (iii) innovation	Refinitiv Workspace
Social	Social Dimensions	RQ 1 & 2	A composite measure comprising (i) community, (ii) human rights, (iii) product responsibility and (iv) workforce	Refinitiv Workspace
Moderating Variables:				
AssetTurn	Asset Turnover	RQ 1	Net Sales divided by Total Assets	Refinitiv Workspace
InventoryTurn	Inventory Turnover	RQ 1	Cost of Goods Sold divided by Average Closing Inventory	Refinitiv Workspace
CCC	Cash Conversion Cycle	RQ 1	The period of time it takes from converting cash spent on inventory to cash received from selling the product. It is calculated via the sum of accounts payable turnover, inventory turnover and accounts receivable turnover	Refinitiv Workspace
Control Variables:				
Governance	Governance dimension	RQ 1 & 2	A composite measure comprising (i) CSR strategy, (ii) company management and (iii) company shareholders	Refinitiv Workspace
ROA	Profitability	All RQ's	Net income divided by average total assets	Refinitiv Workspace
Tangibility	Tangibility	RQ 1 & 3	Net property plant and equipment divided by total assets	Refinitiv Workspace
M2B	Firm Growth	All RQ's	Market value of ordinary equity divided by book value of ordinary equity	Refinitiv Workspace
Analyst_Following	Analyst Following	RQ 2	The number of analysts that are following the firm at a particular point in time	Refinitiv Workspace
FloatShares	Publicly Available Shares	RQ 2 & 3	Proportion of shares available to ordinary investors to the total number (#) of shares	Datastream

ForeignOwnership	Foreign Ownership	RQ 2 & 3	Proportion of shares held by an institution or investor domiciled in a country outside that of the issuing company	Datastream
BoardSize	Board Size	RQ 2 & 3	Total number (#) of board members	Datastream
BoardIndependence	Board Independence	RQ 2 & 3	Proportion of independent board members to total number (#) of board members.	Datastream
ROE	Return on Equity	RQ 3	Difference between net income before preferred dividends and preferred dividend requirement, as a proportion of average common equity	Refinitiv Workspace
Beta	Beta	RQ 3	A measure of how much the company shares move for a given move in the market.	Refinitiv Workspace
ICR	Interest Coverage Ratio	RQ 3	The number (#) of times the company can pay off its interest expense using its earnings before interest and tax (EBIT)	Refinitiv Workspace
Industry-fixed effects	Industry-fixed effects	All RQ's	Reflects fixed effect variables for each industry; (i) Healthcare, (ii) Consumer Discretionary, (iii) Consumer Staples, (iv) Industrials and (v) Basic Materials (5 x dummy variables)	
Year fixed effects	Year fixed effects	RQ 1	Reflects fixed effect variables for each year of the sample; (i) 2018, (ii) 2019, (iii) 2020 and (iv) 2021 (4 x dummy variables)	

PostCovid	Post Covid	RQ 2 & 3	A binary variable equal to 1 if the firm-year observation is in 2021, and 0 otherwise