Supply Chain Contracts: An Examination of Contract Performance through the Lens of Behavioural Factors

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THESIS DECLARATION

I, Fatemeh (Sahar) Goudarzi, certify that:

This thesis has been substantially accomplished during enrolment in this degree.

This thesis does not contain material which has been submitted for the award of any other degree or diploma in my name, in any university or other tertiary institution.

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The research involving human data reported in this thesis was assessed and approved by The University of Western Australia Human Research Ethics Committee. Approvals are as follows:

- Research related to Chapter 2 (Literature Review): Exempt from ethics review
- Research related to Chapter 3 (Collecting data from students at UWA) __ RA/4/20/6003.
- Research related to Chapter 4 (Collecting data from students at UWA) __ RA/4/20/6003.

Written participant consent has been received and archived for the research involving human data reported in this thesis.

This thesis contains published work and/or work prepared for publication, some of which has been co-authored.

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Date: 31 August 2022

ABSTRACT

Recent studies in operations management have revealed interesting and often conflicting differences between theoretical predictions and actual choices of decision-makers. To address the various calls for further investigation on related topics, behavioural operations management (BOM) researchers have strived to examine the reasons for these deviations with the view to improving operational efficiency and effectiveness. Despite the rapidly growing literature on BOM, many operational issues and concerns have remained unresolved, presenting both opportunities and challenges to scholars and practitioners.

This PhD thesis explores the issue of contract selection and planning under uncertainty in the context of the buyer-supplier relationship in a dyadic supply chain. Comprised of a systematic literature review and two empirical studies, this work contributes to the literature on supply chain contracts and practice by adopting a behavioural lens. In this thesis, I provide a theoretically grounded explanation for contract design preference given individual attitudes and behaviours (covering risk attitude, individualism, future orientation, and uncertainty avoidance) while accounting for uncertainty from external sources influencing market demand. Supply chain practitioners may benefit from these findings by revisiting their existing contract selection practices taking into account the characteristics of individuals and introducing targeted interventions to enhance the performance of the firm's operating systems.

In chapter 1, I provide an overview of the thesis, summarising the focus and contents of each chapter. In chapter 2, I present a systematic literature review and synthesise the body of knowledge to identify the research gaps and categorise the behavioural decision theories. I synthesise the literature by applying a systematic literature review methodology to reveal the research gaps and provide a foundation for my empirical studies. I apply three methods comprising of a computer-assisted qualitative data analysis, followed by a *post hoc* analysis

and finally a theory-oriented qualitative analysis. The research in chapter 3 advances the literature on the performance of contracts with different planning time structures. I experimentally investigate the performance of long-term vs. short-term contracts under demand and wholesale price uncertainties and analyse the impact of individualism (Hofstede, 1984) and risk attitudes (Kahneman & Tversky, 1979) on decision-making. I analyse the performance of these contracts by drawing upon the risks associated with each of them and measuring the level of risk tolerated and individualism. Logistic regression, MANOVA, and latent growth modelling are applied. In chapter 4, following the analysis of the performance of supply chain contracts, I provide insights into the performance of green contracts. In this chapter, I examine the performance of two green contracts in a market where uncertainty is driven by unknown levels of sensitivity to product greenness and their prices. I focus on three cultural factors, namely, individualism, uncertainty avoidance and future-time orientation, to explain the intra-individual heterogeneity in decisions (Hofstede, 1984). Logistic and linear regressions, MANOVA, and latent growth modelling are utilised in data analysis.

Finally, in chapter 5, I discuss the theoretical and managerial implications and outline the limitations of this work, with an emphasis on directions for future work. The studies in this thesis investigate the selection of different contracts with a variety of specifications. I evaluate the impact of individuals' heterogeneity as well as external factors such as market demand on decisions to provide a comprehensive understating of the decisions in a real-world setting.

Keywords: behavioural operations management, supply chain contracts, selection of contracts, contract performance, behavioural factors, decision-making, experimental studies

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LIST OF ACRONYMS

Acronym	Definition
SC	Supply Chain
SCM	Supply Chain Management
OM	Operations Management
BOM	Behavioural Operations Management
SCCM	Supply Chain Coordination Mechanisms
CSR	Corporate Social Responsibility
SSC	Sustainable Supply Chain
SSCM	Sustainable Supply Chain Management
BTF	The Behavioural Theory of the Firm
BDT	Behavioural Decision Theory
EUT	Expected Utility Theory
SLR	Systematic Literature Review
CAQDA	Computer-assisted Qualitative Data Analysis
LTC	Long-term Contract
STC	Short-term Contract
SLA	Service Level Agreement
UA	Uncertainty Avoidance
EFA	Exploratory Factor Analysis
LGM	Latent Growth Model
IV	Independent Variable
VIF	Variance Inflation Factor
TLI	Tucker–Lewis Index
CFI	Comparative Fit Index
RCT	Randomised Controlled Trial

ACKNOWLEDGMENTS

The challenging yet extremely rewarding journey of my PhD taught me the importance of resilience and persistence. Looking back at more than three years of my life doing my PhD reminds me of all I have achieved; a better researcher and a better version of myself. However, none of these would have been achievable without the presence of a number of people who have helped me in this journey.

I had two of the most wonderful supervisors to thank for getting me to this point, for being so knowledgeable and patient. First, I would like to extend my sincere gratitude to my primary thesis advisor, Associate Professor Paul Bergey. Paul, thanks to you, I am way more confident in my research, writing and communication skills. I cannot thank you enough for challenging my ideas, drawing my attention to new perspectives, being open to new ideas, generously sharing knowledge and helping me improve my work. Your nice, unique and yet rigorous comments on my work have always boosted my energy. Thanks for supporting me from day one (that first Skype interview seems so distant now!) and for always being so welcoming and having us at your place to enjoy the BBQ and beautiful scenery.

I would like to convey my deepest gratitude to my Co-supervisor, Associate Professor Doina Olaru, for going above and beyond her role and answering my questions in every possible way, being so approachable, and making time for me when she was already slammed. I couldn't ask for a better Co-supervisor, and I'm happy that I got to learn more under your mentorship. Doina, thanks to you, I am a million times more confident in my writing and statistics skills. You are an inspirational human being, and your role in my PhD life is not limited to research. You light up a room with your radiant spirit, your genuine care for others, your conscientiousness in recycling, your impressive cooking skills and finger-licking dishes, your stunning outfits, and your seriousness in Scavenger hunt (always so much fun!) are always to remember.

I have been fortunate to be surrounded by great colleagues in my beautiful office in the Centre for Business Data Analytics (having the outstanding view of the Swan river may be distracting, but who can ever complain about it!). My fellow PhDs and friends, Elena, Xiaolin, Benita, Emika, Hanako, Fahi, Fiona, Ubaid, Mohammed, Almoaid, Frank, and Rezvan, thank you for making coming to work and doing my PhD more fun.

My huge thanks are owed to my loving family. Embarking on a new life overseas might be daunting, but with your support and the love that you have always been sending my way, I have always felt your precious presence with me. *Doosetoon daram kheili ziyad*!

Baba, I know that you are always with me, holding me tight, watching me grow, even if I don't see you in this world. You are in every single moment of my life. I would like to dedicate my PhD thesis to you, as your belief in me has made this journey possible.

Thank you, Maman, for always checking on me, ensuring that I'm doing fine and sending those lovely kisses each time. My siblings, Parvin, Esmaeil, Maryam, Reza, and Parisa, thank you so much for putting up with all of my PhD-related talks, for being ever-present, and for always being a genuine and constant source of support and tremendous encouragement through good times and bad. I'm forever grateful for having you in my life. My nieces and nephews, Sina, Parsa, Newsha, Nima, and Lena, thanks for being in my life and bringing joy to my life. I'm so proud of how wonderful you are, and I have no doubt that your future is so bright. Love you all!

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PREAMBLE

The body of this thesis is presented as journal article manuscripts. At the time of thesis submission, Chapter 2 was published as a peer-reviewed journal article in *Supply Chain Management: An International Journal* (Goudarzi *et al*., 2021). Chapter 3 was published in the *International Journal of Production Economics* (Goudarzi *et al*., 2022). Chapter 4 is likewise in the format of a journal article that has yet to be submitted to a journal outlet (Goudarzi *et al*., in prep). Details of the candidate's contribution to each article are declared in *Authorship Declaration: Co-Authored Publications.*

AUTHORSHIP DECLARATION: CO-AUTHORED PUBLICATIONS

This thesis contains work that has been published or prepared for publication, all of which have been co-authored. The bibliometric details are outlined below.

Details of the work:

Goudarzi, F. S., Bergey, P., & Olaru, D. (2021). Behavioral operations management and supply chain coordination mechanisms: a systematic review and classification of the literature. *Supply Chain Management: An International Journal*. Vol. ahead-of-print No. ahead-of-print. https://doi.org/10.1108/SCM-03-2021-0111

Location in thesis: Chapter 2

Student contribution to work:

Chapter 2 takes the form of an article that has been published in *Supply Chain Management: An International Journal.*

Sahar led the development of this paper from conceptualisation to final proofing and publication (including two rounds of revisions). Sahar undertook the scope definition, the inclusion and exclusion process, reviewing and synthesising the literature, and developing the conceptual map using *Leximancer* and conceptual framework. She also conducted interviews to validate the conceptual map. The core findings, recommendations and future research suggestions were mainly developed by her. Sahar coordinated the review process (the internal reviews and two rounds of review with *SCM*) while acting as the corresponding author to manage the formal communications with the editorial team of *SCM*, leading up to the final acceptance and publication of this paper (Contribution percentage: 70%).

Associate Professor Paul Bergey provided extensive help in improving the paper by proposing the initial idea of the engagement of the external scholars, helping contact the external scholars, suggesting further refinement of the analyses, helping in the review process, including editing the paper and the response to reviewers (Contribution percentage: 15%).

Associate Professor Doina Olaru provided extensive help in improving the paper by undertaking the inclusion and exclusion process to validate the final pool of papers, assisting in *Leximancer* analysis and the use of articles in the software, suggesting further refinement of the analyses, helping in the review process, including editing the paper and the response to reviewers (Contribution percentage: 15%).

Co-author signatures and dates:

Paul Bergey: [redacted] Date: 31 Aug 2022

Doina Olaru: [redacted] Date: 31 Aug 2022

Details of the work:

Goudarzi, F. S., Olaru, D., & Bergey, P. (2022). Beyond Risk Attitude: Unpacking Behavioural Drivers of Supply Chain Contracts. *International Journal of Production Economics,* Vol. ahead-of-print No. ahead-of-print. https://doi.org/10.1016/j.ijpe.2022.108678

Location in thesis: Chapter 3

Student contribution to work:

Chapter 3 takes the form of an article that that has been published in the *International Journal of Production Economics* (*IJPE*).

Sahar led the development of this paper from conceptualisation to submission. The conceptualisation, literature review, theoretical background analysis, hypotheses development and experimental design was developed by her. Sahar fully undertook the data collection process, and she conducted the data analysis. Sahar developed the core findings and wrote the paper from the first stages to final proofing and publication (including two rounds of revision). Sahar coordinated the review process (the internal reviews and two rounds of review with *IJPE*) while acting as the corresponding author to manage the formal communications with the editorial team of *IJPE* (Contribution percentage: 70%).

Associate Professor Doina Olaru provided extensive help in improving the paper by revising and refining the experimental design, contributing to the multilevel analysis (LGM) and further refinement of the analyses. She also helped develop the paper with respect to its writing from the initial stages to the review process (Contribution percentage: 15%).

Associate Professor Paul Bergey provided extensive help in improving the paper by revising and refining the experimental design and suggesting further refinement of the analyses. He also helped develop the paper with respect to its writing from the initial stages to the review process (Contribution percentage: 15%).

Co-author signatures and dates:

Paul Bergey: [redacted] Date: 31 Aug 2022

Doina Olaru: [redacted] Date: 31 Aug 2022

Details of the work:

Goudarzi, F. S., Bergey, P., & Olaru, D. (2022). Green Contracts: Empirical Assessment of the Contract Selection in the Supply Chain.

Location in thesis: Chapter 4

Student contribution to work:

Chapter 4 takes the form of an article. The conceptualisation, literature review, theoretical background analysis, hypotheses development and experimental design was developed by her. Sahar fully undertook the data collection process, and she conducted the data analysis. Sahar developed the core findings and wrote the paper from the first stages to final proofing. She is the corresponding author for this paper and will manage the potential revision rounds in communicating with the editorial team of the potential journal outlet (Contribution percentage: 70%).

Associate Professor Paul Bergey provided extensive help in improving the paper by revising and refining the experimental design. He also suggested further refinement of the analyses, particularly the test of population proportions. He also helped develop the paper with respect to its writing from the initial stages to editing the paper (Contribution percentage: 15%).

Associate Professor Doina Olaru provided extensive help in improving the paper by revising and refining the experimental design. She suggested further refinement of the analyses and provided extensive assistance with the multilevel analysis. She also helped develop the paper with respect to its writing from the initial stages to editing the paper (Contribution percentage: 15%).

Co-author signatures and dates:

Paul Bergey:  Date: 31 Aug 2022

Doina Olaru:  Date: 31 Aug 2022

Student signature:

Date: 31 August 2022

I, Paul Bergey, certify that the student's statements regarding their contribution to each of the works listed above are correct.

Coordinating supervisor signature: 
Date: 31 Aug 2022

CHAPTER 1

General Introduction

1.1. Background and Objectives

In recent decades, with the intensification of globalisation, supply chains (SC) have continuously grown, with increasing requirements for multiple transactions among firms across the world. This inevitably leads to uncertainty and conflict as the complexity of the relationships among SC partners increases. This could be due to several reasons, including the self-serving behaviour of SC partners and misaligned incentives. Therefore, coordination mechanisms such as contracts are deployed to make the SC performance more robust (Van Der Vorst & Beulens, 2002; Choi *et al*., 2008). Extensive studies investigated SC coordination from a theoretical perspective by assuming the rationality of SC partners and suggesting corresponding solutions to enhance channel performance. However, more recently, researchers have argued that behavioural factors play an influential role in real-world operations (Gino & Pisano, 2008; Kalkanci *et al*., 2011; Katok *et al*., 2014; Davis & Leider, 2018; Davis & Hyndman, 2019), concluding that the theoretical predictions are not always sustained when human decision-makers are involved. Behavioural decision theory (BDT) challenged expected utility theory (Keeney & Raiffa, 1976) and suggested deviation from theoretical profit maximisation predictions due to different behavioural factors. In addition, other theoretical concepts and approaches, such as prospect theory (Tversky & Kahneman, 1992) and social preferences (Fehr & Fischbacher, 2002; Loch & Wu, 2007), have been applied to examine and explain the different sources of the observed heterogeneity in individuals' behaviour. These, consequently, suggest that a more nuanced analysis is needed, which can explore outcomes that lay beyond the predictions of normative theory.

Scholars have investigated the impact of behavioural factors on several operational areas, such as supply chain management (SCM), inventory, service, revenue, quality, and project management (Fahimnia *et al*., 2019). In this thesis, the focus is mainly on analysing several behavioural aspects in relation to the selection of SC contracts. Early work in this field,

conducted by Sterman (1989), indicated a systematic underweighting of supply line by SC parties, causing over-ordering and leading to increased bullwhip effects. This observation was consistently reported in several other studies (e.g., Croson & Donohue, 2003, 2006; Croson *et al*., 2014; Narayanan & Moritz, 2015), suggesting a challenge for channel coordination in the context of information sharing and supporting the need for further investigation.

In the supplier-buyer interaction, contract selection is considered a critical decision (Johnsen *et al*., 2021), and several studies examined the performance of different contracts against theoretical predictions. As a general implication, research shows that theoretically optimal contracts do not always outperform non-coordinating contracts, and different behavioural factors were identified as drivers of the actual decisions. For instance, different newsvendor critical ratios can trigger a behavioural bias, such as loss aversion, leading to a preference for one contract, even if the contracts have mathematically equivalent profit (e.g., revenue sharing & buyback contract; Zhang *et al*., 2016). Social preferences may also cause individuals to show concerns about their counterpart's profit (both at horizontal and vertical levels in an SC) which may lead to a selection bias in the choice of contracts, deviating from the theoretical predictions (see Davis & Hyndman, 2018; Nie & Du, 2017 among others). Bounded rationality of individuals when facing complex contracts (Kalkanci *et al*., 2011, 2014), along with mental accounting (Thaler, 1985; Becker-Peth *et al*., 2013; Becker-Peth & Thonemann, 2016) are other examples of behavioural factors impacting individual decisions.

Following the abovementioned research findings, it is imperative to examine the performance of contracts when behavioural factors are present. This helps scholars and practitioners better understand why and how the actual decisions deviate from the theoretical predictions. These observations can then help managers develop more precise predictions about the behaviour of other SC agents, leading to the enhancement of predictive models and a better contract design. From the channel perspective, utilising these observations in practice not only

improves the decision-making through a better contract design but also enhances the operating systems by making the operational processes robust to decision-makers' behavioural biases and cognitive shortcomings in a channel.

In addition to contract selection, another crucial operational issue in SC is planning and ordering behaviour under demand uncertainty. The newsvendor model is a well-known representation of the optimal order quantity problem, which is the foundation for studying inventory ordering decisions under uncertainty. Research shows that, similar to contract performance; there is a mismatch between the observed order quantity when confronted with a newsvendor model and optimal order quantity when considering the normative theory. Several concepts, such as the pull-to-centre effect and demand chasing (see Schweitzer & Cachon, 2000; Moritz *et al*., 2009; Kremer *et al*., 2010, among others), may explain these deviations. Research shows that biases persist under different demand distributions (Benzion *et al*., 2008), planning experience and feedback enhancement (Bolton & Katok, 2008), and cultural differences (Özer *et al*., 2014). The empirical evidence confirms the importance of investigating the behavioural factors in ordering and exploring the de-biasing techniques (Bolton & Katok, 2008; Stangl & Thonemann, 2017).

In light of the shift from normative models to BOM and given the prevalence of these departures from expectations, this thesis investigates the behavioural aspects of decision-making on sourcing strategies in the context of SC contracts. This is achieved by examining the performance of SC contracts under uncertainty when humans as decision-makers are involved. Contact performance analysis traditionally explores and compares different contract designs with respect to levels of profitability or SC surplus, meaning that a contract with greater profit or surplus outperforms the others. In the context of my studies in this thesis, contract performance is measured by the frequency of selection under different conditions and by

different SC agents. That is, a contract that is measurably preferred by an agent fitting a certain behavioural profile outperforms the others under given conditions.

The thesis is revolving around the question that how the selection of contracts with different specifications and ordering decisions can be impacted by individuals' heterogeneity and external factors such as market demand. To investigate this, three pathways are undertaken. Firstly, a systematic literature review delineates the behavioural factors that are already explored in this context. Based on the findings and the revealed literature gaps, the performance of different contracts is explored while accounting for personal traits and attitudes of decision-makers.

The three studies of this thesis provide evidence on how the performance of an SC contract and ordering decisions are tied to individual heterogeneity leading to different evaluations of the same contract. In two experimental studies, I also discuss the influence of exogenous factors, particularly market conditions, which present various sources of uncertainty. I examine the linkage between attitudes and performance of decision-makers in selecting SC contracts with different contractual structures. Managers can develop interventions based upon the findings of this research to improve decisions and enhance the performance of operating systems.

In my studies, I use laboratory experiments to examine the preference of decision-makers and the behavioural drivers of decisions concerning different contracts and order quantity decisions. The utilisation of laboratory experiments is a common practice in BOM to test the existing theories and bridge the gap between theoretical analysis and real-world problems (Katok, 2011). The experiments allow for relaxing the rationality assumptions of decision-makers while controlling for individual differences (Katok, 2011). Below, I provide

an overview of the chapters included in the present thesis and outline how they contribute to addressing the gaps in the literature.

1.2. Overview of the Chapters

This thesis-by-papers comprises of five chapters, including the current chapter. Chapter 1 provides a general introduction and a roadmap to the thesis (Figure 1). Chapters 2, 3, and 4 represent three main studies conducted under this "thesis's umbrella", and they take the format of a journal article at different stages of the publication process. Finally, chapter 5 concludes the thesis by discussing the overall findings of the research.

A summary of all three studies in this thesis is provided in Table 1, indicating the objectives and research questions, operational area of focus, focal theories and behavioural factors, the applied methodologies, and the unit of analysis of each study. Before the chapters' overview, I provide a visual portrayal of the main components of the thesis in Figure 1.

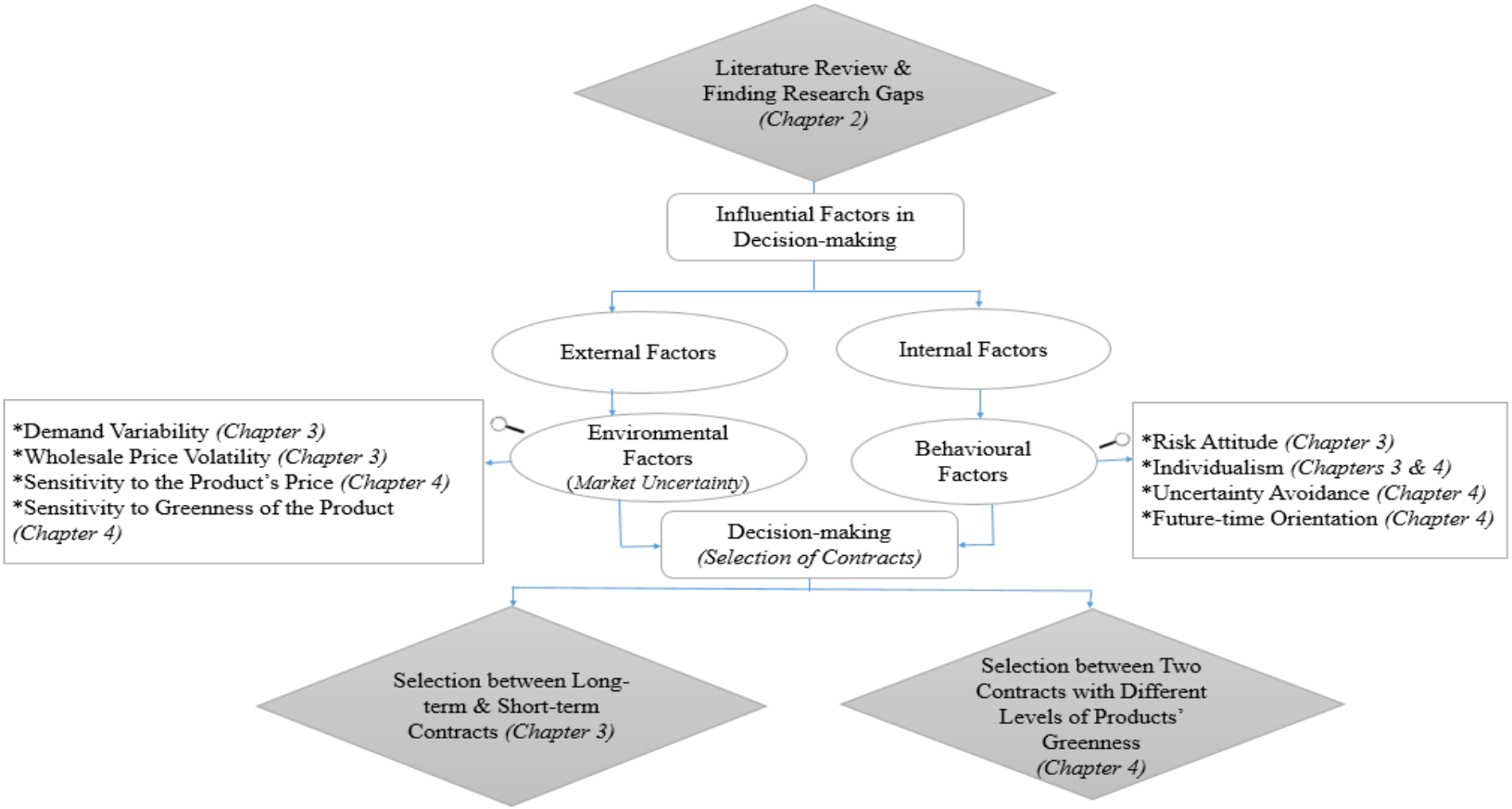

FIGURE 1 - Overall Model for the Thesis

The current chapter is the thesis introduction, where I provide a general introduction to the thesis, an overview of the chapters/studies, and a brief summary of the contributions of the thesis. Chapter 2, entitled "*Behavioral operations management and supply chain coordination mechanisms: a systematic review and classification of the literature"*, takes the format of a journal manuscript, which has been published in the *Supply Chain Management: An International Journal* (Goudarzi *et al*., 2021). As a first step toward achieving the aim of the thesis, I begin by reviewing and synthesising the extant literature juxtaposing BOM and SC coordination mechanisms. I apply a systematic literature review methodology to reveal the gaps and identify fruitful avenues for research. The most recent literature reviews to date either explore other fields of BOM rather than SC coordination mechanisms (Arvan *et al*., 2019; Perera *et al*., 2019) or did not have a behavioural perspective in their scope (Li & Wang, 2007; Arshinder *et al*., 2011). By applying the paradigm proposed by Durach *et al*. (2017), I review the literature to reflect the idiosyncrasies of supply chain management (SCM) by focusing on the coordinating mechanisms of SC. To explore the field in greater depth, I apply a behavioural lens and employ three types of analysis.

The analysis in chapter 2 begins with a bibliometric analysis to depict the field's current state. Next, I apply a computer-assisted qualitative data analysis (CAQDA) automated tool (*Leximancer*) to undertake a content analysis to extract the dominant concepts emerging from the selection of articles and portray their relationships. A *post hoc* analysis assesses the accuracy of the generated conceptual map by receiving insights from the top leading experts in the field. Finally, I use a theory-oriented qualitative analysis to synthesise the literature and to provide a taxonomy of behavioural decision theories applied in this area, and I unify the critical concepts through a theory-driven holistic conceptual framework. The findings of this review highlight the literature gaps and suggest that although there is extensive research on BOM, the research considering the impact of cultural and behavioural factors on the decisions of SC

agents in evaluating contracts is sparse. Also, the sustainability perspective of the contracts and green SCs in BOM is less examined, leaving several unanswered questions and presenting challenges for scholars and practitioners.

Chapter 3 includes the first empirical study of this thesis. It is entitled "*Beyond Risk Attitude: Unpacking Behavioural Drivers of Supply Chain Contracts"* and has been published in the *International Journal of Production Economics* (Goudarzi *et al*., 2022). Following the identified literature gaps through the systematic literature review (chapter 2) and given the importance of environmental factors and the unclear impact of uncertainty on procurement plans, in chapter 3, I examine the impact of behavioural factors of decision-makers on the selection of contracts with different planning horizons (long-term & short-term contracts) by taking into account two different sources of uncertainty: 1) market demand and 2) wholesale price. The trade-offs between long-term and short-term sourcing strategies and associated risks have been the subject of many prior investigations; however, analytical modelling has dominated the research in this field (Cohen & Agrawal, 1999; Seifert *et al*., 2004; Li *et al*., 2009; Talluri & Lee, 2010; Hong *et al*., 2014; Shi & Feng, 2016), with only one very recent empirical research studying the behavioural perspective of these contracts (Johnsen *et al*., 2021). Thus, I reconcile the analytical studies on procurement planning and empirical domains by experimentally examining the performance of these two contracts. The trade-off is between the flexibility of the short-term contract and its price volatility (Cohen & Agrawal, 1999) compared to supply stability at the cost of fixed investment to hedge against the wholesale price volatility in the market that long-term contract offers (Cisternas & Figueroa, 2015; Wang *et al*., 2020).

I draw upon prospect theory (Kahneman & Tversky, 1979) and Hofstede's cultural framework (1984) to analyse the performance of these two contracts by determining the level of risk tolerated while considering individualism when there are different levels of price and

demand uncertainty in the market. By building upon the analytical research by Cohen & Agrawal (1999) and Li *et al*. (2009), I design a 2×2 game and present the experimental results to provide a theoretically grounded explanation for contract performance. The acquired data are analysed using binary logistic regression and MANOVA. I also apply a multi-level analysis through Latent Growth Modelling (LGM) (Arbuckle & Wothke, 1999) to investigate the intra-individual differences in setting the initial order quantity and its rate of change over time.

Chapter 4, entitled "*Green Contracts: Empirical assessment of the contract selection in supply chain,"* is an unpublished manuscript that is in preparation to be submitted to a journal outlet. Similar to the previous chapter, I investigate the performance of two contracts under uncertainty. I explore the impact of market demand uncertainty, which is characterised by the sensitivity to the price of a product and sensitivity to the greenness of a product when deciding between two green contracts. Sustainability practices have a long-term competitive advantage for organisations; however, SC partners are not always willing to take the initiatives and step into the sustainability world (Olynec, 2016). Market uncertainty often impacts the commitment to greening. Thus, I explore the behavioural underpinnings of the selection of green contracts under uncertainty by mainly focusing on the impact of cultural factors, confirmed to be a key determinant in decision-making (Özer *et al*., 2014; Eckerd *et al*., 2016) and in the behaviour of individuals toward sustainability (Eom *et al*., 2016; Beltrán-Esteve & Picazo-Tadeo, 2017). I apply Hofstede's (2001) cultural framework by utilising individualism/collectivism, uncertainty avoidance, and long-term orientation constructs where the literature suggests an association between these dimensions and propensity to support sustainability initiatives. Although the impact of cultural values on sustainability practices is confirmed in the literature (e.g., Parboteeah *et al*., 2012; Jia *et al*., 2017), the discussion is sparse on the impact of culturally embedded behavioural differences on managerial decisions in the SC.

Inspired by a real-world case of IBM and Samsung employing a new semiconductor innovation to save energy compared to a scaled fin field-effect transistor (FinFET) (Adams, 2021), I designed two contracts with different levels of sustainability. The trade-off is between obtaining higher profit through one contract, whilst the other contract offers a product with higher energy efficiency that contributes more to the CO_2 emission abatement. However, a higher CO_2 emission abatement is achieved through a higher greening investment that consequently leads to products with higher wholesale and retail prices. By drawing on the behavioural theory of the firm (BTF) (Cyert & March, 1963), I conduct 2×2 laboratory experiments to obtain a deeper understanding of the impact of the behavioural attitudes mentioned above on contract selection and order quantity. As a common practice in the real world, in my design, I utilise a product-based green initiative (Bowen *et al*., 2006), and I use CO_2 emission as a well-established measure of environmental impact (Bushuev *et al*., 2015). Linear and logistic regressions are applied to estimate the effect of behavioural factors and market conditions on the selection of contracts. I also apply a multi-level analysis to analyse the order quantity decisions of decision-makers and to evaluate the influence of experimental factors on that.

Finally, in chapter 5, I discuss the overall findings of the research. In this chapter, I elaborate further on how chapters 2-4 address the literature gaps and their contribution to understanding behavioural factors in operations management, specifically the selection of contracts in an SC. I outline the theoretical as well as the practical implications for managers and organisations, detailing how they may deal with behavioural biases to improve the contract selection process and foster the performance of an organisation and SC. Finally, by acknowledging the limitations of all studies, I indicate potential directions for future research.

TABLE 1 - A Summary and Comparison of the Studies of the Thesis

Study	Research Objectives/Questions	Operational Area of Focus	Behavioural Focus	Focal Theory	Methodological Approach	Unit of Analysis
Study 1	1. Analyse and synthesise the extant literature on BOM and SC coordination (contracting & supplier-buyer relationships); 2. Identify behavioural theories and assess trends developed over the years; 3. Identify limitations and current research gaps.	Coordination Mechanisms in *Buyer-Suppler Relationship* in SC	Reviewing all Behavioural Factors	Reviewing all Applied Theories	*Systematic Literature Review *Content Analysis *Thematic Analysis	N/A
Study 2	1. What is the trade-off between long-term and short-term contracts in the presence of wholesale price and demand variability? 2. How do behavioural factors influence the decision-makers' choice of sourcing strategies and ordering decisions under these conditions?	Contract Performance Considering Planning Horizon; (*Long-term vs. Short-term Contracts*)	*Risk Attitudes *Individualism	*Prospect Theory (Kahneman & Tversky, 1979) *Hosfstede's Cultural Framework (Hofstede, 1984)	Laboratory Experiment	Individual Level (The Role of *Retailer* as Decision-Maker)
Study 3	1. Considering the market's sensitivities to greening and price and the two contracts with different levels of profitability and sustainability, under what conditions are decision-makers more likely to act in environmentally responsible ways? 2. How do behavioural attitudes (individualism, UA, and future time orientation) impact SC agents' contract preference and ordering decisions?	Contract Performance Considering Sustainability; (*Green Contracts with Different Levels of Products' Greenness*)	*Future Orientation *Uncertainty Avoidance *Individualism	*Hosfstede's Cultural Framework (Hofstede, 2001)	Laboratory Experiment	Individual Level (The Role of *Manufacturer* as Decision-Maker)

1.3. Brief Summary of the Contribution of the Thesis

This work contributes to the literature and practice in several ways, and I outline the contributions to the literature briefly in this section while discussing all the contributions comprehensively in the last chapter of the thesis. First, the proposed conceptual framework and the classification of the literature on BOM and SC coordination mechanisms based on the applied behavioural theories in decision-making in chapter 2 provides a guide for SC scholars to refer to and to set future research through a more targeted approach.

Second, incorporating the behavioural perspective in two lesser-studied contract structures (i.e., planning time horizons and sustainability factors of SC contracts) – that have been historically examined using analytical models and mathematical approaches – contributes to the literature in the selection of contracts. In the study conducted in chapter 3, I find that the participants are not indifferent between two contracts with the same expected profit, and the results of the other empirical study in chapter 4 confirm that individuals are not always willing to maximise their financial results by selecting the more profitable contract. Thus, profit-maximisation may not always be the decision driver in the contract selection process, where behavioural factors play an important role. These studies and findings broaden the literature horizon for BOM researchers by identifying the role of environmental and behavioural factors in sourcing/procurement decisions.

Third, this thesis draws upon two behavioural categories in decision-making, including risk attitude and cultural factors. The results of the experimental studies in chapters 3 and 4 demonstrate how these behavioural factors can systematically drive the decisions of individuals in the context of contract selection under the influence of environmental uncertainty. Also, most of the previous studies were limited to examining the cultural factors at the country level,

yet, the granularity of measures at the country level is unfitting when analysing individual decisions, and this thesis adopted a more refined, micro-level explanation of the findings.

Fourth, scrutinising the findings of the experimental studies revealed some other biases that can inform the design and implementation of future studies in this domain. As an example, in the experimental study of chapter 3, two different scales were applied to elicit the risk attitude of the participants. After assessing their compatibility, the use of self-report reflective scales is recommended; because using the lottery test (which involves calculations) may not necessarily reflect the actual attitudes of the participants; thus, utilising the self-report scales may be more appropriate. Also, the results of the selection of sustainable contracts in chapter 4 revealed potential social desirability bias of the participants in selecting a green contract that can be carefully considered in future experimental designs (i.e., participants over-emphasising choices that are deemed to be socially anticipated/desirable).

Fifth, in addition to these contributions to the operations management's conceptual literature, using novel and less-applied methods is another contribution of this thesis. This thesis applies multi-level analysis and latent growth modelling in chapters 3 and 4, which are yet to become part of the modeller toolkit in BOM. Also, the novel approach to validate the output of the utilised text-mining software through the engagement of prolific scholars in the field in chapter 2 is another contribution to the data analysis in this field.

N.B: It should be noted that the numbering of the tables, figures, equations/relations, and hypotheses are continuous, starting from 1 in the first chapter.

CHAPTER 2

Behavioral Operations Management and Supply Chain Coordination Mechanisms: A Systematic Review and Classification of the Literature

Foreword

To begin my research, I start by reviewing the extant literature juxtaposing SC coordination mechanisms and BOM. The aim is to synthesise the literature and, by doing so, illuminate the behavioural drivers of decisions in buyer-supplier decisions. In this chapter, I discuss the utilised behavioural theories in the literature and outline the theoretical and managerial implications of the research findings. I also identify the research gaps and fruitful avenues for future research based on the existing literature.

In order to capture the ontological and epistemological idiosyncrasies of SCM, I applied the systematic literature review paradigm proposed by Durach *et al*. (2017). In following the suggested steps, I applied different methodologies to ensure a comprehensive analysis. After defining the scope of the literature review, I aimed to undertake an inclusion/exclusion procedure. I started the journey with a bibliometric analysis to get an understanding of the trends in this field over the years. Then, I conducted a content analysis using *Leximancer*, which was followed by a *post hoc* analysis to evaluate the accuracy of the produced conceptual map. Undertaking a thematic analysis, I reviewed all the selected articles and classified the literature based on the applied behavioural theories. A holistic conceptual framework alongside statistics about the applied methodologies and theories are also provided in this chapter.

N.B: Please note that the standard American spelling is used in the following chapter due to the journal's requirements.

Behavioral Operations Management and Supply Chain Coordination Mechanisms: A Systematic Review and Classification of the Literature

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Purpose

The recent surge in behavioral studies on the coordination mechanisms in supply chains (SCs) and advanced methods highlights the role of SC coordination (SCC) and behavioral issues associated with improving the performance of operations. Our study aims to critically review the behavioral aspect of channel coordination mechanisms.

Design/Methodology/Approach

Following a systematic literature review methodology, we adopt a combination of bibliometric (to reflect the current state of the field), content (employing *Leximancer* data mining software to develop thematic maps), and theory-oriented qualitative analyses that provide a holistic conceptual framework to unify the literature's critical concepts.

Findings

Our analysis confirms the plethora of risk-oriented publications, demonstrating that the second largest category of studies is concerned with social preferences theory. Most studies were based on experiments, followed by analytical modeling, revealing the impact of heuristics and individual preferences in SC decisions and suggesting promising managerial and theoretical avenues for future research.

Originality/Value

Our study sheds light on behavioral decision theories applied to SC coordination by categorizing the literature based on the adopted theories. The methodological contributions include using automated content analysis and validating the outcome by interviewing leading

scholars conducting active research on "behavioral operations management and SC contracts". We also propose several directions for future research based on the research gaps.

Keywords: supply chain coordination, behavioral operations management, supply chain contracts, behavioral decision theories, systematic literature review

2.1. Introduction

Improvement in SC performance relies heavily on the efficiency of SC member interactions (Cachon, 2003; Tang, 2006; Davis *et al*., 2014; Choi, 2015) and the intensification of globalization has led to multiplied interactions/transactions among firms across the world. With well-established coordinating policies, agents order close to optimal quantities, enhancing performance (Choi *et al*., 2008). Yet, conflicts arise (e.g., misaligned incentives, imperfect information, and self-serving behaviors by SC players), emphasizing the need to deploy coordination mechanisms to deliver robust performance. Reconciling theoretical rationale assumptions with real-world human behaviors is the driving force that has shaped a new trend in operations management (OM) and behavioral operations management (BOM). The latter aims to study the impact of potentially "non-hyper-rational" human decisions in operations and SC management to enhance the operating systems (Gino & Pisano, 2008). A variety of behavioral factors have been investigated, and their impact tested under various operational themes in BOM studies, using a range of methods (Bendoly *et al*., 2006; Gans & Croson, 2008; Schorsch *et al*., 2017; Fahimnia *et al*., 2019).

Early primary research on BOM investigated the impact of human behaviors in the OM discipline as an emerging field (Donohue *et al*., 2018), and literature reviews broadly reflected on the scope and history of the field (Schorsch *et al*., 2017; Fahimnia *et al*., 2019). Although these reviews drew upon human factors in different operational contexts, SC coordination

mechanisms (SCCM) were only one of the reviewed topics in their studies, and no exclusive analysis has been conducted to systematically explore this field. While two recent literature reviews (Arvan *et al*., 2019; Perera *et al*., 2019) explored BOM in a more granular fashion in fields other than SCCM (e.g., forecasting), three prior literature reviews on SCCM focused on operational aspects without exploring the behavioral aspects. Arshinder *et al*. (2011) studied the theoretical aspects of SCC; Li and Wang (2007) solely investigated the SCCM and the models employed to improve SC performance considering demand and governance decision structure; Chauhan and Singh (2018) focused on coordination in green SC; yet, none examined the behavioral aspects of SCCM. We aim to exclusively investigate influential human factors in the decision-making process to reveal the critical points related to the integration of human factors into SCCM, as presented in the literature.

Therefore, the objective of this systematic literature review (SLR) is to focus on the intersection of BOM with SCCM. We adopt a combination of bibliometric (to reflect the current position of the field), content (to develop thematic maps representing the literature corpus), and theory-oriented qualitative analyzes. The content analysis is followed by a *post hoc* assessment, for which we contacted the top nine leading experts in the field to evaluate the accuracy of the developed conceptual map. This combination of different approaches revealed latent concepts and research gaps. Our study makes three main contributions:

1. It interprets behavioral decision theories and their use in the SCCM context by categorizing the literature based on the adopted theories.
2. It identifies literature gaps in the applied behavioral theories, less-addressed behavioral aspects, and potential real-world issues to provide future research directions.
3. Methodologically, it reveals the use of automated content analysis to develop text-to-data metrics to analyze our literature corpus and support our traditional qualitative analysis; we validated our automated content analysis by interviewing leading scholars

conducting active research in the field of "behavioral operations management and supply chain contracts."

The remainder of the paper is organized as follows. Section 2.2 explains the review methodology. Section 2.3 analyzes the data via the following three subsections—2.3.1, the current state of the research literature using bibliometric analysis; 2.3.2, the results of content analysis and a discussion about research domain clusters identified by *Leximancer*; 2.3.3, a conceptual framework along with a theory-oriented classification of the literature. Finally, we conclude the paper in section 2.4 by highlighting research gaps and addressing potential research avenues.

2.2. Review Methodology

In this study, we applied the SLR methodology to capture all the relevant papers related to SCCM associated with BOM. SLR is an efficient and rigorous method of selecting and analyzing a corpus of literature and investigating potential research gaps. It can offer new insights or identify further advancements in primary studies, create new knowledge, and allow for replication by synthesizing the current evidence (Durach *et al*., 2017).

Despite several guidelines on conducting SLRs, Durach *et al*. (2017) drew upon key SLR publications (e.g., Mulrow, 1987; Tranfield *et al*., 2003; Denyer & Tranfield, 2009) and proposed the following stages to reflect the ontological and epistemological idiosyncrasies of supply chain management (SCM): (1) identifying the research objectives and crafting inclusion/exclusion criteria; (2) identifying the data sources, selection criteria, and keywords relevant to the study; (3) applying the inclusion/exclusion criteria and refining the body of literature by filtering studies; and (4) synthesizing the literature, conducting qualitative and quantitative analysis on data produced from the literature, and reporting the results.

2.2.1. Research Objectives

Following the proposed framework by Durach *et al*. (2017), we started by defining the review purpose, adopting the BOM lens on coordination mechanisms in SC contracting. The behavioral perspective has been increasingly incorporated in various operational contexts, such as service operations (Shunko *et al*., 2018), project management (Kwon *et al*., 2010; Lippman *et al*., 2013; Palit & Brint, 2020), revenue management (Kremer *et al*., 2017), procurement, and auction (Leider & Lovejoy, 2016), and trust in collaboration (Brinkhoff *et al*., 2015). Among all 12 operations fields categorized by Fahimnia *et al*. (2019), several manuscripts addressed SC issues (such as contracting and supplier-buyer relationships); thus, conducting a dedicated literature review in this field is worthwhile. We limited the scope of our research to the individual unit of analysis rather than the firm level. For a comprehensive review of overcoming coordination issues related to organizational level in SC projects, the reader is referred to Favilla & Fearne (2005).

The research objectives of this SLR are to:

1. analyze and synthesize the extant literature on BOM and SCC in contracting and supplier-buyer relationships;
2. provide a bibliometric analysis;
3. identify core behavioral theories and assess trends in behavioral SCCM developed over the years; and
4. identify limitations and current research gaps.

2.2.2. Identifying Relevant Data Sources

The analysis of SLRs in an SCM-related discipline revealed 1 to 9 databases (median=2) that were used to extract articles (Carter & Washispack, 2018). To capture the most relevant articles, we employed a search process with broad coverage across ten databases: *Scopus, ABI/INFORM Complete (ProQuest), Taylor* and *Francis Online, Wiley Online*

Library, *Emerald Plus*, *EBSCOhost*, *Web of Knowledge*, *Springer Link*, *SAGE*, and *Science Direct journals.* Search results were restricted to peer-reviewed English language publications from top-tier journals (Scimago Quartile 1). The search fields included: *title, abstract,* and *keywords* provided by the authors.

Designing a relevant and comprehensive set of keywords is key to the quality of the SLR. Search strings should be based on research objectives and inclusion/exclusion criteria (Durach *et al*., 2017). To fulfill this requirement, we enriched the set of keywords over three rounds by reviewing the contents of the obtained results and adding alternative keywords to the evolving library in each round. As shown in Table 2, we constituted a series of search strings and Boolean operators (e.g., AND, OR) to extract relevant articles related to the intersection between BOM and SCC in contracting and supplier-buyer relationships.

TABLE 2 - Set of keywords

Search Round	Keywords
Round 1	supply chain coordination, channel coordination AND behavioral/behavioural* operations
Round 2	supply chain coordination, channel coordination, collaboration, cooperation AND behavioral/behavioural* supply management, behavioral/behavioural* economics, behavioral/behavioural* experiment, behavioral/behavioural* supply, behavior/behaviour*, experiment, laboratory, risk/loss avers**/seek**, fairness, anchoring, bounded rationality, bias, reference dependence
Round 3	information sharing, knowledge sharing, information-sharing, knowledge-sharing, information technology, sharing benefits, joint decision making, bullwhip, align**, contract** AND behavioral/behavioural* operations, behavioral/behavioural* supply management, behavioral/behavioural* economics, behavioral/behavioural* experiment, behavioral/behavioural* supply, behavior/behaviour*, experiment, laboratory, risk/loss* avers**/seek**, fairness, anchoring, bounded rationality, bias, reference dependence AND supply chain

Note 1: The "*" shows that two different ways to spell the word have been considered in the keyword searching process (e.g., behavioral operations and behavioural operations); Note 2: The "**" shows that all the variations of the keyword have been used (e.g., alignment, aligning, etc.).

The first search round included broad behavioral operations and SCC terms that yielded 37 articles. To access the targeted articles with a higher precision rate, a preliminary examination of the first search round's findings was conducted by reading a dozen articles. This

helped us realize that salient methodologies (e.g., experiment) and commonly studied theories in this context (e.g., *bounded rationality*) could also represent the initially targeted keywords (e.g., SCC, BOM). We also included various forms of our initial keywords (e.g., behavior, behavioral), which yielded 252 articles in total. In the final step, we honed down the set of keywords by including a list of similar terminologies and words that could address the key phrase "supply chain coordination" (e.g., contract, information-sharing, bullwhip as in bullwhip effect). We extracted 569 articles after performing the last search round with the new strings shown in Table 2.

2.2.3. Refinement of Relevant Studies

To shape the final corpus of literature, each paper was independently reviewed by the authors. The appraisal criteria for an eligible paper to be included in the SCCM literature pool were as follows:

- The main idea of the paper had to be grounded in behavioral operations;
- The research questions and findings had to be relevant to SCCM.
  For the first criterion, we included articles delineating that:

- A behavioral perspective is incorporated in the research; and
- The discipline relates to SC and OM. For the second criterion, we considered articles within SCM including "contracting" and "supplier-buyer relationships".

The authors' contrasting opinions were jointly discussed as a team until a consensus was reached. After excluding irrelevant papers and eliminating duplicates, 89 journal articles remained (a complete list of the final article pool is in Table 5 in Appendix 1). Figure 2 illustrates the document collection process for the SLR.

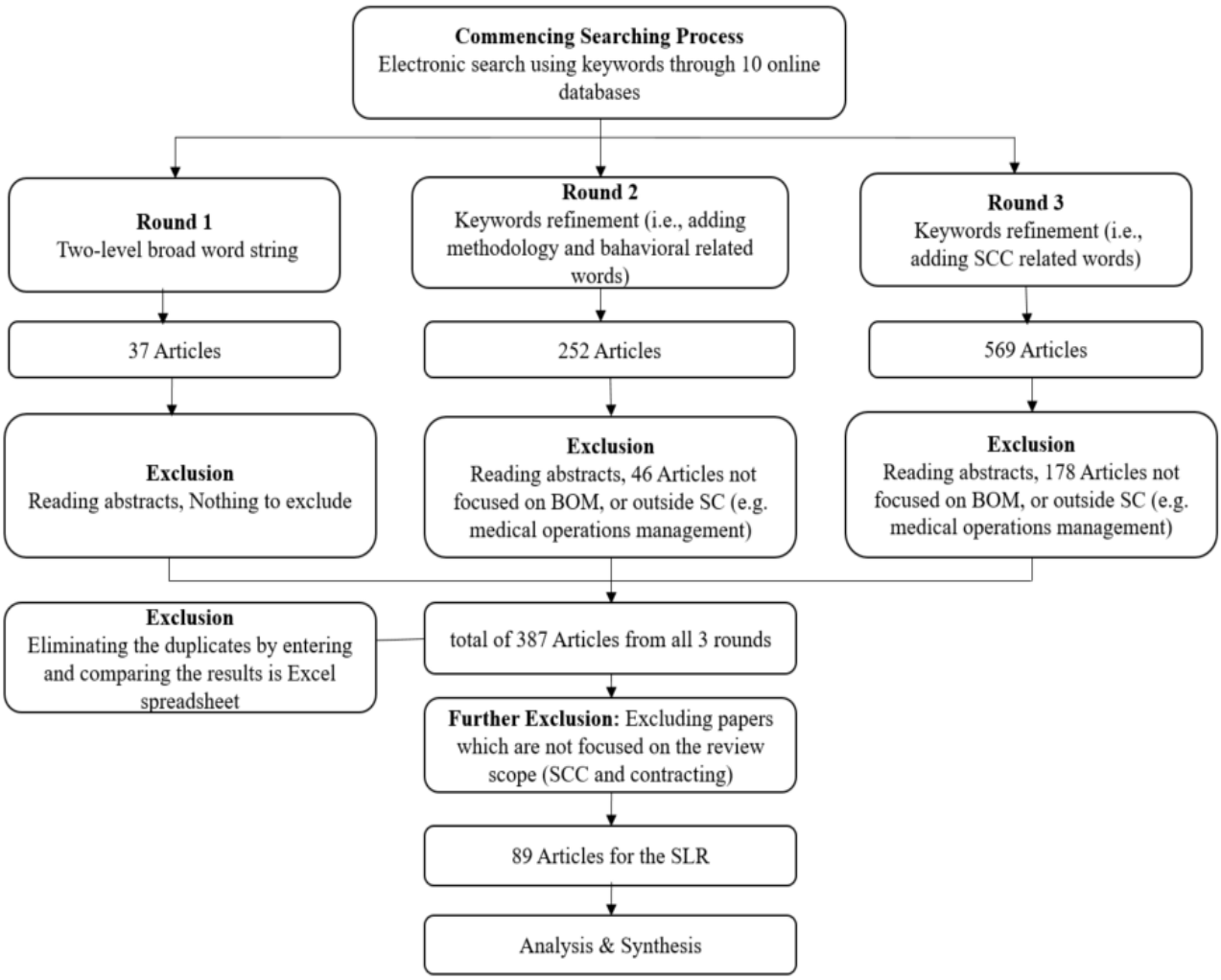


FIGURE 2 - Collection and Appraisal Process

From all the search rounds, we observed that the most relevant papers were found in two databases, *Scopus* and *Web of Knowledge*, confirming a finding previously presented in SCM/BOM SLRs (Fahimnia *et al*., 2015; Fahimnia *et al*., 2019). *SAGE* and *Springer Link journals* included the fewest articles in this review field. The search process was completed on October 6, 9, and 11, 2019. To ensure the reliability of the search process, it was repeated on October 16 and 17, 2019. Since the acquisition of new publications is a common process in databases, an alert was set for all search terms in all the databases two months from the initial search date to cover a whole year.

2.3. Data Statistics

To understand the research trends, the final paper pool was analyzed in terms of the contributing journals and institutes, publication year, and key researchers.

2.3.1. Descriptive Results

The analysis of the number of publications indicates a surge in this topic in the past six years: the number of annual publications peaked in 2014 (13), then declined, and then rose again in 2018 (13), showing that the BOM context vis-à-vis SCCM was attracting scholars' attention. As presented in Figure 3, publications from 2014 to 2019 represent about 67% of the papers related to the scope of this study.

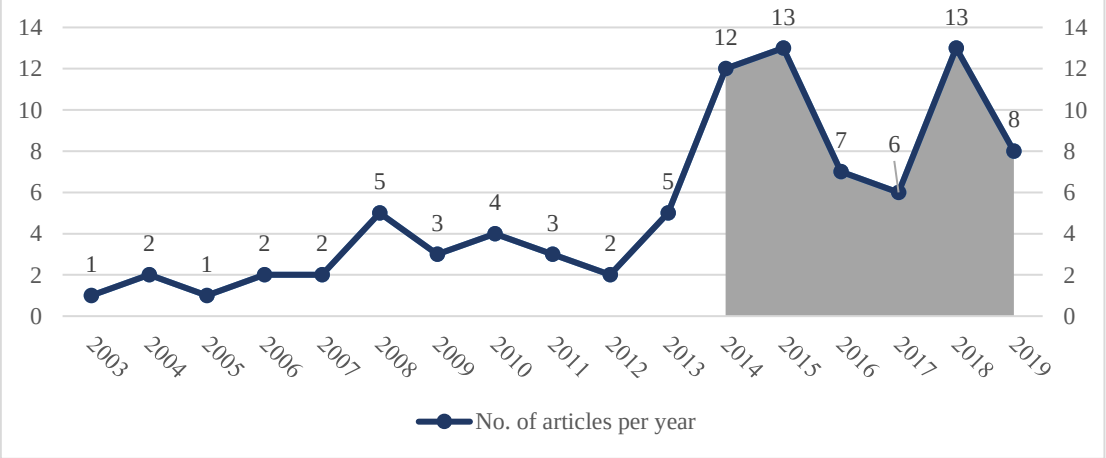


FIGURE 3 - Number of Publications over the Time Span (2003-2019)

The highest number of papers were published in *Production and Operations Management* (18), *European Journal of Operational Research* (14), *Management Science* (12), and *International Journal of Production Economics* (12). Although the articles were published in 21 journals, only half of the journals published more than one paper in this field. The time dimension analysis of publications shows a substantial contribution of two journals—*Production and Operations Management* and *Management Science*—in supporting the field in the seminal years of the emergence of this topic (2003–2014). However, publications within other disciplinary outlets, such as *Computers and Industrial Engineering* and the *Journal of*

Cleaner Production, demonstrate the importance of behavioral SCC in new fields of study in recent years.

The frequency analysis highlighted the following key contributing authors: Tsan-Ming Choi (13), Elena Katok (10), Andrew M. Davis (6), Karen Donohue and Suresh P. Sethi (5), Edwin Cheng, Shaofu Du, Tengfei Nie, and Dian Wu (4 each). The most prolific pair of authors are Karen Donohue and Rachel Croson, as well as Shaofu Du and Tengfei Nie, with three shared publications.

Institutional affiliation and the country where the institute is located were also analyzed. Affiliation analysis does not double count authors from the same institute and only considers one paper towards the total of a given institution. The leading contributing organizations were *The Hong Kong Polytechnic University* and *The University of Texas at Dallas*, with 13 and 12 papers, respectively. They were followed by *Penn State University*, with eight, and the *University of Minnesota*, with six publications. Another classification was based on the country of origin of the contributing organizations, with the United States (54), China (21), Hong Kong (19), Germany (6), and France (4) being the top five ranked countries. The United States had the greatest proportion of US-only affiliations, with 35 out of the 89 studies. Statistics show that several papers are produced through national collaboration, with only 30 of the extracted studies being international collaborations. The United States and China have the most international collaborations, contributing 19 and 15 studies, respectively. Receiving academic qualifications from US universities, collaborating with scholars from English-speaking countries, and boosting networks for newly qualified researchers (including experienced scholars) are some reasons for international collaborations. However, additional exploration and research are required to confirm these surmises.

Our analysis of the papers' authorship confirms that only about 7% of the articles are sole-authored. This is consistent with the authorship trend in the broad field of OM (Koufteros *et al*., 2021). Many studies (62%) are conducted with three or more authors (maximum of five authors); the average number of authors per paper is 2.74, and the average number of unique institutions per paper is 2.01. This shows the attention scholars pay to social networks that create information, expertise, and resource synergy.

We also analyzed the Google Scholar citation index of the papers, discovering that the average citation of the corpus of literature is 104.11, with averages of 121.5 and 110.8 for analytical modeling and experimental studies, respectively. The top four cited papers are Cui *et al.* (2007), Croson and Donohue (2006), Gan *et al.* (2005), and Gan *et al*. (2004). However, the citation analysis should be carefully considered, given that earlier publications have more time to develop the citation than recent articles.

TABLE 3 - Journals' Citation Impact and Productivity

Source Title	No. of articles	No. of times cited	h-Index
Production and Operations Management	18	2180	14
European Journal of Operational Research	14	1124	12
International Journal of Production Economics	12	702	11
Management Science	12	3112	12
Decision Sciences	5	369	5
Journal of Operations Management	4	640	4
IEEE Transactions on Systems, Man, and Cybernetics: Systems	3	177	3
Manufacturing & Service Operations Management	3	145	3
Omega	3	287	3
Computers & Industrial Engineering	2	40	2
International Journal of Production Research	2	127	2
Transportation Research Part E	2	76	2
Annals of Operations Research	1	21	1
Automatica	1	99	1
Business Research	1	10	1
Flexible Services and Manufacturing Journal	1	67	1
IISE Transactions	1	15	1
Journal of Business Economics	1	6	1
Journal of Business Logistics	1	23	1
Journal of Cleaner Production	1	36	1
Journal of the Operational Research Society	1	10	1

We also analyzed the journals' productivity based on the total citations of their publications and the h-index (Cronin & Meho, 2006; Coombes & Nicholson, 2013). *Production and Operations Management*, *European Journal of Operational Research*, *Management Science*, and *International Journal of Production Economics* had the highest h-indices of 14, 12, 12, and 11, respectively (see Table 3).

2.3.2. Literature Content Clusters

The use of the content analysis method to visualize the essence of a stack of documents is common, with some studies using "word clouds" to depict dominant concepts in the literature (e.g., Fahimnia *et al*., 2019). Studies show that conducting SLRs is a costly mechanism involving significant manual effort; consequently, researchers have called for investigating automated solutions (Michelson & Reuter, 2019). A computer-assisted qualitative data analysis (CAQDA) automated tool (*Leximancer*) was applied to facilitate the identification of sub-streams in a paper pool.

We used the rigorous text mining software *Leximancer* which follows natural language processing algorithms to extract common ideas in the text, allowing scholars to mitigate the issues of sample size, duration of analysis, and possible biases. Compared to other CAQDA tools, such as *NVivo*, *Leximancer* provides a wider range of "potentially useful keywords," avoiding a narrow focus on specific anecdotal evidence (Sotiriadou *et al*., 2014, p. 229).

By iteratively analysing word frequencies and their relationships (applying a machine-learning protocol), *Leximancer* produces a conceptual map. The visual presentation is akin to a heat map that portrays color-coded themes with smaller grey dots as nested concepts within the dominant theme (Leximancer, 2018). This rendering occurs when another keyword is frequently used in close proximity to a major theme. The circle size indicates the number of clustered concepts, and the proximity of circles and concepts showcases the strength of semantic relationships (i.e., distant circles for weak semantic relationships). To mitigate the

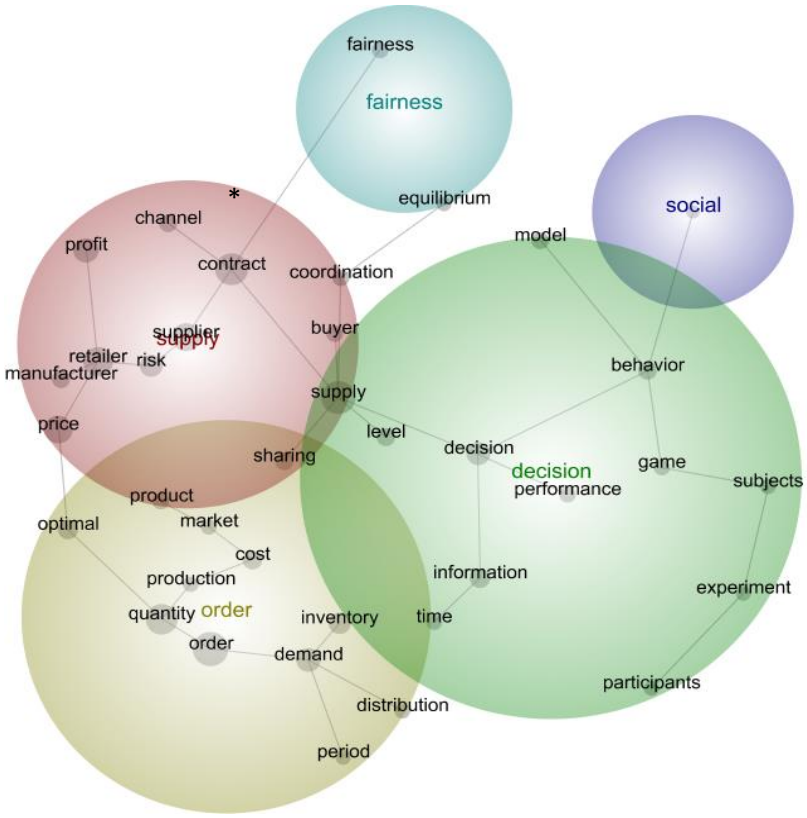
impact of repetitive text in the analysis, a two-stage process was applied, which involved excluding meaningless or irrelevant words (e.g., figure, table) and compounding variations of terms (e.g., supplier/suppliers); and deleting the abstracts, keywords, and references of articles because they simply reword and summarize the content or include information on other sources.

2.3.2.1. Primary Content Analysis Observations

The *Leximancer* conceptual map (Figure 4) suggests that contract parties (i.e., *buyer*, *supplier*, *retailer*, and *manufacturer*) are frequently nested concepts in the ***supply*** theme (in red). The connections between "*manufacturer*, *retailer*, *contract*" and "*retailer*, *supplier*, *contract"* show that dyadic relationships are a popular type of SC structure. *Sharing* is a highly ranked concept at the intersection of ***supply*** and ***order*** themes. By following the spanning tree, we arrive at the word combinations *information sharing* and *cost-sharing*, which suggest that the purpose of utilizing *contract*s is for *sharing* the conflict issues, balancing the *profit* share, and coordinating the *channel*. Similarly, the presence of *risk* delineates the role of *contract*s in *sharing* the *risk*, which stems from the lack of *information* about *production cost* and *demand distribution* (connected concepts). This concept can also address a "revenue-sharing" contract. Despite several contracts studied in the literature, our qualitative analysis shows that the focus was primarily on price-only, buyback, and revenue-sharing contracts, given their widespread use and the simplicity of modeling. Notably, *push* contracts (in which the upstream party pushes the product to a downstream party) are the most common type (Cachon, 2003). They are most prevalent in SCs that are strategically designed to support cost efficiency (at the expense of flexibility) and a "build-to-stock" strategy (upstream of the *push-pull* boundary in most SCs). However, few studies analyzed *pull* contracts, where the upstream agent holds the inventory and incurs the cost of unsold goods (Davis, 2015; Davis *et al.*, 2014; Yang *et al.*,

2018). *Pull* contracts are most prevalent in SCs that are strategically designed to support flexibility (at the expense of cost minimization) and a "build-to-order" strategy.

Making the *price* and *order quantity optimal* enhances the performance of SC. The conceptual map also shows that *risk* is directly connected to the *retailer*, suggesting two approaches: (1) emphasis on the *risk* attitude of the retailer as a behavioral implication; and (2) *risk*-taking of the retailer as a result of contract structure (e.g., taking the inventory risk).



* Including *push* and *pull* contracts

FIGURE 4 - Conceptual Map

Following the pathways between nested concepts in themes shows that when moving from ***supply*** to ***decision*** (green theme), the focus of studies is on *supply* chain *decisions* while analysing *behaviors* through *game*s. Connected dots within the *decision* theme indicate the role of *behavior* in the decision-making process. Regarding BOM, the presence of *behavior* and its impact on *performance* is identified as an expected driver. An explanation for the impact of

information on the decision-making process is the imperfect/asymmetric nature of the *information.* This shows that besides misaligned incentives, achieving coordination among SC members despite imperfect information needs to be considered. The connection between *time*, *information*, *decision*, and *performance* implies that *time* and *information* are key drivers of *decision performance* (i.e., the ability to make optimal decisions). The conceptual map reflects the wide utilization of *game* theory to investigate *performance* via *experiments* in this theme.

The connection between *behavior* and *experiment* suggests that methodologies were designed to assess human behavior. The literature analysis confirms that most studies adopted experiments as a part of their modeling toolkit (49%), followed by analytical approaches (mathematical optimization, 38%) and mixed methods (13%). The utilization of analytical modelling grew remarkably in 2018 and 2019, with 46% and 50% of studies using this method, respectively. Yet, acknowledging the inherent limitations of mathematical and analytical models, some scholars have taken advantage of interviews combined with experiments or analytical modeling to draw richer conclusions. As shown in Figure 5, the mixed-method category comprises several combinations: analytical modeling and experiment (6%), analytical modeling and sensitivity analysis (3%), analytical modeling and numerical experiment (2%), analytical modeling and interview (1%), and experiment and interview (1%).

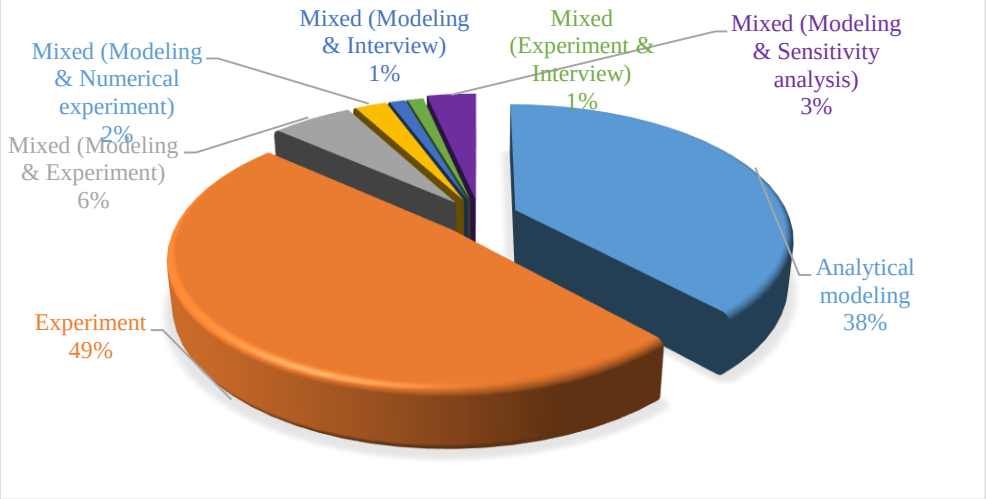


FIGURE 5 - Distribution of Methods in the Field

The third key theme, ***order*** (in yellow), is connected to *quantity*, which reflects the focus of the literature on determining the *optimal order quantity*. A component that influences decision-making about *optimal order quantity* is the wholesale *price* (edge of ***supply*** theme). The lower part of this pathway within the *order* theme illustrates that *demand distribution* and *inventory* are two components that influence decision-making about *order quantity*. The pathways between *order* and *supply* themes reveal that the *retailer's profit* is mostly determined by *decisions* that attempt to achieve the *optimal order quantity*. Concepts connected to *quantity* delineate the role of *production cost*, *product* type, and *market* strategies.

The fourth key theme, ***social*** (in purple), is connected to *decision* through *behavior* (as a concept). *Leximancer* queries indicate that the *social* theme primarily addresses *social* preferences as the most studied aspects affecting the *decision*. The connection between *coordination* and *equilibrium* shows that the goal of this concept pairing is achieving *equilibrium* in a *supply* chain. The last highlighted theme, ***fairness*** (in blue), draws attention to the concept of *equilibrium*. This may suggest that a Nash *equilibrium* point is considered a "fair" solution to the problem of channel *coordination*. The pathway between *fairness* and *contract* themes indicates the impact of *fairness* on *channel profit*.

2.3.2.2. Checking the Accuracy of *Leximancer* Map

We approached top contributing authors in this field for their views on how accurately the conceptual map reflects the research field. To improve engagement and for a specific understanding of *Leximancer*'s performance, we provided these scholars with personalized conceptual maps of their studies and received their comments through online meetings and written feedback. The result of five scholars' feedback in Table 4 shows that they agreed that both conceptual maps captured the critical concepts. They suggested that some terms, namely *retailer*, *agents*, and *seller*, could be represented in other ways. However, they contended that the connection between *retailer* and *supplier* is informative, as it reflects the commonly used

SC structure in the literature (i.e., dyadic SC). The other common feedback referred to the absence of some concepts, such as *double marginalization* and *prospect theory*. However, the *query* function of *Leximancer* showed that these hidden terms are nested in other concepts. Besides, some concepts are addressed along with their components (e.g., risk attitudes represent prospect theory).

TABLE 4 - The Summary of the External Engagement Responses

		Scope of assessment	
		Aggregated conceptual map	**Personal conceptual map**
Sentiment	**Generally positive comments**	**Scholar A:** "... So I think this is great. It actually reminds me a lot of Wikipedia real study your kind of algorithms working with human judgement, right. you come up with a forecast and then you tweak it right based on your own sort of intuition. I'd say with respect to the field, it looks pretty good"… "So you have both of those (e.g. information sharing and SC contracting) captured"... "So I would say it's, you know, in the broad strokes is good and need some massaging" **Scholar C:** "The aggregate map can reflect mostly the existing literature on this topic." **Scholar E:** "Both conceptual maps look reasonable and comprehensive"	**Scholar A:** "incentive for sure is on there. Right. So I'm glad that showed up because it's usually as a bonus, it is a monetary incentive"..."All those [concepts, i.e. inventory, bargaining, contracts] are good" **Scholar B:** "... coordination is just connected to contracts, which shows that contract is a way to make the coordination and cooperation so that it yeah, ... it actually covered one aspect of the coordination" **Scholar C:** "The Leximancer conceptual map can accurately reflect my studies." **Scholar E:** "Both conceptual maps look reasonable and comprehensive"
	Limitation and rooms for improvement	**Scholar A:** "I think Prospect Theory might have popped up, but I don't know if people would use Prospect Theory directly that much because there's so many components, right. Prospect Theory is combined with losses and reference points and probability weighting. So maybe that's why Prospect Theory doesn't show up." **Scholar B:** "... And so I don't know why decision box is a separate box and order is a separate box.... I think the terminology again you will say order sometimes the ordering decision, sometimes a decision, same thing can be said in different ways..." **Scholar C:** "I would like to provide more relevant keywords in the field for your reference, such as, coordination, loss aversion, social preference, profit, utility, behavioral experiment, cognitive bias." **Scholar D:** "...[by using this types of software] things will be in the dark and I always find counter-examples (something missing or something wrong). I think you need to justify why your method makes sense. What people cannot do without your method, and double check for accuracy. "	**Scholar A:** "I think like retailer...I would hope for something more like two stage supply chain where a retailer requires a necessary component ... I kind of used that as a generic term to represent any buyer". **Scholar B:** "...the seller box. I'm not sure it has any meaning"..."sometimes we change the terminology is not always sometimes the retailer could remain retailer. Sometimes you could call it a seller, sometimes an agent"..."there is a word which appears in this literature called double marginalisation. Yeah, that's a bit my language is not showing up in your boxes"..."So those three terms (e.g. decentralized, coordination, contract) right now are kind of not connected the way I would see them to be connected in different places"..."so that connection goes through contract, profits, supply, retailer order, quantity, period, manufacture and centralized. Yeah, it [period] is not necessary. Because period only comes in the problems. Ah, yeah, it is not an essential part of most of these papers except the two period paper....It's not a necessity to be appeared in between the centralised and contracts and the coordination"...

2.3.3. Theoretical and Behavioral Classifiers

To develop a more detailed understanding of coordination mechanisms that is consistent with the content analysis, which shows that the largest theme is the ***decision*** (Figure 4), we further split the corpus of papers into schools of thought and theories. The behavioral SCCM literature reflects two categories of behavioral approaches: (1) diverse preferences of decision-makers; and (2) decision heuristics. The "bucket" of diverse preferences captures details regarding the attributes that decision makers care about, such as loss-aversion, risk aversion, and social preferences. Heuristics capture items such as anchoring, reference dependence, and bounded rationality. The SLR conducted by Kwon and Silva (2020) on behavioral theories suggests that prospect theory (Tversky & Kahneman, 1974) and the theory of bounded rationality (Simon, 1972) appear in the literature more often than do other theories.

Our analysis confirms that prospect theory (40%) is the most dominant, followed by social preference theory (29%), and anchoring/reference dependence (22%). Bounded rationality (13%), mental accounting (2%), and others (2%) constitute the remaining proportion of categories (see Figure 6).

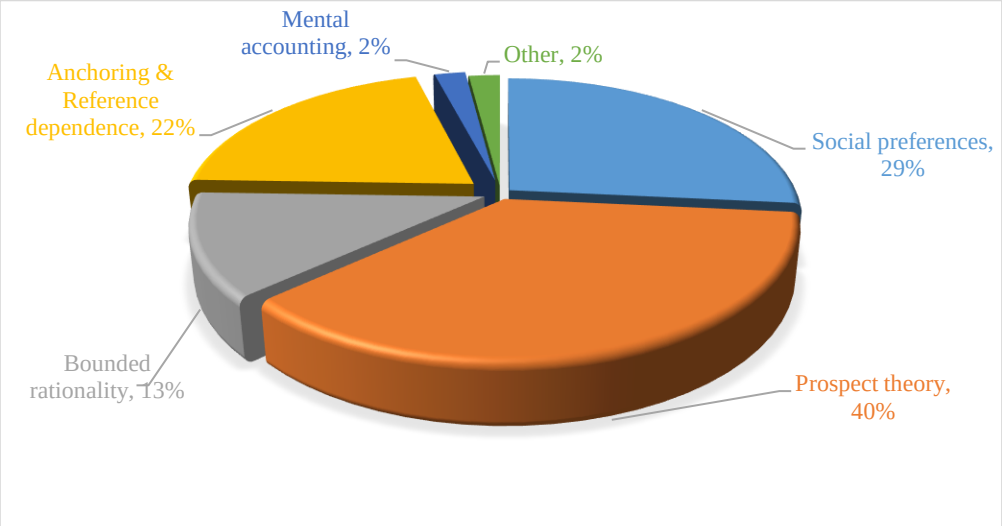


FIGURE 6 - Distribution of Studies Based on the Theory

Our analysis shows that the research on *social* preferences grew from 17% between 2003 and 2013 to 35% of all publications between 2014 and 2019. Research on prospect theory

(i.e., risk-aversion and loss-aversion) has undergone a small decline from 48% in the early years (between 2003 and 2013) to 37% between 2014 and 2019. The trend of studies on other behavioral biases remained steady over the reviewed years. Our finding indicated that "social preferences" is the broadest domain in BOM studies.

These theories have been tested in different settings, highlighting four driving factors affecting decision-maker perceptions: contractual (e.g., complexity, level of risk-sharing), environmental (e.g., demand fluctuation or supply disruptions), structural (e.g., competition in SC, long-term relationships), and individual (heterogeneity in circumstances and preferences) factors.

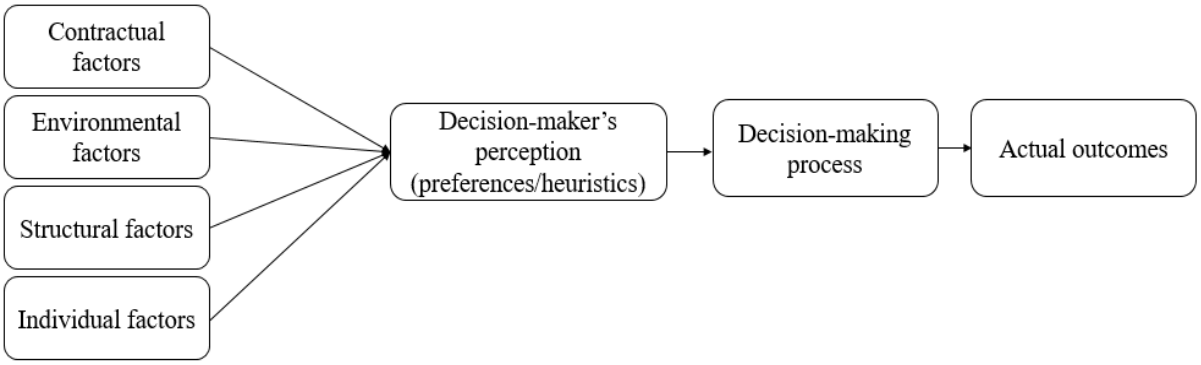


FIGURE 7 - Conceptual Framework

They influence the decision-making process, and the channel ends up deviating from theoretical predictions in terms of actual outcomes. Based on this analysis, a conceptual framework is illustrated in Figure 7.

2.3.3.1. Diverse Preferences

Prospect Theory

Prospect theory not only explains how individual risk attitude depends on the decision context (Tversky & Kahneman, 1974) but also shows that people exhibit different preferences, systematically deviating from rational predictions. The notions underpinning prospect theory are *reference dependence*—which discusses the utility perception of the distance from a reference point rather than the absolute utility of outcomes—and *likelihood dependence*—

which refers to non-linear probability distortion by decision-makers. Achieving channel coordination is negatively impacted if the risk sensitivity of SC members is not considered in contractual settings because of the propensity to order less than the optimal level (Chiu *et al*., 2011; Wu *et al*., 2010; Xu *et al*., 2014; Avinadav *et al*., 2015a,b). Consequently, some studies designed contracts incorporating the risk attitudes of SC parties (Zhao & Zhu, 2018; Lu *et al*., 2019). Including coordinating policies will enhance channel performance by inducing risk-averse agents to order close to the optimal quantity. Some of the proposed policies are coupling contracts with a coordinating return policy (Gan *et al*., 2005; Choi *et al*., 2008) and two-way revenue sharing (i.e., a traditional revenue-sharing contract with a reverse one) (Xu *et al*., 2014). Ohmura and Matsu (2016) found that, in a dyadic SC, if both agents, manufacturer and retailer, are highly risk-averse, a full-return policy is preferred over a no-return one.

The literature demonstrates that an amalgamation of SC members' risk-aversion with non-contractual conditions (e.g., cost uncertainty, product margin) may influence channel efficiency (Chow *et al*., 2014; Zhao *et al*., 2017; Wuttke *et al*., 2018). Besides, the level of risk-aversion impacts contract performance by increasing the order quantity in a *push* more than in a *pull* contract (Davis *et al*., 2014; Yang *et al*., 2018). Choi *et al*. (2008) indicated that a channel could be more efficiently coordinated if agents display a similar level of risk preferences, while Wang *et al*. (2017) showed that contract coordination could be affected by private information regarding the retailer's risk aversion and the manufacturer's production cost. Studies indicate that channel coordination is likely to be achieved if the least risk-averse agent takes the channel risk (Gan *et al*., 2004, 2005; Chen *et al*., 2014; Choi *et al.*, 2018). Wei and Choi (2010) showed that the retailer could gain better profit by exhibiting a less risk-averse attitude, as the manufacturer offers a lower wholesale price. Conversely, a more risk-averse retailer makes the manufacturer demand a higher wholesale price (Choi *et al*., 2018; Choi *et al*., 2019). Shen *et*

al. (2013) showed that the retailer would receive a higher optimal markdown offer when the supplier is less risk-averse.

SC agents may demonstrate different aversion attitudes towards the cost of leftovers and stock-out costs, with a greater perception of loss attributed to the former (Becker-Peth *et al*., 2013). Overweighting losses cause ordering bias and order inflation (Shen *et al*., 2011; Becker-Peth *et al*., 2013), demonstrating that loss-aversion and loss-averse mitigating provisions should be considered in contract design (Wang & Webster, 2007; Villa & Castañeda, 2018). Moreover, SC agents view other contract elements, besides overstock or shortfalls, such as fixed fees, bonuses, or payback amounts, as losses (Wang & Webster, 2007; Katok & Wu, 2009; Shen *et al*., 2011; Davis *et al*., 2014; Davis, 2015). Villa and Castañeda (2018) showed that although participants exhibit aversion to the cost of leftovers, they also prefer leftovers to shortage (to avoid unsatisfied customers). Davis (2015) showed that although, theoretically, the coordinating contracts (service-level agreement or payback) outperform non-coordinating contracts (wholesale price), the increase in profit is significantly lower than the theoretical predictions because agents view the payment for the coordinating parameters as a loss.

Zhang *et al*. (2016) showed that, despite a mathematically equivalent performance (i.e., profit) of revenue-sharing and buyback contracts, a higher newsvendor critical ratio impacts loss perception; in these conditions, a revenue-sharing contract can outperform a buyback contract. The preference between these two contracts is also affected by market demand (Katok & Wu, 2009), as a low-demand market induces the loss-averse retailer to select revenue-sharing contracts, while, for higher demands, a buyback contract is preferred. Under a simple wholesale price contract and in an environment with uncertain demand and spot purchase prices, a loss-averse manufacturer will order a larger quantity as the uncertainty increases (Shen *et al*., 2011). Research demonstrates that in line with the theoretical prediction, a *pull* contract outperforms

a *push* contract in terms of channel efficiency. However, the order quantity is far from the predictions due to loss aversion (Davis *et al*., 2014).

Social Preferences Theory

One of the underlying theories in the BOM context is that of *social preferences*, which shows the intrinsic concern of SC members towards their counterparts' payoffs (Fehr & Fischbacher, 2002). Although it is believed that people pursue their self-interests, empirical results (e.g., Kahneman *et al*., 1986) demonstrate sensitivity towards positive or negative inequity considerations. Social preferences act as much as economic motives, such that salient relationships lead to better collaboration and channel performance improvements (Loch & Wu, 2007; Kirshner & Shao, 2018). There are different types of social preferences:

- Preference for reciprocity refers to responding to the perceived behavior of a reference agent in the same way (exhibited regardless of retaliation or any exception for material gain in future interactions; Fehr & Fischbacher, 2002). Studies show that it can positively impact the SCC (Du *et al*., 2014b; Katok *et al*., 2014; Wu, 2013), while lack of reciprocity can be detrimental (Qin *et al*., 2016). Regarding product quality, reciprocity between channel echelons can enhance relation-specific investment (Haruvy *et al*., 2019). Croson *et al*. (2014) showed that uncertainty/lack of trust regarding the actions of other SC parties causes coordination risk, which leads to ordering oscillation and the bullwhip effect. Channel performance is also enhanced in a multi-period relationship and by repeated interactions due to reputation-building behaviors (Wu, 2013; Choi & Messinger, 2016). Davis and Hyndman (2018) suggested that relational incentives (the credible threat of future punishment, e.g., terminating the purchase) improve product quality and SC efficiency.

- Inequity aversion refers to the tendency of individuals to compare their status with other SC parties, particularly regarding payoffs (Bolton & Ockenfels, 2000). The driver of this behavior is "altruism" or "envy" when attempting to achieve an equitable distribution of payoffs. "Pure altruism" refers to kind behavior, irrespective of the received/perceived behavior. On the other hand, spiteful attitudes made participants value the payoff allocated to their counterparts negatively (Falk *et al*., 2001, as cited in Fehr & Fischbacher, 2002). The envious behavior may be translated into a willingness to reduce the counterpart's payoff even at a personal cost. Since inequality aversion exists even in interactions between a human and a computerized SC member (Kalkanci *et al*., 2014), studies suggest that SC contract designers should take into account fair outcomes rather than structure SC contracts according to financial payoffs (Caliskan-Demirag *et al*., 2010; Haruvy *et al*., 2019). Distributional fairness examines the sensitivity of fairness-concerned agents towards their counterparts' profit (Caliskan-Demirag *et al*., 2010; Nie & Du, 2017). Johnsen *et al*. (2019) showed that knowing the suppliers' production costs provokes inequity aversion among retailers, who may utilize strategic inventory to increase their fair profit share and limit the suppliers' power by reducing the average price (Hartwig *et al*., 2015). Studies show that an upstream party with incomplete information about the retailer's inequality aversion negatively impacts channel coordination (Katok & Pavlov, 2013). However, under a price contract, social preferences may lead to an equitable split of profit distribution due to the generosity of the supplier (Niederhoff & Kouvelis, 2016).

In addition, competition among peers in a horizontal SC level (e.g., multiple retailers/suppliers interacting with a counterpart agent) introduces peer-induced fairness, which can sometimes be even more significant than distributional inequity aversion. In other words, among two competitive retailers, the second is more concerned about the peer's payoff than of

a counterpart's (supplier) (Ho *et al*., 2014). However, Nie and Du (2017) demonstrated that under the quantity discount contract, the impact of distributional fairness is greater than that of peer-induced fairness on retailers' decisions. Chen *et al*. (2015) showed that although using a backup supplier can mitigate yield uncertainty, the backup supplier's horizontal fairness concern may negatively affect the manufacturer's profit.

Besides *self-centred fairness* (i.e., distributional and peer-induced fairness), there is *peer-regarding fairness* (Du *et al*., 2018). A few studies investigated detailed layers of fairness concern. Cui *et al*. (2007) investigated two types—advantageous and disadvantageous—of inequality aversion. Du *et al*. (2018) posited that the two perspectives of peer-regarding fairness are sympathy (empathy for a peer's negative outcome) and schadenfreude (reveling in a peer's misfortune). If the retailer exhibits schadenfreude fairness, it could reduce the channel and the retailers' profit, but showing strong sympathy fairness may increase the retailers' share of the channel surplus.

Researchers showed that different levels of fairness among SC members also influence channel performance. Agents' relatively high fairness concern obliges their counterparts to favor their claim (Du *et al*., 2014a; Sharma *et al*., 2019). Some studies designed contracts that are robust to fairness concerns, employing different solutions such as higher profit differences between contract alternatives under a "menu of contracts" by the supplier (Voigt, 2015) or eliminating the disadvantage by equally distributing the minimum profit share rate (Chow *et al*., 2015).

2.3.3.2. Heuristics

Decision heuristics represent an intuitive, rapid system (Shiloh *et al*., 2002) that attempts to accelerate the decision-making process and make the judgment operation simpler (Tversky & Kahneman, 1974) by reducing the effort through (1) incorporating less

information; (2) testing fewer signals; (3) testing fewer alternatives; (4) simplifying the storage and retrieval of signal values; and (5) simplifying the signals' weighting (Shah & Oppenheimer, 2008). The underlying mental process of this category is reactive. A review of studies across various disciplines (Gigerenzer & Gaissmaier, 2011) indicated that employing decision-making heuristics may be more accurate than utilizing complex rational strategies. Cantor and Macdonald (2009) showed that under limited (local) information, abstract thinkers could outperform concrete thinkers. However, when exposed to system-wide information, both groups find it overwhelming, and the difference in their performance is negligible. Studies show that the higher the cognitive profile of a decision maker (i.e., the tendency to allow "structured problem-solving processes to monitor an intuitive answer"), the lower the order variability and bullwhip effect (Narayanan & Moritz, 2015, p. 1216). Grounded theories supporting these heuristics include bounded rationality, anchoring, reference dependence, and mental accounting.

Bounded Rationality Theory

Bounded rationality refers to "making rational decisions within the limits of the available information and mental capabilities" (Simon, 1972, p. 162). It can be the result of complex, incomplete information about the alternatives, risk, and uncertainty, which compound the cognitive burden. Consequently, when complexity increases, decision makers rely more on heuristics and as such, simple contracts can perform better in practice (Kalkanci *et al*., 2011, 2014; Johnsen *et al*., 2019). The level of uncertainty also amplifies the bounded rationality bias, which diminishes the supplier's decision-making efficiency (Katok & Pavlov, 2013). Ancarani *et al*. (2013) showed that the level of uncertainty (e.g., coupling two uncertainties, such as lead time and demand) increases the ambiguity of decision-making; moreover, SC echelons hold less inventory in response to supply uncertainty. *Reinforcement* (i.e., inertia and favoring past decisions) and *memory biases* (i.e., short-sighted calculations

influencing decision-making) are some of the reasons for this preference (Kalkanci *et al*., 2011; Wu & Chen, 2014). Hartwig *et al*. (2015) demonstrated that a boundedly rational supplier prefers simpler contracts over nonlinear contract schemes due to the possible strategic risk of the retailer. Besides, bounded rationality increases the possibility of suboptimal decisions in setting contractual parameters, which leads to relatively poor SC performance (Katok & Pavlov, 2013; Qin *et al*., 2016).

Bounded rationality's impact also manifests in channel coordination when information-sharing is employed as a risk mitigation strategy to alleviate the bullwhip effect (Tang, 2006). Despite the presence of rich information and relaxing/controling all the operational causes of the bullwhip effect, this phenomenon still exists, causing decision-makers to depart from optimal order quantity (Croson & Donohue, 2014; Zhao & Zhao, 2015). SC owners need to be careful about sharing information, as overloading decision makers with information may lead to poor performance (Steckel *et al*., 2004; Cantor & Macdonald, 2009; Tokar *et al*., 2012). Although sharing point-of-sale information alleviates the bullwhip effect in a stable demand setting by reducing the order oscillation in environments with more dynamic demand, particularly at the channel's higher echelons (Steckel *et al*., 2004), it can dampen the channel efficiency (Croson & Donohue, 2003). They suggested that under a non-stationary demand setting, providing additional information may bias the demand estimation of upstream parties. Kalakbandi (2018) demonstrated that under- or over-reporting costs in revenue-sharing or buyback contracts, respectively, increase the value of these contracts. Currently, the impact of obtaining information through social media has become significant. In a fashion quick response program, the value of quick response has been affected by social media comments and moderated by the attitude of the agents (optimistic, pessimistic, or neutral) about the future market demand of the product (Choi, 2015).

Experimental studies suggest that the gain of SC parties (i.e., downstream vs. upstream) from sharing information is not necessarily equal (Croson & Donohue, 2006; Sarkar & Kumar, 2015). Sharing disruption information of a downstream echelon does not significantly improve the SC performance (Sarkar & Kumar, 2015); however, sharing inventory information helps upstream echelons to anticipate the demand fluctuations in downstream echelons (Croson & Donohue, 2006).

Haines *et al*. (2017) showed that incorporating pieces of information in decision-making depends on how well the decision makers understand cause-effect relationships in the SC. The higher the perception of "analysability," the better the use of demand information and the better the performance. Higher procedural rationality (i.e., the extent of including relevant information in the decision-making process) results in lower inventory management costs (Haines *et al*., 2010). Decision makers also select information based on their perceptions of its relevance to performance (Haines *et al*., 2017). This can be a cost-saving strategy, highlighting the importance of learning and training in SC. Wu and Katok (2006) indicated that SC performance is enhanced when training is coupled with communication among SC members, eliminating instances of bounded rationality, and even more remarkable if training is not limited to one member's role but includes system-thinking and knowledge of the whole SC. Tokar *et al*. (2012) confirmed that providing declarative knowledge (i.e., descriptive, conscious knowledge that can be verbalized) through instructional training enhances inventory management.

Reference Dependence and Anchoring

R*eference dependence* and *anchoring* are key cognitive aspects of prospect theory. Reference points can emerge from many different sources, such as salient counterfactuals (Kahneman & Miller, 1986), expectations (Mellers *et al*., 1997), and the status quo (Kahneman *et al*., 1991). Reference dependence demonstrates how people frame outcomes based on a

reference state to evaluate the cost and benefits of a decision. Anchoring refers to relying heavily on initial information in making decisions and failing to adequately adjust for subsequent information. It comprises two focal points: (1) contractual parameters; and (2) outcome-dependent anchoring, which stems from a partial computation (Tversky & Kahneman, 1974). Our analysis shows that in the newsvendor setting, the market demand is a source of uncertainty that influences channel members vis-a-vis their order quantity decisions. Due to outcome-dependent anchoring bias, SC agents tend to set the order quantities near the mean demand, one of the most provided pieces of information to newsvendors (Katok & Wu, 2009; Becker-Peth *et al*., 2013; Kalkanchi *et al*., 2014; Davis, 2015; Villa & Castañeda, 2018; Castañeda *et al*., 2019).

Davis and Hyndman (2019) demonstrated that channel parties do not exploit their bargaining power due to anchoring bias; they suggested that under a simple wholesale price contract, including negotiation of both order quantity and wholesale price leads to higher channel efficiency. Wu and Chen (2014) highlighted recency bias, reinforcement, and chasing the most recent demand as the causes of deviation from theoretical predictions. Embedded thresholds in a contract (such as fixed-fee) may also act as alternative anchoring points (Ho & Zhang, 2008). Consequently, a loss-averse decision maker, who considers fixed-fee as a loss, may choose a quantity discount contract with a less salient discount, which outperforms the mathematically equivalent two-part tariff contract. Option contracts and service-level agreements can effectively induce first-best investment rates while intensifying "superficial fairness." That is, channel parties narrowly focus on the wholesale price rather than any secondary parameter associated with contracts (Davis & Leider, 2018).

Katok *et al*. (2008) observed a forward-looking bias that incorporates the expected profit in decision-making. They showed that in a service-level agreement contract with a high and medium-size bonus, longer review periods induce higher order quantities by reducing

demand chasing, decreasing the variability of feedback, and helping decision-makers focus on bonuses. Kirshner and Shao (2018) studied the impact of an internal reference point that stems from the disutility caused by an ex-post inventory error. A fully informed supplier with the retailer's behavioral biases can increase the wholesale price, leading to higher order quantity and channel coordination for low-profit margin products. Davis (2015) also showed that decision-makers consider a psychological cost for over- and under-stock by setting the demand as the reference point.

SC agents (generally downstream parties) are also subject to systematic underweighting of the supply line (i.e., on-order inventory) by following anchoring and adjustment policies (Sterman, 1989). This will cause over-ordering, which will significantly increase the bullwhip effect (Croson & Donohue, 2003, 2006; Croson *et al*., 2014; Narayanan & Moritz, 2015). Under stochastic demand, channel performance is adversely influenced by underestimating the supply line. Seasonal demand and costly order changes due to production capacity constraints induce order smoothing behavior (Cantor & Katok, 2012). Although order smoothing is employed to eliminate the "bullwhip effect," the presence of demand shocks can question the positive impact of this policy (Udenio *et al*., 2017). On the other hand, agents deal with inventory mismatches (i.e., desired vs. actual inventory) by overreacting and ordering more. Although this may be beneficial in cases of demand shocks, its excessive level degrades channel performance. Rong *et al*. (2008) showed that supply disruptions could cause a reverse bullwhip effect (i.e., order quantity variability as we move down the channel) due to overweighting the supply line and overreacting to capacity shocks.

A solution to anchoring bias is to provide complete information to SC parties, which improves downstream echelons' stock-out costs by alleviating the supply underestimation bias. However, it cannot enhance SC performance, as it may increase supply expectations and any deviation from which will lead to repeated severe irrational orders (Zhao & Zhao, 2015). Since

one of the triggers of anchoring bias is the limited attention span of decision makers, improving the learning trend and weakening demand chasing by providing collective feedback, such as total profit, can reduce this bias (Elahi *et al*., 2013; Kalkanci *et al*., 2014; Wu & Chen, 2014). However, Li *et al*. (2015) demonstrated that the manufacturers may not be willing to increase the learning rate significantly (a consequent lower production cost is expected) because it will lead to lower wholesale prices that will negatively impact their profitability.

Mental Accounting Theory

Mental accounting gives rise to a novel evaluation of different income streams and financial transactions. Despite the outcome-oriented belief in normative theory, people evaluate materially equivalent outcomes/events differently, based on their perception of how they are obtained, following a source-dependence effect. Mental accounting refers to coding, categorizing, and evaluating the processing of financial decisions following a specific framework (Thaler, 1985). People who engage in mental accounting categorize their activities into "mental accounts" rather than accumulating all the activities needed to make a decision.

As an aspect of mental accounting, contract-specific reference points were investigated by Becker-Peth *et al*. (2013), who suggested that people apply source-dependent valuations of income in their decisions (e.g., sale income vs. returned items' income under buyback contract), which leads to decision biases. Becker-Peth and Thonemann (2016) designed a customized revenue-sharing contract to influence inventory decision-making behavior and offer robust solutions to potential reference points in contracts.

2.4. Conclusion and Avenues for Future Research

Despite increasing globalization and international interactions, investigations on the impact of cultural background on contract design have remained largely unaddressed. Empirical research confirms the effect of culture on contract performance and on undertaking

different strategies to reduce the bullwhip effect (Shan *et al*., 2014; Lee *et al*., 2018). Thus, uncovering the role of cultural impact and considering the impact of collectivistic and individualistic cultures on decision-making will shed light on the performance of international organizations. The endogenous membership process and the costly protocol (i.e., entry fee) for channel membership (Fan *et al*., 2018) should be the focus of further studies in the future.

Considering prospect theory, several effects deserve further attention, namely the *fourfold pattern of risk preferences* that discusses situations in which people are prone to be risk-averse and risk-seeking versus the probability and the perceived loss/gain. Another aspect scarcely discussed is the *diminishing sensitivity* to gains and losses. The *framing effect* can also be explored to show how the perception of loss/gain of an option counters its constant prospects following the way it is presented. Analysis of social preferences shows that studies on *reciprocity* are fewer than those on *inequality aversion*, perhaps due to simpler modeling of the latter; yet, the impact of reciprocity is stronger than inequity aversion (Fehr & Fischbacher, 2002). Therefore, it is worth addressing this prediction by simultaneously studying different social preferences and their interactions.

Heuristic-related theories require further exploration. Advancements in big data and high-tech tools, platforms, and devices necessitate incorporating the effect of these advanced complexities on decision-making. Despite our analysis of different reference dependence types, some, especially status quo or forward-looking biases such as expectation-oriented bias, have received little consideration in the literature.

In terms of methodology, vignette-based methodology and field experiments are suggested for future research. Although experiments can portray a real-world setting, combining field experiments with qualitative interviews and adding external validation to findings can be a new contribution to the current body of literature. However, the lack of sufficient control over influential factors and their resource-intensive nature may prevent

scholars from adopting a broader strategy for field experiments. Human-to-human experiments have advanced the negotiation and bargaining protocol, and the concept of contract breach and utilization of *renegotiation process* in SC parties' interactions has been overlooked in BOM (Sloof *et al*., 2006).

Considering the global impact of the recent COVID-19 pandemic, supply disruptions have illuminated the crucial need for robust manufacturing and distribution (medical equipment and pharmaceuticals in particular) of SC contract redesign and reconfiguration. Thus, contracts that explicitly incorporate remedies for supply disruptions and limited production capacity on the upstream side (imperfect information) would be a fruitful direction for future research. An insufficiently explored area in SC structure is the multi-period SC that investigates the impact of sequential iterations of decisions on SCC outcomes. This area can be a successful avenue for future research. Although modeling complex environments is challenging, including asymmetric information and supplier reliability would help SC managers alleviate the impact of associated risk in a contractual setting.

Traditionally, research on SC contracts and BOM aimed at maximizing the economic value of the SC as its single goal. Yet, economic development needs to consider social and environmental perspectives for long-term sustainability. With the increase in popularity of closed-loop SC (Zhao & Zhu, 2018) and the growth of green SC, examining the BOM in a reverse SC is a promising research area. Scholars can assist in the efficient implementation of the United Nations sustainable development goals (i.e., responsible consumption and production, economic growth, and reducing inequality) by considering new behavioral constructs.

The growing concern about uncertain lead-time, unpredictable stock-outs, and scarce resources are some of the triggers of ordering biases. Brittle SCs are prone to supply disruptions and behave differently when interacting with different product types. Based upon Kraljic's

matrix for procurement (1983), we anticipate that contracts designed to take behavioral factors into account will affect the "strategic and bottleneck items" the most because of the relatively limited number of suppliers in the overall procurement portfolio of the buyer. The incorporation of *product* and *supplier* types will also shed light on decision makers' behavioral biases and their impact on channel coordination. In addition, the most common SC structure is a simple serial or dyadic SC. However, global interactions among different tiers of an SC require extending the number of associations within the SC. Moreover, the authors call for literature reviews of the operational fields, such as project, service, and revenue management, to unpack the evolution of BOM across different disciplines and provide a holistic view for scholars and practitioners.

Even though behavioral issues and SCCM are well-established concepts in the academic field, from the business perspective, their real-world importance is still valid. Investigating behavioral factors that potentially influence the critical operational decisions of SC practitioners will help design more efficient SCCM and more effective contracts, ultimately leading to a richer decision-making process.

Learning about the behavioral drivers of decisions and quantifying the behavioral influences will provide (1) a deeper understanding of the deviations from normative decision theories, (2) lead to a higher precision rate for predictive models of the actual decision in an operational setting, and (3) can potentially act as a proactive mechanism to prescribe optimal decisions. More specifically, this research field ultimately helps organizations enhance performance through robust and well-designed systems by taking relevant behavioral factors that guide practitioners' decisions in times of uncertainty into account.

Appendix 1

TABLE 5 - Pool of Papers

Reviewed Articles	Year	Source Title	Focus of Theory	Research Method	No. of times cited
Croson & Donohue	2003	Production and Operations Management	Reference dependence & Anchoring	Experiment	339
Gan *et al.*	2004	Production and Operations Management	Prospect Theory (Risk attitude)	Analytical modeling	431
Steckel *et al.*	2004	Management Science	Bounded Rationality	Experiment	260
Gan *et al.*	2005	Production and Operations Management	Prospect Theory (Risk attitude)	Analytical modeling	445
Croson & Donohue	2006	Management Science	Reference dependence & Anchoring	Experiment	633
Wu & Katok	2006	Journal of Operations Management	Bounded rationality	Experiment	261
Cui *et al.*	2007	Management Science	Social Preferences (Inequity aversion)	Analytical modeling	707
Wang & Webster	2007	Decision Sciences	Prospect Theory (Loss aversion)	Analytical modeling	243
Choi *et al.*	2008	European Journal of Operational Research	Prospect Theory (Risk attitude)	Analytical modeling	259
Choi *et al.*	2008	Omega	Prospect Theory (Risk attitude)	Analytical modeling	212
Ho & Zhang	2008	Management Science	Reference dependence & Anchoring Prospect Theory (Loss aversion)	Experiment	385
Katok *et al.*	2008	Manufacturing & Service Operations Management	Reference dependence & Anchoring	Experiment	95
Loch & Wu	2008	Management Science	Social Preferences (Fairness concern)	Experiment	269
Rong *et al.*	2008	Flexible Services and Manufacturing Journal	Reference dependence & Anchoring	Mixed methods (Experiment & Sensitivity analysis)	67
Cantor & Macdonald	2009	Journal of Operations Management	Bounded rationality	Experiment	119
Katok & Wu	2009	Management Science	Prospect Theory (Loss aversion) Reference dependence & Anchoring	Experiment	292
Caliskan-Demirag *et al.*	2010	European Journal of Operational Research	Social Preferences (Inequity aversion)	Analytical modeling	235
Haines *et al.*	2010	Journal of Business Logistics	Bounded rationality	Experiment	23
Wei & Choi	2010	European Journal of Operational Research	Prospect Theory (Risk attitude)	Analytical modeling	181
Wu *et al.*	2010	Int. J. Production Economics	Prospect Theory (Risk attitude)	Analytical modeling	77
Chiu *et al.*	2011	Automatica	Prospect Theory (Risk attitude)	Analytical modeling	99
Kalkanci *et al.*	2011	Management Science	Bounded Rationality	Experiment	148
Shen *et al.*	2011	Int. J. Production Economics	Prospect Theory (Loss aversion)	Analytical modeling	35
Cantor & Katok	2012	Transportation Research Part E	Bounded rationality	Experiment	42

Ancarani *et al*.	2013	Int. J. Production Economics	Bounded rationality Prospect Theory (Risk attitude)	Experiment	50
Becker-Peth *et al*.	2013	Management Science	Reference dependence & Anchoring Prospect Theory (Loss aversion) Mental accounting	Experiment	190
Elahi *et al*.	2013	Int. J. Production Economics	Reference dependence & Anchoring	Experiment	37
Katok & Pavlov	2013	Journal of Operations Management	Social Preferences (Inequity aversion) Bounded rationality	Experiment	253
Shen *et al*.	2013	IEEE Transactions on Systems, Man, and Cybernetics: Systems	Prospect Theory (Risk attitude)	Analytical modeling	123
Wu	2012	Int. J. Production Economics	Social preferences (Reciprocity)	Experiment	39
Chen *et al*.	2014	Production and Operations Management	Prospect Theory (Risk attitude)	Analytical modeling	46
Croson *et al*.	2014	Production and Operations Management	Social Preferences (Reciprocity)	Experiment	220
Davis *et al*.	2014	Management Science	Bounded rationality Prospect Theory (Loss aversion)	Experiment	80
Du *et al*.	2014a	International Journal of Production Research	Social Preferences (Reciprocity)	Analytical modeling	106
Du *et al*.	2014b	European Journal of Operational Research	Social Preferences (Reciprocity)	Analytical modeling	40
Ho *et al*.	2014	Production and Operations Management	Social Preferences (Inequity aversion)	Experiment	187
Hyndman *et al*.	2014	Production and Operations Management	Reference dependence & Anchoring	Experiment	15
Kalkanci *et al*.	2014	Production and Operations Management	Social Preferences (Inequity aversion) Reference dependence & Anchoring	Experiment	53
Katok *et al*.	2014	Production and Operations Management	Social preferences (Reciprocity)	Mixed methods (Analytical modelling & Experiment)	131
Wu & Chen	2014	Production and Operations Management	Reference dependence & Anchoring	Experiment	76
Xu *et al*.	2014	Int. J. Production Economics	Prospect Theory (Risk attitude)	Analytical modeling	290
Zhang *et al*.	2014	Manufacturing & Service Operations Management	Prospect Theory (Risk attitude)	Mixed methods (Analytical Modelling & Interviews)	20
Avinadav *et al*.	2015a	Int. J. Production Economics	Prospect Theory (Risk attitude)	Analytical modeling	50
Avinadav *et al*.	2015b	European Journal of Operational Research	Prospect Theory (Risk attitude)	Analytical modeling	47
Chen *et al*.	2015	Decision Sciences	Social Preferences (horizontal fairness concern)	Mixed methods (Analytical modeling & Experiment)	19
Choi	2015	IEEE Transactions on Systems, Man, and Cybernetics: Systems	Prospect Theory (Risk attitude)	Mixed methods (Analytical modeling & Sensitivity analysis)	34
Choi	2015	Transportation Research Part E	Bounded rationality	Analytical modeling	34
Chow *et al*.	2015	Omega	Social Preferences (Inequity aversion)	Mixed methods (Analytical modeling & Experiment)	27

Davis	2015	Production and Operations Management	Prospect Theory (loss aversion) Reference dependence & Anchoring	Experiment	30
Hartwig *et al*.	2015	Production and Operations Management	Social preferences (Fairness concerns)	Experiment	43
Li *et al*.	2015	Production and Operations Management	Reference dependence & Anchoring	Analytical modeling	52
Narayanan & Moritz	2015	Production and Operations Management	Bounded Rationality	Experiment	60
Sarkar & Kumar	2015	Int. J. Production Economics	Bounded rationality	Experiment	56
Voigt	2015	Journal of the Operational Research Society	Social Preferences (Inequity aversion)	Mixed methods (Analytical modelling & Sensitivity analysis)	10
Zhao & Zhao	2015	Int. J. Production Economics	Reference dependence & Anchoring	Experiment	19
Becker-Peth & Thonemann	2016	European Journal of Operational Research	Mental Accounting	Experiment	65
Choi & Messinger	2016	European Journal of Operational Research	Social preferences (Reciprocity)	Experiment	60
Niederhoff & Kouvelis	2016	European Journal of Operational Research	Social Preferences (Inequity aversion)	Experiment	24
Ohmura & Matsu	2016	Int. J. Production Economics	Prospect Theory (Risk attitude)	Analytical modeling	18
Qin *et al*.	2016	European Journal of Operational Research	Social preferences (Reciprocity)	Experiment	62
Tokar *et al*.	2016	Decision Sciences	Bounded rationality	Experiment	34
Zhang *et al*.	2016	Management Science	Prospect Theory (Loss aversion)	Experiment	101
Haines *et al*.	2017	Int. J. Production Economics	Bounded Rationality	Experiment	21
Nie & Du	2017	European Journal of Operational Research	Social Preferences (Inequity aversion)	analytical modeling	103
Udenio *et al*.	2017	IISE Transactions	Reference dependence & Anchoring	Analytical modeling	15
Sadrieh & Voigt	2017	Journal of Business Economics	Bounded Rationality	Experiment	6
Wang *et al*.	2017	Computers & Industrial Engineering	Prospect Theory (Risk attitude)	Analytical modeling	23
Zhao *et al*.	2017	Annals of Operations Research	Prospect Theory (Risk attitude)	Mixed methods (Analytical modeling & Numerical experiment)	21
Choi *et al*.	2018	Decision Sciences	Prospect Theory (Risk attitude)	Analytical modeling	59
Davis & Hyndman	2018	Management Science	Social Preferences (Reciprocity)	Mixed methods (Analytical modeling & Experiment)	18
Davis & Leider	2018	Manufacturing & Service Operations Management	Social Preferences (Inequity aversion)	Experiment	30
Du *et al*.	2018	International Journal of Production Research	Social Preferences (Inequity aversion)	Analytical modeling	21
Fan *et al*.	2018	Production and Operations Management	Other regarding theories (Costly channel membership)	Experiment	5
Kalakbandi	2018	European Journal of Operational Research	Boundedly rational Mental accounting	Mixed methods (Analytical modeling & Numerical experiment)	1
Kirshner & Shao	2018	European Journal of Operational Research	Reference dependence & Anchoring Social Preferences (Inequity aversion)	Analytical modeling	13

Lee *et al*.	2018	Journal of Operations Management	Other regarding theories (Cultural impact on bonus and penalty contracts)	Experiment	7
Villa & Castaneda	2018	European Journal of Operational Research	Reference dependence & Anchoring Prospect Theory	Experiment	19
Wuttke *et al*.	2018	Production and Operations Management	Prospect Theory (Risk attitude)	Experiment	15
Xie *et al*.	2018	IEEE Transactions on Systems, Man, and Cybernetics: Systems	Prospect Theory (Risk attitude)	Analytical modeling	20
Yang *et al*.	2018	Production and Operations Management	Prospect Theory (Risk attitude)	Analytical modeling	29
Zhao & Zhu	2018	Journal of Cleaner Production	Prospect Theory (Risk attitude)	Analytical modeling	36
Anderson & Monjardino	2019	European Journal of Operational Research	Prospect Theory (Risk attitude)	Analytical modeling	15
Castañedaa *et al*.	2019	Int. J. Production Economics	Reference dependence & Anchoring Prospect Theory (Risk attitude)	Mixed methods (Interview & Experiment)	10
Choi *et al*.	2019	Omega	Prospect Theory (Risk attitude)	Analytical modeling	48
Davis & Hyndmand	2019	Management Science	Reference dependence & Anchoring Prospect Theory (Risk attitude)	Experiment	29
Haruvy *et al*.	2019	Business Research	Social preferences (Reciprocity)	Mixed methods (Analytical modeling & Experiment)	10
Johnsen *et al*.	2019	Decision Sciences	Bounded Rationality Social Preferences	Experiment	14
Lu *et al*.	2019	Production and Operations Management	Social Preferences (Inequity aversion) Prospect Theory (Risk attitude)	Analytical modeling	3
Sharma *et al*.	2019	Computers & Industrial Engineering	Social Preferences (Inequity aversion)	Analytical modeling	17

CHAPTER 3

Beyond Risk Attitude: Unpacking Behavioural Drivers of Supply Chain Contracts

Foreword

In the previous chapter, I conducted an SLR, and the results showed that decision-makers are not "perfect optimisers" and following biases and heuristics are commonplace in personal and professional decisions (Donohue *et al*., 2020). These findings confirm the importance of behavioural studies in operations management, also highlighting that research on the behaviour of SC agents in dealing with contracts with different time horizons is largely unaddressed. Also, my literature review in the current chapter demonstrates the dominance of theoretical/analytical studies rather than empirical research in this field (e.g., Cohen & Agrawal, 1999; Li *et al*., 2009; Talluri & Lee, 2009; Hong *et al*., 2014). In addition, although analysing cultural orientation in studying BOM is identified as an emerging field of research (Goudarzi *et al*., 2021) and individualism is one of the factors explaining the risk preferences (Mihet, 2013; Breuer *et al*., 2014; Gaganis *et al*., 2019), there are very few studies in this area examining the impact of individualism on decisions; thus, I attempted to bridge the gap by investigating this behavioural factor along with risk attitudes.

This chapter takes a step forward toward achieving a better understanding of the performance of SC contracts. Considering contracts with different structures representing different procurement plans, I examined the performance of long-term *vis-à-vis* short-term contracts when human decision-makers are involved. Specifically, I conducted experiments with four treatments in each of which there is uncertainty with respect to the market demand and the wholesale price. I applied the principles of prospect theory (Kahneman & Tversky, 1979) and individualism (Hofstede, 1984) to explain the decision-makers' choices. This study enabled me to estimate the impact of behavioural factors on the selection of contract and order quantity decisions when decision-makers are exposed to these contracts.

N.B: Please note that the standard American spelling is used in the following chapter due to the journal's requirements.

Beyond Risk Attitude: Unpacking Behavioural Drivers of Supply Chain Contracts

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This paper reports on experiments conducted to investigate managers' choice between long-term contract (LTC) and short-term contract (STC) in a two-tier supply chain, accounting for risk and individualism. Results of logistic regression show when market uncertainty elevates, risk-averse individuals prefer STC, which enables more control over order quantity, while risk-tolerant decision-makers prefer LTC. Individualist decision-makers prefer LTC, confirming the positive association between individualism and risk tolerance. LTC selection is less likely to occur when both demand and wholesale price variability increase. Latent Growth Modeling (LGM) highlighted the impact of behavioral drivers on order quantity and its rate of change over time. While high risk tolerance is associated with low initial quantity placement, 'individualism' is associated with a high initial quantity. Females placed higher initial quantities and had a decreasing rate of change over time.

Keywords: behavioral supply management, supply chain contracts, risk attitude, individualism, experimental studies, latent growth modeling

3.1. Introduction

The increased complexity of the global supply chains (SC) and the dynamic business environment have led to greater uncertainty in operations, which makes the design of an optimal procurement plan more challenging (Blanchard, 2010). The use of contractual agreements to tackle uncertainties and improve SC strengths is well-recognized (Van Der Vorst & Beulens, 2002), and SC managers often prefer different contractual options when

given different planning horizons: long-term contract (LTC), short-term contract (STC) (Talluri & Lee, 2009).

STC is a common practice in several industries such as technology-oriented companies (Carbone, 2001), retail and industrial products such as e-bay, Amazon, and AliExpress, whereas, in B2B companies, courier services (Terzi & Callejas, 2013), and heavy industries such as mining and automobile manufacturing, LTCs are more popular (Shi & Feng, 2016). STC has been a popular option in the commodity market, particularly in the "OPEC-dominated crude oil market", since the 1980s as a result of oligopoly (Neuhoff & von Hirschhausen, 2005:2). Conversely, LTCs were used in the natural gas market to hedge against the opportunistic behavior of suppliers, given their strategic character and the competitive environment (Crocker & Masten, 1988). There are also companies such as HP that established a combination of both LTC and spot market for their supply of memory chips (Gürbüz, n.d.). Also, the terms of contracts can be altered or even revoked, such as the action of Maersk in suspending the spot market for booking containers due to the Suez Canal closure in March 2021 (Hand, 2021). However, businesses change their common contractual practices due to uncertainty, with some mixed results in their response. For example, after the 2008 financial crisis (Clay, 2018), moving to LTC has become a frequent practice for companies to mitigate their supply risks. However, a great deal of STC redesign is now expected following the COVID-19 SC disruptions. Long, brittle, and low-cost SCs supported by LTCs are now riskier than STC alternatives when greater flexibility and responsiveness are needed.

The trade-offs between LTC and STC sourcing strategies and associated risks have been the subject of many prior investigations. Long-term relationships are considered a proactive supply strategy to secure minimum capacity in advance, provide supply stability (Hong *et al*., 2014), reduce administration costs, mitigate purchasing uncertainties (Peleg *et al*., 2002), and ultimately improve operational performance (Lawson *et al*., 2009). Yet, LTC

often requires investment costs to protect against wholesale price volatility (Cisternas & Figueroa, 2015; Wang *et al*., 2020), and a high cost/time for negotiating and signing causes some decision-makers to avoid them. In opposition, the STC offers immediate acquisition of products with the risk of volatile purchase price, inconsistent product quality (Modi & Mabert, 2007), and high searching cost for the best available option in the market (De Toni, 1999), as a reactive strategy.

Our research is inspired by a real case from the Australian pharmaceutical industry and the challenge of procurement managers at hospitals in selecting between two common options: 1) several suppliers, such as Janssen, Roche, and Sanofi-aventis, offer a rebate contract (which represents an LTC) where the buyers are to satisfy a pre-defined fill-rate indicated in the contract, to be awarded a rebate; versus 2) a simple wholesale price contract (STC) that offers a generic brand of the drugs, without rebate. This case is discussed by Li *et al*. (2021) through analytical modelling; however, we analyze the issue through the behavioral lens. The pivotal role of the pharmaceutical industry in economies (Zhao *et al*., 2012; Abdi, 2014) warrants deeper research to capture the influential factors in decision-making, to help managers improve their procurement process.

Despite many theoretical advancements driven by analytical modeling of LTC *vs.* STC (Cohen & Agrawal, 1999; Li *et al*., 2009; Talluri & Lee, 2009; Hong *et al*., 2014), limited attention has been paid to empirical research methods, which directly examine the individual preferences for contracts. The analysis of 'people issues' can explain the causes of systematic deviations from the normative theory predictions (Bendoly *et al*., 2006; Fahimnia *et al*., 2019), which are rooted in cognitive biases/shortcomings such as risk attitudes, bounded rationality, and social preferences (Simon, 1957; Tversky & Kahneman, 1992; Fehr & Fischbacher, 2002). The assumption of individuals' optimal decisions was long held in the literature, and operations management (OM) studies were disconnected from social science until the

emergence of behavioral decision theory (BDT) and prospect theory where it is demonstrated how actual decisions are made by individuals considering their risk perception. The nuances and phenomenon associated with the people issues were discussed earlier in section 3.2.2. For greater details, the curious reader is referred to Donohue *et al*. (2018), Fahimnia *et al*. (2019), and Goudarzi *et al*., (2021).

Cohen & Agrawal (1999), in their seminal investigation of the contract term structure in SC, concluded that the benefits of STC or LTC could be negated by decision-makers' risk preferences, and they called for empirical studies to further explore this area. Arguably, the OM community responded in force with a special issue focused on behavioral studies in the *Journal of Operations Management* (Bendoly, 2006). Also, analyzing the behavioral biases of individuals directly, as opposed to applying models at an aggregate level, was indicated as an "important opportunity for future research" (Davis, 2014: 338). These sources, along with the indicated real-world case of pharmaceutical companies, sowed the seeds of our motivation to experimentally investigate procurement strategies where participants make purchasing decisions, considering LTC and STC in a two-tier SC, to address the following research questions:

1. What is the trade-off between LTC and STC in the presence of wholesale price and demand variability?
2. How do behavioral factors influence the decision-makers' choice of sourcing strategies under these conditions?

In our research, we examined an LTC that covers the entire horizon (one year) and a series of repeated STCs (four quarters in a year). We assume that the conditions of the contracts offered by the suppliers are fixed during the experiment, and there is no dynamic competition going on between the suppliers. We characterized the contracts based on the corresponding features relative to the time frame. A service level agreement (SLA) serves as

the LTC supply option with a fixed wholesale price over a year and initial fixed investment. The STC has a variable wholesale price (=, <, or > than the wholesale LTC price) with no fixed cost required. The LTC has a stationary ordering policy (i.e., a one-off order quantity placement at the beginning of the period) and offers a rebate if the retailer can satisfy a defined fraction of the uncertain market demand. Under the STC, the retailer can place an order quantity (Q) and enjoy a possible immediate lower price in the market while facing the risk of wholesale price volatility in each quarter. This volatility could be due to customer demand instability (Hazra & Mahadevan, 2009) and unreliable supply and competition across the chain (Fang & Shou, 2015).

Thus, we manipulate demand and wholesale price uncertainty as two influential factors (Cohen & Agrawal, 1999; Li *et al*., 2009; Hong *et al*., 2014) to experimentally investigate the selection between LTC and STC. In such a risky context, the risk attitude of decision-makers is expected to influence the contract preferences (Kahneman & Tversky, 1979; Cohen & Agrawal, 1999). Since individuals' attitudes toward risk may be affected by other behavioral factors, we include individualist-collectivist orientation and risk attitude as explanatory variables. Based on Hofstede (1984), culture forms behavior and attitudes and may impact managerial decisions. Several economic studies identified cultural orientation as a factor influencing risk-taking (e.g., Guiso *et al*., 2006; Mihet, 2013; Breuer *et al*., 2014), and the literature suggests a positive association between individualism and risk-taking (e.g., Gaganis *et al*., 2019).

We use experiments to test the sustainability of the theoretical predictions. Laboratory study, like other empirical research methods, bridges the gap between analytical studies and real-world issues and has become a popular research method in behavioral operations management (BOM) (Fahimnia *et al*., 2019; Goudarzi *et al*., 2021). Particularly, they help researchers to test and refine analytical models by controlling/manipulating the conditions

(intended factors at desired levels), which leads to higher internal validity compared to surveys and field experiments.

The contribution of our study is threefold. First, we reconcile analytical and empirical domains of BOM by testing relations between behavioral factors and contract selection. The trade-off between LTC and STC, particularly the selection of contracts in the pharmaceutical industry, is predominantly investigated *vis-a-vis* analytical modelling; however, we incorporate behavioral factors to provide empirical evidence for the actual performance of these contracts and present several findings, some of which contradict the previous analytical studies and hence highlight the importance of intensifying the empirical work in this field. Second, decoupling the impact of risk attitudes and individualism in explaining the contract selection across individuals is a novel contribution. The extant literature considering the impact of culturally-embedded behavioral differences on managerial decisions in evaluating contracts is sparse. Hence, by incorporating risk and individualism, our analysis provides a richer understanding of the impact of critical behavioral factors on sourcing strategies. Importantly, most of the previous studies were limited to examining the cultural factors at the country level, whereas this research adopted a more refined, micro-level explanation of the findings by measuring cultural values at the individual level.

Finally, we contribute to the literature by applying a less-utilized methodology in the BOM discipline, LGM, to investigate the trajectories of the order quantity (Q) over time. Our analysis of two different risk elicitation tests also provides insights into the compatibility/validity of these two tests. The organisation of the rest of the paper is as follows: section 3.2 presents a review of the relevant literature and describes how this study is positioned within the extant body of research, section 3.3 presents the theoretical background, hypotheses, and experimental design, and section 3.4 discusses the data analysis results. We

conclude the paper by summarising our findings, discussing the research limitations, and providing directions for future research (section 3.5).

3.2. Literature Review

The credence and accuracy of successful implementation of any SC system significantly rely on understanding human behaviour (Bendoly *et al*., 2006). Selecting contracts with the objective of channel efficiency and profit-maximisation was examined theoretically through mathematical models (Cachon, 2003). However, studies showed that the actual outcomes of contracts intended to optimise chain-wide profit are not exclusively based on theoretical predictions, and behavioural biases may alter contract selection. Here, we focus on two main literature streams: 1) studies that investigate the trade-offs between the LTC and STC, and 2) studies that examine SC contracts' performance while considering behavioural attitudes. Finally, we compare our study with the extant literature in Table 7.

3.2.1. The Performance of Long-term *vs*. Short-term Contracts

In SCs, a widespread procurement practice is either purchasing through an LT relationship, which is referred to as 'contract supplier', or buying from the spot market (i.e., immediate purchase with negligible lead time). Research suggested that LTC dominance is explained by sharing the price uncertainty between buyer and supplier. Still, results of analytical models show that despite potential wholesale price improvements in the LTC, a variety of contractual and environmental conditions can make STC optimal (Cohen & Agrawal, 1999). Some of the upsides and downsides of the STC and LTC are difficult to quantify due to their design complexity. However, we provide a literature-informed list of positive and negative points associated with these contracts in Table 6.

The analytical study by Cohen & Agrawal (1999) showed that in some conditions (e.g., buyer's risk attitude, the LTC required investment), STC is better, despite the general

belief of the LT contract outperformance. Under price volatility and stochastic market demand, Li *et al*. (2009) investigated supply contracting through both LTC and spot market and found that price uncertainty has the most significant impact on the supply plan among many parameters. Using mixed-integer programming, Talluri & Lee (2010) examined the optimal sourcing strategy over three-time horizons (ST, MT, and LT). With a cost-minimization objective, they showed that a dual-sourcing strategy could secure the procurement plan by hedging against the market prices in unstable conditions.

TABLE 6 - Upsides and Downsides of LTC & STC

Contract Type	Upsides	Downsides
LTC	Potential for quality improvement (Weissman, 1991; Cohen & Agrawal, 1999; De Toni & Nassimbeni, 1999; Peleg *et al*., 2002; Li *et al*., 2009)	Low flexibility particularly in reacting to demand volatility (Chiam & Ahuja, 2006; Aggarwal & Ganeshan, 2007)
	Trust development and information exchange opportunity (Li *et al*., 2009; Swinney & Netessine, 2009; Talluri *et al*., 2010)	Upfront investment (Chiam & Ahuja, 2006)
	Mitigating uncertainties through the upfront investment (Cohen & Agrawal, 1999); Peleg *et al*., 2002; Kleindorfer & Wu, 2003; Aggarwal & Ganeshan, 2007; Talluri *et al*., 2010)	High switching cost due to increased level of dependency on suppliers (De Toni & Nassimbeni, 1999; Talluri *et al*., 2010)
	Cost improvement (Weissman, 1991; Cohen & Agrawal, 1999; Terwiesch & Bohn, 2001; Peleg *et al*., 2002; Cisternas & Figueroa, 2015)	Higher risks of supply disruptions (De Toni & Nassimbeni, 1999)
	Higher delivery reliability and improved lead-time (De Toni & Nassimbeni, 1999)	
	Supply chain stability and supply security (Shi & Feng, 2016)	
STC	Possibility of renegotiation to adjust contractual terms and conditions (Johnsen *et al*., 2019)	Requirement of high strategic degree (Johnsen *et al*., 2019)
	Higher flexibility to respond to the dynamics of the markets (Peleg *et al*., 2002; Talluri *et al*., 2010)	Higher variability in profits (Seifert e*t al*., 2004)
	Higher expected service level (Seifert *et al*., 2004)	Price instability (Li *et al*., 2009)
	Smooth out the peaks and valleys in demand (Li *et al*., 2009)	Lack of coordination and partnership with the short-term supplier (Li *et al*., 2009)
	Price competitiveness (Li *et al*., 2009)	Cost of searching for supplier and their evaluation (Li *et al*., 2009)
	Zero fixed investment costs (Talluri *et al*., 2010)	

Seifert *et al*. (2004) showed that the online spot market and forward contract (i.e., LT procurement contract to buy products at a specific time in the future at a certain price) might provide a higher service level but with higher variability in profit. Hong *et al*. (2014) showed that by considering stochastic demand and associating random yield with LTC (i.e., a probable difference between the ordered and received quantity), a risk-averse buyer seeks a reliable reward/a stable profit, while a risk-tolerant buyer prefers volatility, allowing for potentially higher profits.

Shi & Feng (2016) suggested accepting LT supply contracts when demand is uncertain but high and when the cost volatility is substantial, but the cost is low. Johnsen *et al*. (2021) assessed the performance of ST and LT contracts in a two-period SC under asymmetric cost information and suggested that payoff inequality from one period to another causes a dynamic form of inequality aversion, which induces the buyer to reject offers and limits the supplier in exploiting the cost information in earlier periods. Several other studies investigated optimal mixed procurement strategies, utilizing LT contracts and the spot market (Peleg *et al*., 2002; Wu *et al*., 2002; Kleindorfer & Wu, 2003).

3.2.2. SC Contract Performance from a Behavioural Perspective

Following the expected utility theory (EUT), it was long held that decision-makers act rationally to maximize their utility/profit (Keeney & Raiffa, 1976). However, BDT acknowledged its limitations (Edwards, 1961; Wright, 1985; Poulton, 1994), highlighting that the decisions may not be reconciled with normative theoretical predictions, given multiple behavioral influences. Several behavioral drivers have been proposed as factors/processes explaining deviations from theoretical expectations: bounded rationality (Simon, 1957), risk attitudes (Tversky & Kahneman, 1992), loss aversion (Kahneman & Tversky, 2013), anchoring (Tversky & Kahneman, 1974), mental accounting (Thaler, 1985) and social preferences (Fehr & Fischbacher, 2002; Loch & Wu, 2007).

Despite the mathematically equivalent profit, revenue-sharing and buyback contracts are shown to have different performances, which may be driven by the risk attitudes of decision-makers. These attitudes may be triggered by the newsvendor critical ratio of the products (Zhang *et al*., 2016) or by different market demands (Katok & Wu, 2009). The performance of push vis-à-vis pull contracts is also examined, and the research shows order quantity increases due to risk aversion (Davis *et al*., 2014; Yang *et al*., 2018). The literature also suggests that the profit of coordinating contracts such as SLA or payback, compared to a simple wholesale price contract, is lower than the theoretical prediction because individuals perceive a loss in the contract structure (Davis, 2015). For example, paybacks and fixed fees are perceived as losses, which cause loss-averse agents to 'correct' their decisions (Katok & Wu, 2009; Shen *et al*., 2011). This leads to the outperformance of a quantity discount contract compared to a two-part tariff contract with equivalent mathematical profit performance (Ho & Zhang, 2008). Structural complexity also plays an important role in contract performance (Davis & Hyndman, 2018) and research shows the simpler contracts are preferred due to bounded rationality (Kalkanci *et al*., 2011, 2014).

Following the reviewed literature in these two categories, the distinct aspects of our study are incorporating the planning horizon of the contracts and investigating the decision-making process on STC and LTC through a behavioral lens by taking into account risk attitudes and individualism. A detailed comparison is presented in Table 7.

TABLE 7 - Comparison between the Extant Literature and the Current Paper

	Focus of Study		Methodology		Behavioral Perspective		
Articles on Contract Performance	Contract Time Structure	Other Contractual Terms	Theoretical/ Mathematical Modeling	Empirical	Prospect Theory (Risk/Loss aversion)	Inequity Aversion	Individualism
LTC vs. STC Studies							
Cohen & Agrawal (1999)	✓		✓		✓		
Seifret *et al.* (2004)	✓		✓				
Li *et al.* (2009)	✓		✓				
Talluri & Lee (2010)	✓		✓				
Hone *et al.* (2013)	✓		✓				
Shi & Feng (2016)	✓		✓				
Johnsen *et al.* (2021)	✓			✓		✓	
BOM studies							
Ho & Zhang (2008)		✓		✓	✓		
Katok & Wu (2009)		✓		✓	✓		
Shen *et al.*, (2011)		✓	✓		✓		
Davis *et al.*, (2014)		✓		✓	✓		
Davis, (2015)		✓		✓	✓		
Avinadav *et al.*, (2015)		✓	✓		✓		
Zhang, Donohue, & Cui (2016)		✓		✓	✓		
Yang *et al.*, (2018)		✓	✓		✓		
Davis & Hyndman, (2019)		✓		✓	✓		
The current paper	✓			✓	✓		✓

3.3.Methodology

3.3.1. Background and General Model

Our study aims to investigate the preference between STC and LTC, and for this purpose, we selected SLA as the LTC. SLA offers a fixed wholesale price throughout a set of periods, at the cost of fixed investment (FI) at the beginning of the year, with zero lead time and no ordering cost. The FI is the cost that the retailer pays to secure the fixed price, i.e., hedge against price volatility over the year (Cisternas & Figueroa, 2015; Wang *et al.*, 2020). According to transaction cost theory (Williamson, 1981), relying on STC causes repeated transaction costs. We operationalized this in our experiment by imposing on the participant the burden of selecting a supplier and setting the order quantity in each quarter.

The retailer faces stochastic demand, which is independent from one period to another. The un-filled orders are lost, which causes a shortage/stock-out cost that is calculated by the difference between the selling price and production cost. We assume that products are perishable and will be disposed of at the end of each ordering period with no salvage value or

disposal cost (see Kalkanci *et al*., 2011; Katok & Pavlov, 2013; Zhang *et al*., 2016, among others). As one of the SLA conditions, if the retailer can meet the demand to a defined 'target level', a rebate will be added to the total profit at the end of the review period. The satisfied fraction of the demand is called the 'fill rate', and the rebate is a percentage of the total amount spent. As a coordinating contract, the rebate contract shares the channel risk (e.g., demand uncertainty) such that the supplier sets the rebate based on the demand-related fill rate (Katok *et al*., 2008) to motivate the retailer to place a higher order quantity, which will ultimately increase their revenue. At the same time, it improves the channel performance by encouraging the retailer to meet the market demand. However, stochastic demand alters the target fill rate achievement due to the difficulty in prediction. The review period consists of t = 1, …, T ordering months (here, the review period is annual). Let D, t, α represent demand, time period, and fill rate, respectively. The target fill rate is also notated by α^*. Fill rate is calculated by the minimum of demand and Q in each period divided by the demand for that period. Then, the total fill rate is:

$$\alpha\,(Q) = \sum_{t=1}^{T} \min(Q, D) \;/\; \sum_{t=1}^{T} D \qquad (1)$$

For the SLA contract, the wholesale price W is constant throughout the review period. If the target fill rate is met (i.e., $\alpha\,(Q) >= \alpha^*$), rebate (R) is applied to the total profit (P), which is:

$$R = \sum_{t=1}^{T} Q \times W \times r \qquad (2)$$

where r is the rebate proportion of the unit sale, and R is the total rebate, based on the total order quantities from round 1 to T. Subsequently, with the selling price for each unit (S), the expected profit would be:

$$P\,(Q) = \sum_{t=1}^{T} \min(Q, D) \times S - \left(\sum_{t=1}^{T} Q \times W\right) \times (1-R) - FI \qquad (3)$$

where FI represents the fixed investment cost. The probability of reaching the target level is a function of Q, which is difficult to anticipate when demand variability is high. Following the specifications of the SLA contract in Katok *et al*. (2008), we also assume a stationary ordering policy (i.e., one-off order at the beginning of the year), which plays the role of contract commitment. For the STC, we selected the traditional wholesale price contract, which offers a flexible order quantity (i.e., quarterly) to portray the spot market concept in the literature. STC requires no fixed cost investment, and the wholesale price varies from one quarter to another (P_i, i=1, …, T). Irrespective of the wholesale price variability in the STC (P_i), both contracts have the same average wholesale price in one year ($W = \mu (P_i)$). Given this equality, price volatility becomes the source of risk under STC. Yet, decision-makers can adjust their order decisions based on the realized demand and observed price in the previous quarter. On the other hand, LTC has the advantage of a fixed price over the year, the source of risk being the fixed ordering policy for the whole period before demand realization.

While under LTC, the buyer deals with a single supplier, STC assumes multiple suppliers with their price offers in the market. In our experiments, participants (i.e., the buyers) are shown the best available option in the market with respect to the price for a particular round. Thus, the STC price is stochastic and independent across rounds, as it is offered by different suppliers; however, the quarterly price stream is based on the market demand (a higher demand leads to higher prices). The design of the STC price is similar to Peleg *et al*. (2002), in which the unit price is random; however, it follows a known distribution with a stationary mean. Also, in our experiment, the price offered by the supplier is not a decision variable (non-negotiable), as the focus of the experiment is on the buyer's decision (Swinney & Netessine, 2009). The differences between the two contracts are presented in Table 8:

TABLE 8 – Differences between STC & LTC

Contract	Review period	Fixed investment	Fixed wholesale price	Cost improvement (Rebate)	Ordering Policy
Long-term	One year	✓	✓	✓	Fixed order quantity placed annually
Short-term	3-month	×	×	×	Flexible order quantity placed quarterly

In selecting the STC, if the wholesale price is lower than the wholesale price in the LTC, the retailer can enjoy an immediate saving (IS) calculated as follows:

$$IS = \sum_{t=1}^{T}(W - P_i) \times Q \quad (4)$$

To make the participants indifferent, we aimed for equal expected profit under both contracts. There are variables in each contract that assisted us in achieving this. Under LTC, FI has a negative impact on profit, whereas the possible rebate has a positive impact. Under STC, the IS has a positive/negative impact on the profit if the wholesale price is lower/higher than that in the LTC. Also, the selling price S is held constant and equal for the products supplied from either contract.

3.3.2. Hypotheses Development

Our research applies a theory-based empirical approach, testing two categories of hypotheses: a) experimentally examining findings of previous analytical studies (H1); and b) aiming to identify influential behavioral factors in decision-making (H2, H3, H4). For the second category, we focus on two behavioral dimensions: risk attitudes and individualism. In response to uncertainty, the natural tendency of people to make certain decisions reflects their risk attitudes. Risk-neutral individuals have equal utility and expected value (thus indifferent), while risk-averse/risk-seeking individuals avoid or prefer risk (Tversky & Kahneman, 1992). Also, we utilize the individualism/collectivism scale, one of the well-established theoretical frameworks to measure cultural impact (Hofstede, 1984), to ascertain to what extent it affects the choice of contract. Individualism emphasizes promoting self-interest, individual

achievements, independence, personal autonomy, and being less concerned about others' needs. Conversely, collectivism refers to group loyalty and dependence, considering the group's concerns and decisions above individual interests and having high self-monitoring (Darwish & Huber, 2003; Van den Steen, 2004).

We developed our experiment based primarily on the analytical findings of two notable studies in this area: Cohen & Agrawal (1999) and Li *et al*. (2009). Although in a real-world setting, LTC appears 'safer' and encourages cooperation and SC coordination, prior research shows this assumption does not hold under all circumstances (Cohen & Agrawal, 1999). Cohen & Agrawal (1999) concluded that the magnitude of required investment in LTC could deem the flexible STC a better option. Under price volatility and stochastic market demand, Li *et al*. (2009) found that an increase in price variability favors LTC, while an increase in market demand turbulence favors STC supply strategy. Their sensitivity analysis showed that with low investment costs, LTC is optimal, while STC is superior when the investment cost increases. Yet, this finding does not hold when the price uncertainty is high, and thus the STC is used along with LTC (i.e. dual sourcing) to enjoy the flexibility and mitigate the cash-flow uncertainty.

Following these findings, we expect to observe a greater preference for LTC when the wholesale price variability increases (Cohen & Agrawal, 1999; Li *et al*., 2009). Under high demand variability, we expect to observe a higher preference for the STC, as there is no lock-in contract obligation, and the retailer can adjust Q throughout the year (Li *et al*., 2009). Considering σ_P and σ_D as the variability in wholesale price and market demand, we formulated the following hypotheses:

Hypothesis 1: a) The probability of selecting LTC (P_L) increases with the increase in wholesale price variability of the STC (σ_P), and b) the probability of selecting STC (P_S) increases with the increase in demand variability (σ_D).

As already indicated, in our study, both STC and LTC have the same maximum expected value, and thus we expect participants driven by a profit-maximizing motivation to demonstrate indifference between options. Yet, as Hong *et al*. (2014) suggested, in uncertain situations, a risk-averse buyer seeks a reliable profit, while a risk-tolerant buyer prefers potentially higher profit despite volatility. Therefore, future uncertainty avoidance may explain the dominance of LTC over STC. Also, Cohen & Agrawal (1999) showed that the benefit of hedging against wholesale price uncertainty by selecting LTC might be minimal, and contract benefits can be negated by the risk preference of decision-makers. Thus, the risk attitude significantly impacts the supply strategy, and we expect to observe more risk-averse participants selecting LTC and more risk-tolerant participants choosing STC, hence H2.

Hypothesis 2: All else being equal, for any given condition and considering the equal maximum expected value of LTC and STC, the higher the risk-aversion level (A), the higher the probability of selecting LTC ($P_{AL} > P_{AS}$) and, conversely, the higher the risk tolerance (T), the higher the probability of selecting STC ($P_{TS} > P_{TL}$).

The next hypothesis aims to provide new insights into the influence of cultural orientation on decision-making. The review conducted by Gupta and Gupta (2019) showed that individual decisions are impacted by cultural values. The risk attitude of managers/retailers is also expected to reflect their values stemming from individualism (Shane & Venkataraman, 1996). In the context of household finance, Breuer *et al*. (2014) showed that individualism has a significant positive impact on taking financial risks (e.g., holding stocks). The positive association between individualism and risk attitude is also confirmed in the insurance industry at both the individual (Gaganis *et al*., 2019) and the organizational level (Mihet, 2013). Likewise, Li *et al*. (2013) showed that manufacturing firms in individualist countries tend to take risky initiatives. Studies have shown positive associations between individualism and risk-taking in banks, with managers in individualistic countries displaying

higher risk-taking to maximize shareholders' wealth (Ashraf *et al*., 2016; Mourouzidou-Damtsa *et al*., 2019). We conclude that individuals with a higher level of individualism engage more in risky behaviors, compared to their collectivist counterparts. Thus, we posit that if retailers show individualistic behavior, their risk-taking predisposition could manifest as a preference for STC.

Hypothesis 3: All else being equal, for any given condition and considering the equal maximum expected value of LTC and STC, the higher the individualism (I), the higher the probability of selecting STC ($P_{IS} > P_{IL}$).

We also expect to observe the impact of risk attitude and individualism on order quantity. As discussed in H3, the literature reveals a positive association between risk-taking and individualism; thus, we expect to observe this relationship when considering order quantity. To analyze this, we draw upon two main determinants of individualism and risk attitudes in the literature: overconfidence and over-optimism. Overconfidence is the perception of having an above-average performance (Guenther & Alicke, 2010), and it is argued to cause risk-taking in investment contexts (Merkle, 2017) and be associated with risk tolerance (Puri & Robinson, 2007; Pan & Statman, 2010). This is also the case for individualists, as personal decisions made in individualistic societies are more likely to be influenced by overconfidence (Chui *et al*., 2010). Overconfidence is also driven by over-optimism (Markus & Kitayama, 1991). While individualists with risk-tolerant behavior tend to overestimate the accuracy of their prediction, exaggerate the ability to control, and have low self-monitoring of their actions (Van den Steen, 2004; Giordani & Söderlind, 2006), collectivists with risk-averse behavior tend to undertake high self-monitoring of their actions and tend to be cautious. We, therefore, posit that,

Hypothesis 4: Individualists/risk-tolerants exhibit overconfidence in predicting the demand by placing a higher initial Q and adjusting their order over time.

3.3.3. Experimental Method

3.3.3.1. Game Setup and Procedures

We used a within-subjects design where each participant is exposed to all treatments. An advantage of this design is the ability to control for any individual differences among subjects. Also, to control for the potential *order effect*, the treatments were presented in random order. Before the experiment, we asked the participants to provide demographic details (i.e., age, gender, country of birth, the field of study), which we used to control for individual differences. The experimental procedure started with detailed instructions explaining the main concepts, the roles, the decision-making process, and providing examples of the calculations behind the tasks. To ensure a good understanding of the test, we developed a comprehension test with nine questions, such that participants could only proceed with the experiment if they passed the test by answering all the questions correctly.

The decision-making process had two steps: 1) the subject, playing the role of a retailer, first selected the preferred contract to explore, either STC or LTC; 2) then, the subject set their Q under the chosen contract. Participants played 10 rounds in each treatment (STC *vs* LTC). After completing the choices (contract and Q), in the case of the LTC, the participants were shown the actual demand for each month through contract completion. They were also shown the cumulative demand, shortage/excess of Q, monthly/ annual (total) profit, and finally, the fill rate and the rebate amount. For the STC selection, the observation of the demand and wholesale price happened quarterly, and the results were displayed to the subjects after each selection. Because this study does not examine the impact of information-sharing, in each repeat of the treatments, demand and price ranges were disclosed to the participants. After each treatment, they were asked to select their final choice of the contract (debrief question) and explain the reason for their choice. We conducted this out-of-task preference to give the participants enough opportunities to declare their overall contract preferences. To

ensure that the data meets the aim of the study, the survey included questions to capture both personal characteristics and attitudinal questions reflecting risk predisposition and the level of individualism/collectivism.

3.3.3.2. Software and Subjects Utilised

Our initial plan was to conduct a physical laboratory experiment; however, due to the COVID-19 restrictions, we switched to an online channel for data collection. The online experiment was developed using oTree, through a Python-based framework (Chen *et al*., 2016). Data collection was completed in May 2021, and the average completion time was 40 minutes. We used participants who work in retail (while studying) and identified as managers. Participants were recruited through class announcements and advertisements for undergraduate students enrolled in a management course at a large Australian university. The use of undergraduate students as the subject pool is a common practice in the BOM literature (Katok, 2011; Katok & Wu, 2009; Zhang *et al*., 2016; Davis & Hyndman, 2018; Castañeda *et al*., 2019; Johnsen *et al*., 2021). Although it was expected for the managers to perform better in practice, Cooper *et al*. (1999) found that younger students have stronger strategic performance than older managers in lab experiments. Also, a newsvendor study conducted by Bolton *et al*. (2008) showed no significant difference between the performance of professionals and students, with even better performance of master's students compared to managers in one of the studies.

Participation in the data experiment was compensated by giving course credit, which is frequently used in behavioral studies (e.g., Andrade, 2005; Choi & Messinger, 2016). To incentivize outperformance, we applied a tournament method, and the top 10 participants with the highest profits were given extra credit in the course upon completion. This incentive method encourages the performance of participants (Paul *et al*., 2019), and in our study, it was indicated in the experiment instruction.

3.3.3.3. Experimental Variables

Our experiment is a 2×2 game with the conditions shown in Table 9. We applied 'low' and 'high' levels for our explanatory variables, variability of the wholesale price of STC, and demand variability. Condition 1 is denoted as low-demand variability and low wholesale price variability (LD, LP), condition 2 as high-demand variability and low wholesale price variability (HD, LP), condition 3 includes low-demand variability but high wholesale price variability (LD, HP), and condition 4 represents high variability for both demand and wholesale price (HD, HP). Compared to a randomized controlled trial (RCT), the meaning of the control group is different in a factorial experiment, and "each factor has its own control group, made up of a combination of conditions" (Collins *et al*., 2014, p.6). In a factorial experiment, there is more than one experimental condition as opposed to a single condition with a control group. In our experiment, we controlled for price in conditions 1 and 2 by changing the level of demand uncertainty while holding price uncertainty constant. This is also the case for conditions 1, and 3, where we controlled for demand by holding demand uncertainty constant. Thus, we isolate changes in behavior due to demand and price uncertainty levels after controlling for other effects.

The SLA (LTC) is characterized by a $70 fixed investment (FI), $2.3 wholesale price (W), 5% of the total spent as a rebate (R), 95% of demand as the target fill rate (α^*). All these variables, plus the time horizon, were considered as blocking factors. By selecting the LTC, the FI was deducted from the total profit of the year, and when the target fill rate was achieved, the rebate was added to the total profit. The STC is a price-only contract, with the average annual wholesale price equal to the wholesale price of the SLA (Li *et al*., 2009). The variables in LTC and STC were defined considering the equal maximum expected value, and the final test of this assumption was undertaken using *Evolver* software from the *Palisade* package.

We generated 10 demand streams for 10 repeats in each treatment (i.e., rounds), applying a uniform distribution which is common in the literature (e.g., Davis *et al*., 2014; Chow *et a*l., 2015; Zhang *et al*., 2016). To control for the effect of demand realization between treatments, these streams were randomly generated and applied consistently across all the treatments (Zhang *et al*., 2016). The probability distribution of the wholesale price in STC is discrete, with three values: 0.3 (the probability of STC cost below the wholesale price of LTC after applying the rebate), 0.4 (the probability of STC cost being higher than the wholesale price after applying the rebate and lower than the original LTC price), and 0.3 (the probability of STC wholesale price above the original wholesale price of the LTC) (Li *et al*., 2009).

To provide the participants with an estimate of the demand and the STC wholesale prices, the ranges of these two variables were shown before the start of the round (demand range, low variability: $50=<D_L=<100$, high variability: $30=<D_H=<150$; wholesale price in STC, low variability: $\$1.3=<P_L=<\$3.5$, high variability: $\$1.7=<P_H=<\$3$) (Table 9). To control for the differences between low and high variability in wholesale price vs. demand streams, we generated them such that the coefficients of variation (CV) of low and high variability are the same (CV low variability = 0.18 & CV high variability = 0.3.

TABLE 9 - Experimental Design

Conditions	Low demand variability	High demand variability
Low wholesale price variability	Demand: $\mu_d = 85, \sigma_d=15$; Price: $\mu_p = \$2.3, \sigma_p=0.4$	Demand: $\mu_d = 85, \sigma_d=25$; Price: $\mu_p = \$2.3, \sigma_p=0.4$
High wholesale price variability	Demand: $\mu_d = 85, \sigma_d=15$; Price: $\mu_p = \$2.3, \sigma_p=0.8$	Demand: $\mu_d = 85, \sigma_d=25$; Price: $\mu_p = \$2.3, \sigma_p=0.8$

It should be noted that variability refers to the range of intervals. Also, the actual mean demand/price is calculated based on the average of all individual values of demand/price over a year simulated for a scenario from the uniform distribution. Consequently, the mean demand

from the sample distribution may not represent the mean of the uniform distribution with the reported upper and lower bounds due to sampling error.

We assumed there was no drift in mean demand and wholesale price, meaning they were held constant across all treatments. Also, the retail selling price (S) in the market for the supplied products from both contracts is equal to $5, indicating we did not explore the effects of consumer price elasticity on the retailer's decision.

3.3.3.4. Attitudinal Measures

To investigate the behavioral factors, we used distinct survey modules to measure risk attitudes (a lottery task with 10 decisions, each of which has two options with different outcomes and probabilities as described by Holt & Laury, 2002), a self-reported domain-specific risk attitude scale (Weber *et al*., 2002), and a scale to measure individualistic-collectivistic orientations (Triandis & Gelfand, 1998). The preferred selections between the safer and riskier lotteries indicate the risk attitude of the subject. The domain-specific risk elicitation test (Weber *et al*., 2002) is indicative of risky behavior in different areas, given specific psychological traits. Following the financial perspective of our study, we used 10 financial-related questions measured on a Likert-type scale (1 to 5) to elicit respondents' likelihood of undertaking several 'risky' actions. Cultural values were measured through the individualism dimension using the proposed scale by Triandis and Gelfand (1998), in which 16 items were rated by participants on a 1-5 Likert scale.

3.4. Data Analysis and Results

3.4.1. Descriptive Analysis

We collected the data from 117 subjects, 71 of whom were females and 46 males. An attention check question included in the surveys and the lack of variance of Q across all conditions assisted us in identifying those who failed to answer the question correctly and

those non-attending to the experimental conditions. These cases were excluded from the analysis. There was no missing data in our dataset, as the participants could not proceed without completing the requirements at each step. The final data set includes 92 cases (N=92), 62 females and 29 males, and one participant who preferred not to mention their gender.

3.4.1.1. Measurements for Risk Preference

To understand the risk preferences, we analyzed the data obtained from the two tests. For the lottery test, a risk-neutral subject is expected to switch points from the first lottery to the second one after the first four pairs, and a more frequent selection of the first lottery indicates a higher aversion to risk. The frequency analysis showed that there were 35 risk-averse (i.e., less than 4 choices of the first lottery), 29 risk-neutral (i.e., 4 and 6 choices of the first and the second lotteries, respectively), and 28 risk-tolerant (i.e., more than 6 choices of the second lottery) participants. This suggests a general risk-averse attitude of the sample, consistent with the findings of previous studies (Gibson & Johnson, 2019). For the second risk elicitation test, to ensure that constructs are accurately represented, we conducted an exploratory factor analysis (EFA). One item (item 8 of this test in Appendix 2) was excluded from the analysis given its low communality, and EFA on the remaining questions suggested two factors of financial risks. The underlying concept in the first factor (including questions 1, 2, 6, 7, 9, and 10 - see Appendix 2) was a mix of social and financial elements (i.e., mostly reflecting impulsive actions or the actions that involve trust and care for friends); however, the second factor reflects purely investment-related perspective (questions 3 to 5 in Appendix 2).

The factors were labeled as 'Risk_FS1' and 'Risk_FS2', and their scores were further used in the analysis. The correlation between these two factors (Pearson correlation) was 0.455 (p-value < 0.001, 2-tailed t-test), suggesting that the two constructs capture distinct aspects of risk attitudes. The descriptive analysis of this risk scale also confirms a general

risk-aversion attitude of the participants (on a 1 to 5 scale, Risk FS1: mean =1.76; SD = 0.64 & Risk_FS2: mean =2.67; SD = 0.91). We were interested in comparing the results of both risk elicitation tests to validate the measures, as previous studies confirmed the higher performance of survey measures (i.e., domain-specific risk survey) over experimental measures (i.e., lottery tests) in terms of external validity (Dohmen *et al.*, 2011; Schildberg-Hörisch, 2018). To assess the compatibility of the two tests, we ran a general linear model to regress the factors of the domain-specific risk scale on the results of the lottery test. We expected to see increasing 'mean scores' when moving from risk-averse to risk-tolerant categories. However, the score means formed a convex function suggesting that the lottery test cannot explain the results of the domain-specific scale. Following this inconsistency, we excluded the lottery results.

3.4.1.2. Individualism Analysis

Similar to the domain-specific risk test, we conducted a preliminary EFA to calculate the individualism and collectivism scores. EFA showed a low variance in responses in all items, and the pattern matrix (Alpha Factoring method and Direct Oblimin rotation) did not separate the individualistic and collectivistic items. To examine whether measures of the constructs are consistent with the pre-defined variables, we conducted a confirmatory factor analysis (CFA) in *AMOS 26*. Four items with very low communality, two in the individualistic ("I rely on myself most of the time, I rarely rely on others" and "When another person does better than I do, I get tense and aroused") and two in the collectivistic category ("Family members should stick together, no matter what sacrifices are required" and "I feel good when I cooperate with others") were excluded from the analysis. The scores of individualistic (total mean = 3.75, SD = 0.55) and collectivistic attitudes (total mean = 4.06, SD = 0.47) are significantly different at 0.05 level.

3.4.1.3. Initial Analysis of Choices

We started our analysis with the frequency of contract choice under each condition (Figure 8). In all conditions, the participants selected LTC more than STC with an average frequency of 621 vs 299. However, the choice of STC showed the highest frequency in condition 4, where the variability of both demand and price is the highest. Conversely, participants were more willing to select LTC compared to STC in condition 1, with the lowest variability for both demand and the wholesale price.

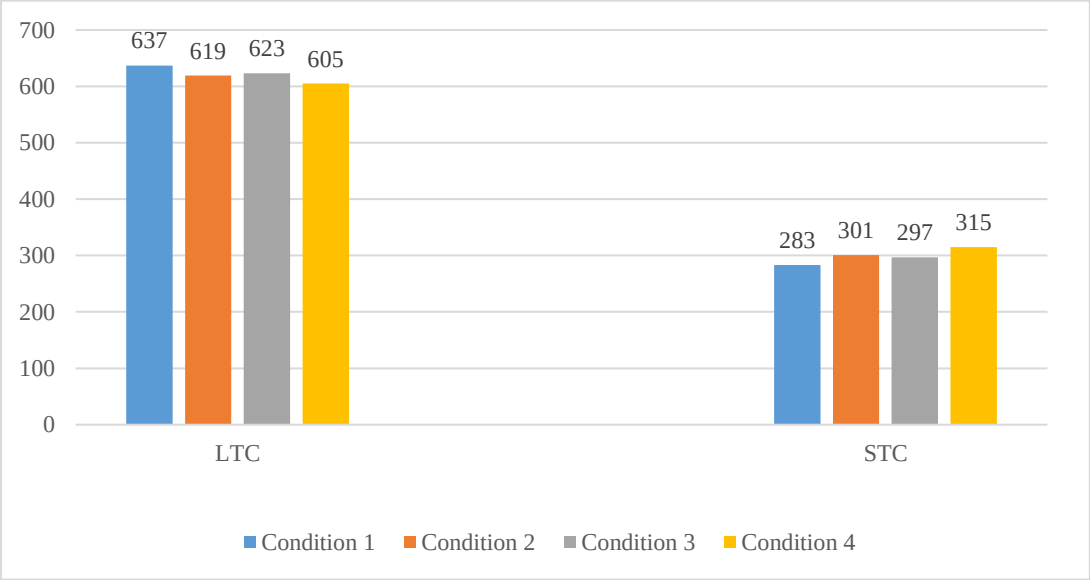

FIGURE 8 - Frequency of Contract Choice

The average profit made by participants by selecting the LTC and STC is $2,187.96 and $2,146.57, which shows similar performance in terms of profit. This confirms that the identical expected profit by both contracts (tested in section 3.3.3) is compatible with the actual performance of the participants, which implies that contract selection is driven by factors other than profit-maximization.

3.4.1.4. Analysis of Self-report Reasons for Choices

To explore whether the complexity of the design may have influenced the choice of contract and to better understand the drivers of decisions, we examined participant comments

in the debrief question. A total of 368 answers were collected under all conditions. The text analysis highlighted the three most frequent keywords (Table 10).

TABLE 10 - Analysis of Self-Report Reasons for Choices

Contract	Frequency of selection	Keywords and the frequency		
LTC	251	Higher profit (43%)	Fixed product cost (18%)	Consistency in profitability (17%)
STC	117	Adjust/adjusting (32%)	Predictability (19%)	Lower shortage & excess (11%)

Note: Variations of a word were collapsed (e.g., adjust, change, correct).

There were no indications that fixed costs in LTC (Ho & Zhang, 2008) or the design complexity (Kalkanci *et al*., 2011; 2014) could have been the driver of their selection. This confirms that contract decisions were not biased by these two factors, and the experimental design has captured the intended variables in decision-making.

3.4.2. Multivariate Analysis of Variance (MANOVA)

A one-way MANOVA was conducted to evaluate gender differences between risk attitude and individualism measures. There was a significant difference between males and females on the individualism, Risk_FS1, and Risk_FS2 considered jointly, with Wilk's λ= 0.841, p = 0.019, partial η^2 = 0.083. The assumption of homogeneity of variance was tested using Levene's test, F(1, 89) = 0.62, p= 0.986 (for individualism), F(1, 89) = 0.60, p = 0.807 (for Risk_FS1),and F(1, 89) = 0.084, p = 0.772 (for Risk_FS2). The results showed a significant difference on 'individualism', F(1, 89) = 4.421, p = 0.015, partial η^2 = 0.09 with males (M=3.99) scoring higher than females (M= 3.65). There was no statistically significant difference between males and females in risk attitudes considering Risk_FS1. However, there was a marginally significant difference in risk attitudes under Risk_FS2, F(1, 89) = 2.898, p =0.06, partial η^2 = 0.061 with males (M=2.97) scoring higher than females (M= 2.53), indicating a higher level of risk tolerance among males in this cohort.

3.4.3. Binary Logistic Regression Analysis

To understand the determinants of contract selection, we employed a binary logistic regression, as the dependent variable is dichotomous (1 = LTC; 0 = STC). Given that a key assumption in obtaining unbiased results for logistic regression is the absence of multicollinearity, this analysis was conducted first. Observed correlations between predictors below 0.5, tolerance index above 0.8, and variance inflation factors (VIF) below 3 confirm the absence of multicollinearity. The low 'condition indexes' and 'variance proportions' further support the analysis. The logistic regression controlled for gender, risk attitudes, and individualism. The goodness-of-fit measures (Hosmer-Lemeshow $p < 0.001$, $\chi^2 = 59.09$, degree of freedom (df) = 8); and the overall prediction accuracy of 67.2%, while predicting 8.2% the STC and 95% LTC indicated modest fit. In addition, only one explanatory variable (i.e. demand variability) was statistically significant. Given these results, further analysis considered the responses from the debrief section of the experiment (i.e., out-of-task preference). The model with the final choice of contract as a response variable showed a good model fit (Hosmer-Lemeshow χ^2=14.187, df = 8, p= 0.77 and hit ratio of 72.6%, more than 25% above the classification by chance). Table 11 reports the parameter estimates with their significance levels and odds ratios.

TABLE 11 - Values of Variables in Binary Logistic Regression

	B	S.E.	Wald	Sig.	Exp (B)
Gender	-.475	.085	31.410	<.001	.622
Demand variability	-.134	.008	273.759	<.001	.874
Wholesale price variability	-1.302	.270	23.227	<.001	.272
Risk_FS2	.137	.043	10.196	<.001	1.147
Average Q	.026	.003	108.820	<.001	1.027
Individualism	.245	.077	10.111	.001	1.278
Constant	.905	.441	4.210	.040	2.472

The results suggest that both demand and wholesale price variability are significant in explaining the choice of contract. The sign of coefficients suggests a decrease in LTC

selection with each unit increase in demand and wholesale price variability. A one-unit increase in demand and wholesale price variability results in the LTC being less likely to be selected (odds ratio of 0.874 and 0.272). This suggests a more pronounced impact of market demand variability on contract selection, confirming (H1b) and rejecting (H1a) regarding wholesale price variability. We expected to observe more frequent LTC selection when price variability increases; however, low prices throughout the year were appealing to the participants and stimulated them to select the STC. This contradicts the results of Li *et al*. (2009), confirming the importance of incorporating behavioral factors into the analysis.

Risk attitude, Risk_FS2, was found to be a significant and positive predictor of the contract choice (B= 0.133, $p < 0.001$, Exp (B) =1.142), suggesting a higher selection of LTC as the risk-tolerance increases. This result disconfirms H2, as Cohen and Agrawal (1999) found LTC to be selected by risk-averse individuals. Our distinct result can be explained by the contracts' ordering policy. Given the stationary ordering policy in LTC, there is no control over Q throughout the year. The results suggest that risk-averse people prefer observing the demand and choosing the more flexible quarterly ordering option under STC. The results also indicate that the LTC induces a higher Q (B= 0.026, $p < 0.001$, Exp (B) =1.027) required to achieve the target level and enjoy the rebate. Individualism appears to be positively associated with 'individuals' risk attitudes. The odds of choosing an LTC increased by a factor of 1.278 when the score of the individualism trait increased by one unit. This result disconfirms H3 as we expected to observe a positive association between individualism and STC selection. However, consistent with the discussion in 'H2's findings, this can be explained by LTC offering less control over Q, thus perceived as a riskier option. Regarding the variability of the contract selection across different conditions, no significant difference was observed in three conditions (conditions 1, 2, & 3). However, switching between contracts shows less

variability when the uncertainties in both demand and the wholesale price are relatively high ($\sigma_{LD,\,LP} = 0.7$, $\sigma_{HD,\,LP} = 0.67$, $\sigma_{LD,\,HP} = 0.7$, $\sigma_{HD,\,HP} = 0.64$).

3.4.4. Order Quantity Behaviour

We monitored the dynamics of purchase behavior in setting the Q across the repeats of each treatment to analyze how participants adjusted their Q over time. Under both contracts, we observed an average Q of 95.64 and an SD of 19.3. We also analyzed the Q of LTC and STC across all treatments and noted an under-ordering behavior for low-demand variability compared to conditions with high-demand variability (Figure 9), attributed to the achievability of the target level. In addition, the highest SD of the Qs is observed in condition 4. This is justifiable by 1) the higher possible loss due to under- /over-ordering and difficulty in predicting these variables throughout the year; and 2) the difficulty in achieving the target level in the LTC.

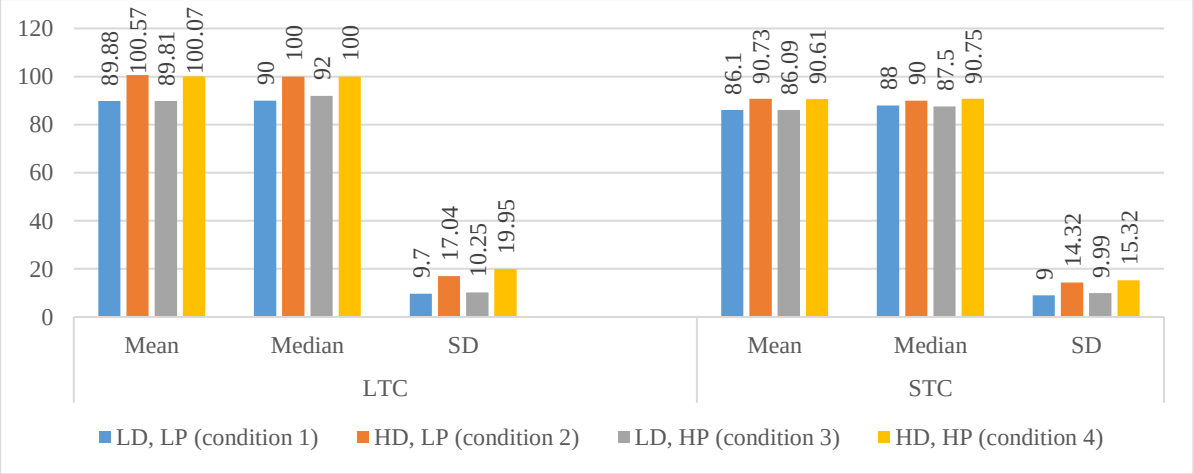

FIGURE 9 - Descriptive Analysis of Q across All Conditions

A visual presentation of the average Q by treatment in STC and LTC is provided in Figures 10 and 11. Compared to the LTC, the ordering behavior of the participants in the STC fluctuates much more, and this oscillation is because the retailer can adjust the Q following the realized quarterly demand/wholesale price throughout the year.

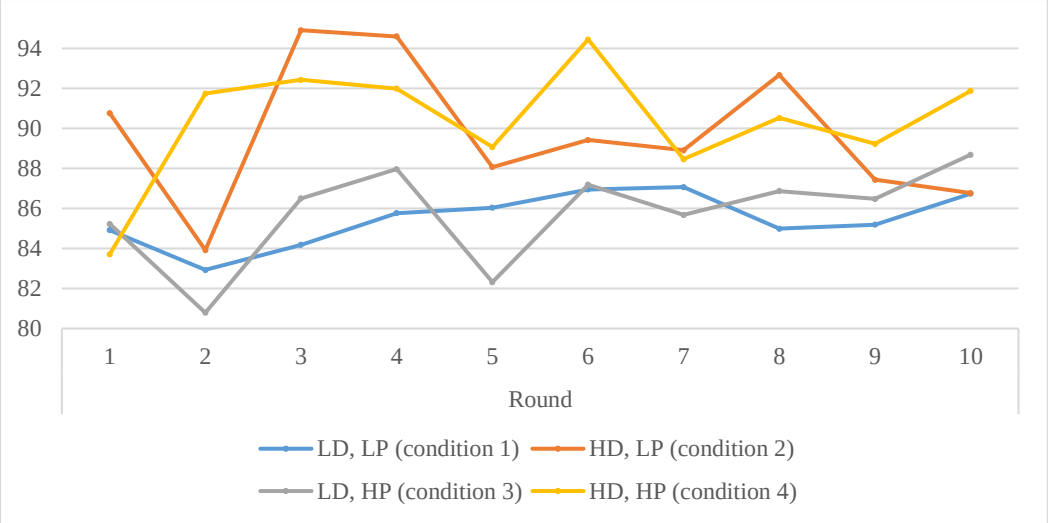

FIGURE 10 - Q Trend in STC across Treatments

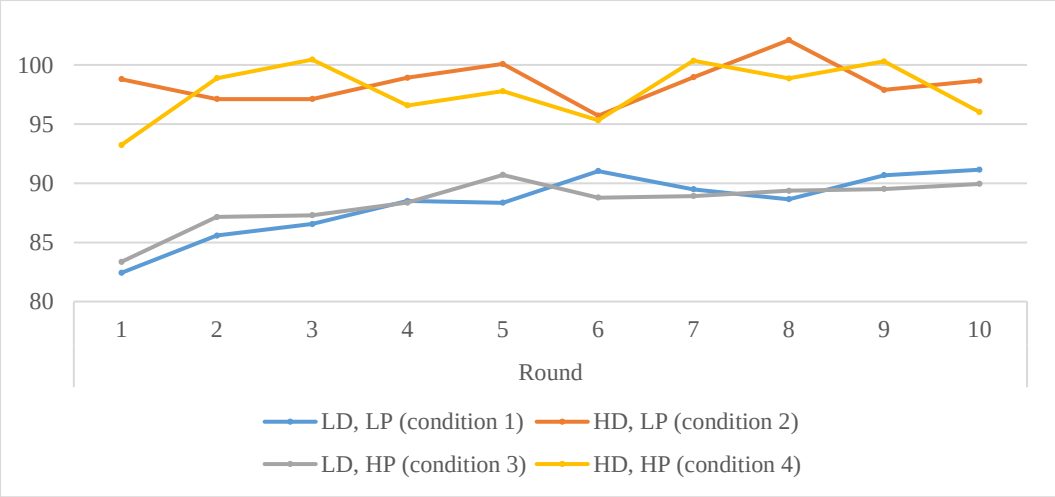

FIGURE 11 - Q Trend in LTC across Treatments

We also calculated the SD of Q, and the analysis shows a positive correlation between the Risk_FS1 and SD of Q (Pearson correlation = 0.230, p = 0.033), which suggests that with the increase in risk-tolerant attitude, the SD of Q increases across all treatments. This indicates that risk-tolerant individuals exhibit higher variation in placing Q, which lends support to the risk definition provided by March & Shapira (1987), suggesting that risk-tolerant individuals are willing to withstand a higher variability in the possible outcomes.

3.4.4.1. Latent Growth Modelling (LGM)

To test H4 and to explore the differences among individuals in setting Q, an additional analysis was performed through LGM using *AMOS 26* (Arbuckle & Wothke, 1999). LGM is an integrative approach that overcomes many of the limitations of traditional SEM (structural equation modeling) by predicting changes in endogenous/dependent variables (DVs) through longitudinal data. LGM allows for estimating inter-individual differences in trajectories over time by revealing factors that influence intra-individual changes (Duncan & Duncan, 2004). The LGM model examines developmental trajectories and estimates the mean intercept (i.e., starting average point of the trajectories) and mean slope (i.e. change rate of the response variable as time progresses) of these trajectories, highlighting differences across individuals. LGM was tested in two steps: 1) We estimated changes in Q with an unconditional model, without any predictors. The factor loadings of the observed variables were fixed at 1 to model a constant for any given individual across time. The loadings for the linear change factors, describing individual differences in the constant rate of mean-level change across measurement points, were set in ascending order (in this case, 1 to 10; Duncan & Duncan, 2004). The estimation of parameters was done using maximum-likelihood (ML), and goodness-of-fit was evaluated by using the χ^2 test (Bollen, 1989). All model fit indices, such as the root mean square error of approximation (RMSEA), 0.093, the Tucker–Lewis index (TLI), 0.897, and the comparative fit index (CFI), 0.906 indicate modest but acceptable fit (Schermelleh-Engel *et al.*, 2003), although the Chi-square test was significant (χ^2= 1,612.768, df = 41, $p < 0.001$). A quadratic model was also estimated with a better fit (χ^2 = 1,049.450, df = 38, $p < 0.001$, TLI = 0.928, CFI = 0.940, & RMSEA = 0.0078). Note that the quadratic change rate explains the acceleration rate of change per unit of time, reflected in the loadings set to 1, 4, 9, etc. Table 12 shows the estimates of the mean and variance of intercept, linear and quadratic slopes of the unconditional model. The mean Q intercept (i.e. the average

starting point of all individuals) was 89.04 ($p < 0.001$) with an average increasing speed of 1.213 ($p < 0.001$), which is decelerating (-0.082) over the rounds across all treatments.

2) The second step of the LGM represents the extension of the unconditional model by including variables associated with the trajectory (demand variability and personal traits).

TABLE 12 - Intercept and Slope of the Unconditional LGM

	Estimate	S.E.	P
I_order	89.04	.307	<.001
L_order	1.213	.101	<.001
Q_order	-.082	.008	<.001

Based on the literature, we accounted for gender, risk attitudes (Risk_FS1 and Risk_FS2), and individualism as time-invariant predictors. LGM is presented in Figure 12, in which $Order_i$ represents the Q at each time point (i.e., in each round).

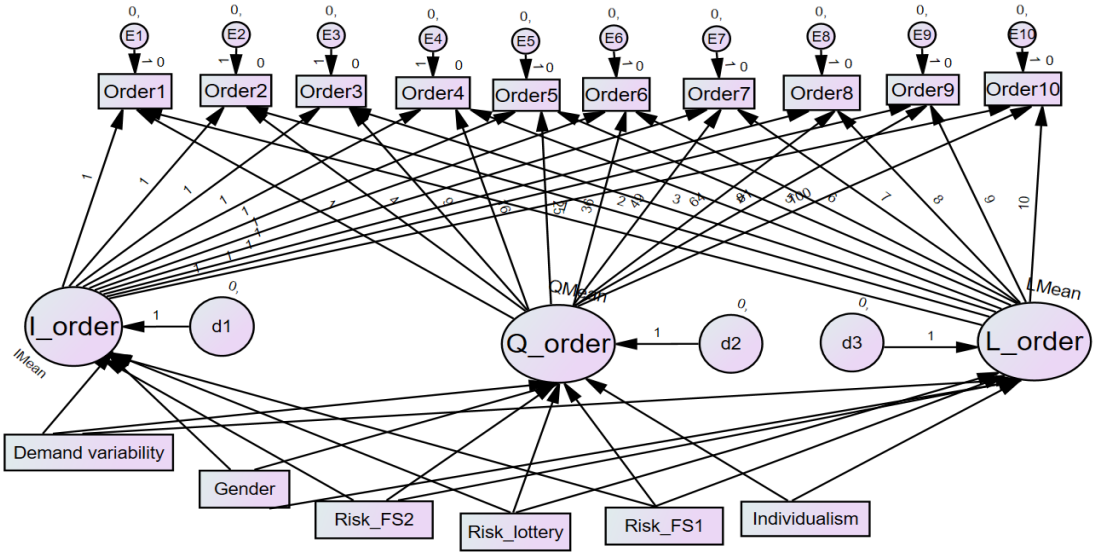

FIGURE 12 - Graphical Presentation of a Quadratic Conditional LGM of Q

In this model, growth is represented by latent intercept (I_Order), linear slope (L_Order), and quadratic slope (Q_Order), and d_i represent the disturbance terms. The factor loadings of the observed variables and linear and quadratic slopes are based on the above-mentioned discussion in unconditional LGM. For a better visual presentation, the covariations between IVs and time-specific residuals of the Qs are omitted in Figure 12. Table 13 shows the

parameter estimates for the conditional LGM. The fit is adequate (χ^2 = 1,770.175, df = 98, p<0.001, TLI = 0.891, CFI= 0.922, RMSEA= 0.062) with statistically significant predictors for intercepts and linear/quadratic terms of Q, except for two factors (i.e., demand variability in quadratic slope, and Risk_FS2, marginally significant in predicting the linear slope and insignificant for quadratic term).

The results suggest that demand variability has a significant impact on the intercept of Q and causes a higher starting point for Q (β = 1.146, p < 0.001). However, as time progressed, individuals tended to decrease their order Q (β = -0.072, p < 0.001). Risk_FS1 & Risk_FS2 both predicted the intercept of Q. An unusual finding was that the more risk-tolerant individuals had a lower Q starting point (β = -6.324, p < 0.001 of Risk_FS1 & β = -0.834, p = 0.027 of Risk_FS2). This result is counter-intuitive, as based on H4, we expected to observe a higher average of initial Q for risk-tolerant participants; hence this aspect needs more exploration in future research.

TABLE 13 - Results of the Conditional LGM Model of Q

			Estimate	S.E.	C.R.	P
I_order	<---	Demand Variability	1.146	.058	19.784	<.001
L_order	<---	Demand Variability	-.072	.02	-3.605	<.001
Q_order	<---	Demand Variability	.002	.002	1.445	.148
I_order	<---	Risk_FS1	-6.324	.552	-11.449	<.001
L_order	<---	Risk_FS1	1.468	.191	7.703	<.001
Q_order	<---	Risk_FS1	-.092	.016	-5.766	<.001
I_order	<---	Risk_FS2	-.834	.378	-2.207	.027
L_order	<---	Risk_FS2	-.243	.13	-1.861	.063
Q_order	<---	Risk_FS2	.018	.011	1.683	.092
I_order	<---	Gender	2.382	.655	3.639	<.001
L_order	<---	Gender	-.743	.226	-3.287	.001
Q_order	<---	Gender	.039	.019	2.054	.04
I_order	<---	Individualism	2.481	.554	4.478	<.001
L_order	<---	Individualism	-.7	.191	-3.661	<.001
Q_order	<---	Individualism	.04	.016	2.534	.011

The results suggest that more individualist participants start with higher order quantities (higher intercept of Q, β = 2.481, p < 0.001) and this high Q tends to decrease (β = -0.7, p < 0.001) with an accelerating rate over time (β = 0.04, p = 0.011). Taking together

these findings, H4, about the individualists' overconfidence and Q, is supported. An interesting result of our model is that gender also shows a statistically significant positive association with the intercept of Q (β = 2.382, p < 0.001), showing that females had higher starting Q compared to their male counterparts. However, they decreased their Q over the time (β = -0.743, p < 0.001) with an accelerating rate (β = 0.039, p = 0.04). While not critically examined in this study, we report this consequential finding as a reference point for researchers interested in gender studies in BOM.

3.5. Conclusion and Future Research Directions

This study reports results from an experimental test on the choice between LTC and STC and order Q when the decision is driven by demand and wholesale price variabilities. Our study adopts a behavioral perspective of decision-making through risk attitudes and individualism. Our theoretical contribution to the literature is threefold: First, we reconcile analytical and empirical domains of BOM in an analytically dominated literature (Cohen & Agrawal, 1999; Seifert *et al*., 2004; Li *et al*., 2009; Talluri & Lee, 2010; Hong *et al*., 2014; Shi & Feng, 2016), through testing relations between behavioral factors, choice of contract, and ordering behavior. Next, we decouple the impact of risk attitudes and individualism in explaining the contract selection across individuals, in which the latter is identified as a salient factor explaining risk preferences in behavioral economics, marketing, and insurance, at both organizational and individual levels (Mihet, 2013; Breuer *et al*., 2014; Gaganis *et al*., 2019). This has been less examined in SC, as suggested in a recent literature review (Goudarzi *et al*., 2021). Finally, our analysis goes beyond the aggregate level by applying a multilevel analysis to explore intra-individual behavior.

The main insights of our research are as follows: 1) Our research shows that sourcing decisions between STC and LTC are contingent on both wholesale price uncertainty and

demand volatility. The selection of LTC decreases when demand and price variability increase; however, this association is more pronounced with the former. 2) The analysis of the ordering behaviour shows that when market uncertainty escalates, risk-tolerant participants are expected to opt for LTC with a larger variation in Q, and when combined with an individualistic mindset, their preference is magnified by a larger initial Q. Conversely, we found risk-averse people to opt for STC with a smaller variation in Q, and when combined with a collectivist mindset, participants' preference was expressed in a lower initial Q. 3) Regarding gender groups, the logistic regression suggested that females select STC more often, and the LGM analysis showed that females place higher initial Q with a decreasing rate of change over time. Our study shows that LTC is more robust to price and demand variability because of the consistency in profitability and fixed product cost, reported to be the main drivers of contract selection.

This research entails several implications for managers and provides directions to answer a key question regarding contract selection: 'what can managers do to better predict the selection of a particular type of contract and increase the probability of acceptance of the offered contracts?'. Our results suggest that there is no optimal universal contract for individuals, and trade-offs must be analysed in the presence of behavioural and environmental factors. Specifically, if the market demonstrates high demand uncertainty along with high price volatility, the likelihood of selecting an LTC decreases, which may signal the other SC parties to be more focused on offering STCs under these circumstances. We propose that procurement professionals create a go-to portfolio of contracts from which they can choose the contract that best suits a particular agent, taking into account market specifications rather than using a single approach concerning the contract's time frame.

Our research confirms that individual decisions are governed by behavioural factors, not necessarily cost efficiency or profit maximization. Results suggest that if the LTC is

desired, a less risk-averse retailer should be selected. Conversely, if the targeted SC agent is risk-averse, the likelihood of selecting the STC increases. This emphasizes the importance of screening contract parties before commencing a contractual relationship. Hence, a decision support system (DSS) can effectively improve the decision-making process through systematic market segmentation to facilitate decision-making and help managers make informed decisions.

Also, the findings demonstrated that individualists tend to initially place higher order quantities due to overconfidence, but these quantities decrease at an accelerating rate over time. Changes in Q can often be costly to inventory managers, and it is particularly important to make informed decisions about the contract features with realistic expectations of how individuals behave in different phases of a contract.

We also acknowledge the limitations of our research, and we point them out here as they can potentially be future research avenues. The design of our experiments was focused on a few factors, such as contract length, price and demand volatility, individual risk propensity, and individualism. Concerning demand variability, additional differential patterns might include seasonal and business cycle-related effects. We considered perishable goods; however, the nature of the end product could modify decision patterns, as the behaviors may be triggered by goods with distinct value and shelf life. Also, for simplicity, we excluded the impact of production capacity; however, this can be an influential factor in contract selection. In addition, the issue of the "power" of SC agents could be worth exploring. We also solely focused on decision-making from the retailer's perspective. However, examining supplier behavior in active negotiation with the retailer could bring new perspectives to the field. Finally, we acknowledge that individuals represent the unit of analysis in our research, and other factors such as organization priorities, industry norms, and company strategy also impact the selection of contracts.

Appendix 2

Risk Elicitation Tests _Domain-Specific Risk Attitudes

For each of the following statements, please indicate the likelihood of engaging in each activity. Provide a rating from 1 to 5, using the following scale:

1	2	3	4	5
Extremely unlikely		Not sure		Extremely likely

1. …….. Betting a day's income at the horse races.
2. …….. Co-signing a new car loan for a friend.
3. …….. Investing 10% of your annual income in a blue-chip stock.
4. …….. Investing 10% of your annual income in a very speculative stock.
5. …….. Investing 10% of your annual income in government bonds (treasury bills).
6. …….. Investing in a business that has a good chance of failing.
7. …….. Lending a friend an amount of money equivalent to one month's income.
8. …….. Spending money impulsively without thinking about the consequences.
9. …….. Taking a day's income to play the slot machines at a casino.
10. …….. Taking a job where you get paid exclusively on a commission basis.

CHAPTER 4

Green Contracts: Empirical Assessment of the Contract Selection in the Supply Chain

Foreword

In the previous chapter, I analysed the performance of long-term and short-term contracts and explored the behavioural drivers of the decisions. In this chapter, I extend my work on contract performance by incorporating the impact of sustainability into the contractual structure. I investigate the impact of the sensitivity to greening and sensitivity to price in the market on selection over two contracts, one of which offers a higher contribution to the CO_2 emission abatement. I examine the preference for green contracts by considering future orientation, uncertainty avoidance and individualism (Hofstede, 1984). The review of the literature on sustainability confirms the extensive analytical/theoretical research in this field rather than empirical studies (e.g., Savaskan & van Wassenhove, 2006; Ghosh & Shah, 2015; Zhu & He, 2017; Biswas *et al*., 2018; Song & Gao, 2018). Also, despite several studies on managerial behaviour in the context of sustainability (e.g., Klassen, 2001; Berson *et al*., 2008; Pagell & Gobeli, 2009), the impact of managerial cognition on the buyer-supplier relationship is less examined.

In this chapter, I provide insight into how differently crafted sustainable contracts in different markets are preferred by individuals and how decision-makers are willing to take a pro-environmental stance and improve their environmental-related goals. I aim to explore the perception of decision-makers with respect to greening and how their attitude toward individualism, uncertainty avoidance, and long-term orientation potentially impact their choices over two contract types when there is uncertainty regarding the level of sensitivity to greenness and sensitivity to the price of the products in the market.

Green Contracts: Empirical Assessment of the Contract Selection in the Supply Chain

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We investigate the impact of market uncertainty driven by product price and level of greening on contract selection and ordering behaviour. Under experimental conditions, the participant-as-manufacturer has two contract options, one that offers moderate energy-efficient products and the other with high energy-efficient products, the latter with increased CO_2 abatement. We examine how contract selection is influenced by the market's price sensitivity versus green products, accounting for decision-makers' attitudinal behaviours, theoretically comprising individualism, future orientation, and uncertainty avoidance. Results show that contract selection for greener products increases under conditions of high market sensitivity to green products and low sensitivity to price. Evidence of "social desirability bias" is uncovered in the analysis of participants' exploration of market conditions.

Analysis of decision makers' attitudinal behaviour revealed a positive association between future orientation and selection of the greener contract and a negative association between individualism and this contract. Latent growth modelling examined ordering decisions and confirmed an under-ordering bias with anchoring to mean demand, interpreted as risk-averse behaviour. The intra-individual analysis suggested that uncertainty avoidance, future orientation, and individualism can be predictors of order quantity when different sensitivities to greening and price are present in the market.

Keywords: behavioural operations management, supply chain contracts, sensitivity to price, sensitivity to greening, green contracts

4.1. Introduction

To promote corporate image, enhance reputation, gain competitive advantage, and consequently achieve market growth, companies undertake initiatives toward corporate social responsibility (CSR) and sustainability (Hsu *et al*., 2013; Schrettle *et al*., 2014). Motivational inputs of sustainability for companies are threefold: 1) responding to pressures coming from external stakeholders such as regulators and consumers due to the rise in awareness about social and environmental matters (Gunawardena *et al*., 2018), 2) accruing competitive benefits of sustainability and performance improvement, and 3) acting ethically and inspiring self-determination within the culture of a company that values sustainability (Aguinis & Glavas, 2012). Based on stakeholder theory (Freeman, 2010), which seeks to balance different and sometimes conflicting interests of stakeholders (i.e. regulators, shareholders, employees, and consumers), it is imperative to understand the impact of firms' sustainability policies on consumer demand. Failure to consider the evolution of society's values can threaten economic demand (Nunes *et al*., 2021), one of the most important drivers of sustainability practices by firms (Ehrenfeld, 2005; Kleindorfer *et al*., 2005; Yalabik *et al*., 2011; Hsu *et al*., 2013).

One of the main sustainability camps, "triple bottom lines", suggests that the three dimensions of economic, social, and environmental development should be considered in a balanced and integrated manner to foster a company's long-term value (Elkington, 1994). As public attitude evolves toward a pro-environmental stance, trading off short-term economic performance with long-term competitiveness may be beneficial. The standard economic theory and the cumulative evidence from the literature confirm a positive association between the sustainable supply chain (SSC) and organisational performance (Melnyk *et al*., 2003; Pagell & Wu, 2009; Golicic & Smith, 2013; Biswas *et al*., 2018). Considering these assumptions, developing sustainability strategies has attracted more attention from executives, and several companies stepped up to actively investigate cleaner technologies to

enhance sustainability expectations. For example, AstraZeneca is trying to replace firewood and charcoal fires with biogas stoves to reduce overall CO_2 emissions and improve the air quality locally (Cote, 2020). Apple claims to have decreased its carbon footprint by 40% in 2020, steadily progressing towards the carbon-neutral target by 2030 (Apple Inc., 2021). By 2025, in addition to launching 10,000 energy-efficient retail stores, Starbucks is aiming to provide 100 million coffee trees to farmers aiming for ethically-sourced coffee (Matthews, 2020). More recently, the COVID-19 pandemic has urged businesses to increase resilience in mission-critical SCs, by localizing their supply to reduce the chances of disruptions and have a positive environmental impact (Sarkis, 2020).

Despite the demonstrated long-term competitive advantage of sustainability and real-world examples of sustainability practices, SC parties are not always willing to take on greening initiatives; there is also a big gap between the managers' intention and the actual incorporation of sustainability practices (Olynec, 2016). The survey conducted by Kiron *et al*. (2017) showed that although 90% of executives understand the importance of sustainability, only 60% of the companies incorporated sustainability in their strategy, and 30% of them incorporated sustainability goals into business models. Managers wear different hats when thinking about the financial, environmental, and social performance of the organisations, and they respond differently to the sustainability importance and commitment to developing/implementing environmental/social practices. The commitment to sustainability initiatives may be impacted by execution difficulties or require trade-offs with economic performance (Bowen *et al*., 2006). For instance, environmental initiatives, say curbing CO_2 emission, require an upfront investment in technology development and extra effort to redesign the products, which increases economic uncertainty. This is a major concern when the cost minimization objective is not satisfied by the environmental initiatives (Biswas *et al*., 2018).

While external factors, such as society and regulators' pressure, are shown to influence the execution of environmental initiatives, our experiment is designed to focus on managers' decisions. The support of managers as decision-makers in organisations is recognised as one of the key internal drivers of sustainability (Siebenhüner & Arnold, 2007; Schaltegger & Zvezdov, 2015). Research confirms that the behavioural underpinnings of supply chain management (SCM) can challenge rational decision-makers' actions, particularly under uncertainty (Kahneman & Tversky, 2013; Kaufmann & Carter, 2006). Like many other SC decisions, contract selection is influenced by individual factors and behavioural attitudes. The behavioural theory of the firm (BTF) contends that understanding the decision-making process of firms requires taking into account behavioural factors and deviations from rational decision-making (Cyert & March, 1963). Thus, teasing out the mismatch between theory/desirability and practice/implementation would benefit practitioners and researchers.

Although several studies have investigated managerial behaviour in the general context of sustainability and organisations (e.g., Klassen, 2001; Berson *et al*., 2008; Pagell & Gobeli, 2009), the literature on sustainability is silent on the impact of managerial cognition in the buyer-supplier relationship. To examine the linkages between attitudes and performance, we focus on cultural orientation, a critical factor in both individuals' behaviour toward sustainability (Camarero *et al*., 2013; Eom *et al*., 2016) and SC decision-making (Gray & Massimino, 2014; Özer *et al*., 2014; Eckerd *et al*., 2016).

We apply Hofstede's (2001) cultural framework, and among the five proposed dimensions, we mainly focus on uncertainty avoidance (UA), long-term/future orientation, and individualism/collectivism, where previous scholars revealed an association between these dimensions and sustainability. We elaborate on these relationships in hypotheses development in section 4.3.2. We exclude power distance and femineity/masculinity dimensions, consistent with the reasons presented by Parboteeah *et al*. (2012): 1) Power

distance analyses individuals in a larger context (e.g., society) by measuring the hierarchical power acceptance and expectations. Our study does not portray society's perspective directly but rather focuses on the behavioural preferences of individuals*;* 2) Prior research explores the femineity/masculinity dimension with respect to preferences for gender roles. While we do record participants' gender as part of our study, our experimental design does not aim to measure/manipulate any aspect of gender role preference.

The impact of cultural values on sustainability practices is confirmed in the literature (e.g., Parboteeah *et al*., 2012; Semenova, 2015), yet, the discussion is sparse on the impact of culturally embedded behavioural differences on managerial decisions. Specifically, we explore contract selection between two options: 1) Contract A, offering a product with low energy efficiency, low market demand uncertainty, and small upfront greening investment; & 2) Contract B, offering a product with high energy efficiency, greater uncertainty in demand and a relatively large upfront greening investment cost. We also investigate the ordering behaviour, and we posit that these managerial decisions may be driven by factors other than immediate improvements to financial/operational efficiency.

For this research, we utilise a product-based green initiative (Bowen *et al*., 2006), and given the adopted environmental perspective, we use CO_2 reduction as a measure of environmental impact (Bushuev *et al*., 2015). Specifically, we focus on two products that deploy different technologies and consequently reduce CO_2 emissions by different amounts. In developing our research, we are inspired by a real-world case of IBM and Samsung employing a new semiconductor innovation to save energy compared to a scaled fin field-effect transistor (FinFET) (Adams, 2021). This development was reported to decrease energy usage by 85%. In our research, CO_2 abatement is production-driven, such that by selling cleaner products to the market, the manufacturer makes a contribution. Our research aims to bridge the gap in the literature by answering the following questions:

1. Considering the market's sensitivities to greening and price and the two contracts with different levels of sustainability, under what conditions are decision-makers more likely to act in environmentally responsible ways?
2. How do behavioural attitudes (individualism, UA, and future time orientation) impact contract preference and ordering decisions by SC agents?

Through investigating the first question, we provide insights into how differently crafted sustainable contracts in different market conditions (different sensitivities to greening & price) are preferred by decision-makers. This will guide academics and practitioners in understanding the critical contract factors in decision-making when sustainability practices are in place. Answering the second question will identify the individual drivers of decisions and enlighten the contract designers to craft sustainability factors to increase the acceptance rate.

We believe that this research contributes to the literature in two main ways: First, by incorporating the behavioural factors influencing the decision-making on supply chain contracts, we contribute to sustainable supply chain management (SSCM) literature. As a research direction, Reefke and Sundaram (2017) suggested the examination of biases that impacts individual decision-making in SSC. Also, scholars called for more empirical studies to examine and refine SSCM (Seuring & Müller, 2008; Kirchoff *et al*., 2016). Our research responds to the above gaps expressed in the literature by unpacking the behavioural drivers of individuals' choices and their impact on decision-making. Second, although the literature on consumer behaviour and raising their environmental awareness is well-established (primarily in the Marketing literature), there is insufficient coverage of the behavioural biases from the SC parties' perspective, which is the unit of analysis in our study. Therefore, we contribute to behavioural operations management (BOM) literature by juxtaposing supplier-buyer relationships and sustainability using controlled experiments. The integration of SSCM

into behavioural buyer-supplier relations has been emerging, and this matter was raised by the recent literature review (Fahimnia *et al*., 2019; Goudarzi *et al.*, 2021). The contract selection analysis, in the presence of sustainability factors, is largely unaddressed, and our research informs manufacturing strategy, as well as shedding light on how decision-makers, at the individual level, perceive and react to different sustainable contract options.

In order to bridge the gap between analytical studies and real-world practices, we use laboratory experiments which helps to test the findings of analytical models through manipulating conditions at a desired level. The use of laboratory experiments has been prevalent in BOM studies as it leads to higher internal validity compared to other research methods (Fahimnia *et al*., 2019; Goudarzi *et al*., 2021).

The organisation of the rest of the paper is as follows: section 4.2 presents a literature review of related streams, and section 4.3 presents the theoretical background, experimental hypotheses, and experimental design. Section 4.4 presents the results of the statistical analysis and the conclusions drawn from the empirical evidence. The paper concludes with recommendations for research and management and future directions of work in section 4.5.

4.2. Literature Review

The triple bottom line suggests that sustainability brings long-term value to companies (Elkington, 1994) and helps them achieve long-term positive performance, mostly due to reducing inputs through environmental-friendly products and creating better products through innovation (Nidumolu *et al*., 2009). However, research in behavioural economics/operations and theories such as BTF challenges the standard economic theory and argues that individuals are not always mindful of the future's impact and long-term strategies, and they seem to be constrained by behavioural factors (Cyert & March, 1963). Individual decisions are influenced by several behavioural factors, such as social preferences (Fehr & Fischbacher,

2002), risk aversion (Kahneman & Tversky, 2013), bounded rationality (Simon, 1957), and cultural values (Hofstede, 1984).

The concept of sustainability in SC coordination has been studied analytically (e.g., Choi & Chiu, 2012; Zhu & He, 2017; Song & Gao, 2018; Hong & Guo, 2019; Zhang & Yousaf, 2020), with few empirical studies (e.g., Cousins *et al*., 2019), and most of the empirical studies have examined this notion at the consumer level (see Groening *et al*., 2018 for a review). Research on sustainability has been conducted at the macro-level, examining the impact of sustainability on an organisation's performance (e.g., Margolis & Walsh, 2003; Godfrey *et al*., 2009), and at the micro-level, focusing on individuals' performance. The latter is well-known for the focus on consumers' behaviour that falls in the realm of marketing (e.g., Kollmuss & Agyeman, 2002; Govindan *et al*., 2014), and it confirms the influence of individual factors such as personal values and cultural norms on green behaviour (Groening *et al*., 2018). Our micro-level study aims to uncover the manager's preference for SSC contracts while accounting for the impact of behavioural factors. The extant literature confirms the importance of examining behavioural perspectives by showing that managers' decisions are influenced by cognition and behavioural biases originating from values (Berson *et al*., 2008) and expertise (Kaufmann *et al*., 2009). We review two categories of the literature, one with the focus of behavioural factors in the general context of supplier-buyer relationship and the other with specific focus on SC sustainability.

In the general context of supplier-buyer relationship, some studies examined cultural values. Ribbink and Grimm (2014) suggested that cultural differences originating from different backgrounds have an impact on negotiations between buyer and supplier, resulting in lower SC performance. Gray and Massimino (2014) showed that process compliance could be facilitated by cultural compatibility between the headquarters and manufacturing facilities. Through the identification of cross-national differences in trustworthiness between the U.S.

and China, Özer *et al*. (2014) showed the impact of these differences in forecast sharing. Focusing on the same countries and considering supply disruptions, Eckerd *et al*. (2016) evaluated the consequences of psychological contract breach (i.e., insufficient fulfilment of obligations based on individual perceptions) on behavioural and attitudinal responses.

The second category of literature review is dedicated to studies with the focus on cultural factors when SC sustainability is accounted for. Klassen (2001) analysed the impact of internal factors, such as managers' personal views (i.e., social orientation, opinion on the environment, and business), on the development of the environmental management system. Their study suggested that having less emphasis on ethical values and more emphasis on short-term economic values makes the managers develop a more reactive plant-level environmental management system rather than a proactive one. It is also shown that the commitment to SSC is influenced by the experiences and preferences of managers regarding the importance of sustainability in an organisation (Klassen, 2001; Pagell & Gobeli, 2009). Pagell and Gobeli (2009) contended that the experience and attitudes of the operational managers influence the employees' well-being and environmental performance. By applying the BTF, Kirchoff *et al*. (2016) showed that managers can be sceptical about implementing environmental-related strategies in SC and concluded that intuitions and emotions are critical in decision-making by teams. Aligned with the previous research, Soundararajan and Brammer (2018) investigated decision-makers' cognition and showed that in a multi-tier SC, the way that intermediaries frame social sustainability requirements impacts the fairness perception and reciprocation of the sub-suppliers (either negatively or positively). Du *et al*. (2016) indicated that fairness concern is an effective tool to enhance performance and reduce potential manufacturer-supplier conflicts. They found that concurrent/joint innovation teams were more successful than siloed innovation teams when developing innovative sustainable products. Decisions on pricing and CO_2 emission abatement are studied by Li *et al*. (2019) with a fairness-neutral

manufacturer and a fairness-concerned retailer. Bird and Soundararajan (2020) suggested that pre-contractual signals, through the offers of repeated exchange and relation-specific investment, can build trust and consequently enhance the implementation of SSC practices. In SSC, Xiao *et al*. (2021) analytically studied the impact of behavioural factors of SC parties (i.e., fairness concerns & overconfidence) in optimal contract design. Through analytical modelling, Lan (2019) showed that with a loss-averse retailer and risk-neutral manufacturer, the channel could be coordinated if the retailer gets a part of the manufacturer's profit by sharing the green emission reduction cost.

Belhadi *et al*. (2021) argued that interpersonal trust and positive relational experience can develop sustainable SC governance. The relationship between the pro-environmental behaviour and future orientation is investigated by Carmi and Arnon (2014) and it is concluded that individual with developed future orientation demonstrated more pro-environmental tendencies.

Chan and Ma (2020) argued that the international buyer's environmental orientation influences their green supplier development activities. Guo *et al*. (2020) compared the selection of two contracts based on their profitability and environmental impact by sales platforms and manufacturers and concluded that the profitable contract (i.e., agency contract) is preferred by the former while the contract with greater environmental improvement (i.e., wholesale price) is selected by the latter. The impact of reference point on procurement strategies is investigated through analytical game model by Liu *et al*. (2019). With a dominant retailer, stronger green efforts by suppliers were observed when order quantity was allocated equally between suppliers.

Some scholars suggested the existence of culturally patterned individual responses to environmental problems and indicated that how higher level of collectivism causes a weaker willingness to support pro-environmental actions (Eom *et al*., 2016; Sherman *et al*., 2021).

With a green conscious market, Toktaş-Palut (2021) suggested that the higher the consumers' sensitivity toward the greening level of products, the manufacturer and the remanufacturer exert higher greening efforts and proposed an integrated two-part tariff contract to coordinate the three-echelon SC under fairness concern.

While the literature review shows the advancement in the topic in recent years, the investigation of behavioral and cultural factors is still less examined, leaving questions for scholars and practitioners. Also, the aforementioned studies examined the cultural values mainly at an aggregate level (e.g., national-level culture scores), while we measure cultural values at the individual level to explain the decision-makers' behaviour. Culture-level and person-level individualism was studied by Eom *et al*. (2016) only. They showed that person- and national-level individualism exert independent influences on the link between environmental concern and pro-environmental action. Using aggregated values may result in false stereotypes as not all the members of society necessarily reflect the same cultural values. McCoy *et al*. (2005) warned about the unfitting use of country scores to individuals, as people's orientation can differ from their national culture. Consequently, in this study, we measure the participants' cultural dimensions individually. Our study addresses the dearth of studies examining cultural values in SSC and provides a comprehensive analysis of sustainability in SC beyond the behavioural biases that have already been reported.

4.3. Methodology

4.3.1. Background and Model

Green products are appealing to two categories of consumers: environmental-conscious consumers and cost-conscious consumers by considering the long-term impact of green products (e.g., energy efficiency) on cost-cutting (Song & Gao, 2018). Although more consumers have become aware of the sustainability concept and "green consumer behaviour" is a fairly common concept nowadays (Steg & Vlek, 2009), there is a gap between their

intention and their actual purchase behaviour, called the "green gap" (Kollmuss & Agyeman, 2002). This can primarily come from the higher price of green products, as producing them typically requires utilising green technology that ultimately increases product cost (Eccles *et al*., 2014). Consequently, there is risk associated with demand due to simultaneous consideration of greening efforts and consequent higher product prices in a market sensitive to price and greening of products (Ghosh & Shah, 2015).

We assume that the market (consumer demand) is environmentally conscious, but the level of this sensitivity towards greening differs and can be characterised as either low or high. Following a widely adopted model in the literature (e.g., Savaskan & van Wassenhove, 2006; Ghosh & Shah, 2015; Li *et al*., 2016; Zhu & He, 2017; Biswas *et al*., 2018; Moon *et al*., 2018; Song & Gao, 2018), we assume that demand is a linear function of price (p) and level of greening (θ), such that the demand derived from an environmentally conscious market is increasing with greening level and decreasing when the retail price is rising. This reflects the willingness of environmentally concerned consumers to pay a premium for green products (e.g., Simon, 1992; Nielsen, 2015; Moon *et al*., 2016; Nguyen & Johnson, 2020). The greater θ indicates a higher level of the greening of the product resulting in higher environmental protection via CO_2 abatement. This simple linear demand function allows analytical comparison among different scenarios (Raj *et al*., 2018). Given all the above, the demand function follows the relation (5) below:

$$D(p,\theta) = a - \beta p + \alpha\theta \quad (5)$$

where D is the actual market demand, a is the baseline market potential that increases with the greening effort θ and decreases with price p; α and β are the sensitivities to greening effort and to price, respectively. Note that $a>\beta p$, $\beta>\alpha$, $\beta>0$, necessary conditions of our model that can be interpreted as follows: 1) $a>\beta p$ means that base market demand is always greater than the negative impact of the price sensitivity; 2) $\beta>\alpha$ indicates that the impact of retail price on

demand is greater than the impact of greening (Li *et al*., 2019); and 3) β>0 means that consumers prefer inexpensive products (market demand is inversely proportional to price). The demand function shows how the environmental awareness and willingness to pay the premium for low-carbon products influence demand uncertainty. This is a common assumption in the sustainability literature (see Ghosh & Shah, 2015; Raj *et al*., 2018; Li *et al*., 2019 among others). The actual market demand will be higher than the baseline potential demand when the product's greening is improved and the retail price is decreased. The average market demand is known to the manufacturer (the participant's role in our experiment); however, both sensitivities to greening and price are unknown. The willingness of consumers to pay higher prices (premium) for green products encourages the SC parties to deploy green technologies by investing in sustainability initiatives to enhance financial performance (Taghikhah *et al*., 2019). Consistent with the cost structure in the literature (Banker *et al*., 1998; Swami & Shah, 2013), we consider an upfront fixed investment for product greening, assumed to be convex for greening effort (θ):

$$I = z\theta^2 \tag{6}$$

where I is the fixed investment parameter and z is the greening cost-efficiency coefficient that, for simplicity, we assume is 1. This quadratic function of greening cost represents the declining rate of returns of greening initiatives (Yenipazarli, 2017; Raj *et al*., 2018). Sustainable practices impose additional costs, and to compensate for the investment, contract parties set higher wholesale prices, leading to higher retail prices of green products compared to conventional ones (Nidumolu *et al*., 2009; Panda *et al*., 2015). In our model, we assume that the manufacturer incurs all the greening investment cost, and the wholesale price to the retailer w is a function of the amount the manufacturer allocates to the greening activities $W(\theta)$. We apply the cost structure used by Raz *et al*. (2013) and Yenipazarli (2017) to calculate

the impact of green innovation/technology by the manufacturer on wholesale price. The greening investment increases the wholesale price such that:

$$W(\theta) = w\,(1+\mu\theta) \tag{7}$$

where $\mu \in [0, 1]$ represents the cost increase effectiveness of greening effort in wholesale price per unit of θ. The retail price after greening follows the same relation. Before greening investment, the retailer sells the product to consumers at the retail price of *p*; however, the retailer increases the retail price to $P(\theta)$ per unit of θ for the greener product they offer.

$$P(\theta) = p(1+\sigma\theta) \tag{8}$$

where $\sigma \in [0, 1]$ is cost increase effectiveness of greening effort in retail price and $\mu > \sigma$. The units produced under either of the contracts are sold to the retailer in two ways: 1) if there is sufficient demand for the quantity of units produced, they are sold at the original wholesale price; and 2) if there is insufficient demand for the quantity of units produced, the leftovers (L) are sold at the end of the season at a discount (half wholesale price, the salvage value of the leftovers). It should be noted that if the total market demand D is larger than the production quantity Q, there are no leftovers as L = max(0, Q-D). Each product sold contributes to CO_2 reduction, and since all the products are to be sold, CO_2 emission abatement is based on the units produced and expressed as tonnes of CO_2. The CO_2 reduction G for contracts A and B are as follows, where λ is the CO_2 reduction coefficient, and $\lambda_A < \lambda_B$, which shows the higher energy efficiency for products available in contract B:

$$G_A = \lambda_A * Q, \quad G_B = \lambda_B * Q \tag{9}$$

As a common practice in the real world, different types of incentives (e.g. tax concession, rebate) are offered by governments to encourage companies to take part in sustainability activities (Sairinen, 2000; Harrison, 2010; Mortimore, 2019; Vidyattama *et al*.,

2021). In our experiment, we consider a cap-and-trade scheme (Du *et al*., 2016) where, if the manufacturer manages to reduce the CO_2 emission, they can sell the unused credits at a pre-determined amount to other companies. We call this rebate N, which is expressed in terms of production quantity Q, the value of each tonne of CO_2 abatement in dollar (V) the level of CO_2 abatement for contracts A and B as:

$$N_A = Q^* V^* G_A, \quad N_B = Q^* V^* G_B \tag{10}$$

Finally, the gross profit F of the manufacturer is the difference between total revenue R and total costs F = R – C, where R and C follow the relations (11)-(12):

$$R = [\min (D, Q)^* W(\theta)] + L^* (0.5)(W(\theta)) + N \tag{11}$$

$$C = (Q^* c) + I \tag{12}$$

where *c* is the production cost by the manufacturer and *Q* is the production quantity set by the manufacturer considering the shared information about the market potential.

4.3.2. Theoretical Model and Hypotheses Development

We draw upon theories and previous empirical research in the literature to develop our hypotheses. Two sustainable options are offered to participants with different potential profits and CO_2 reductions: Contract A uses a simpler technology that requires less investment, which leads to a moderate contribution to CO_2 abatement and less rebate. Contract B uses a more costly technology that requires a higher greening investment and produces more expensive products with a high contribution to CO_2 abatement, which in turn leads to a higher rebate (Yalabik *et al*., 2011). However, due to the new technology used, the market uncertainty is higher for contract B compared to A. Following a cap-and-trade scheme (Du *et al*., 2016), for products with higher energy efficiency, a proportionally higher rebate is awarded.

We manipulate the sensitivities to greening and price as two experimental factors. By way of reminder, in an environmentally conscious market, demand is positively associated with the level of the greening of products and negatively associated with price (Tascioglu *et al*., 2019). But, when sensitivity to greening is higher than price sensitivity, the result is a net increase in demand (Zhu & He, 2017; Biswas *et al*., 2018; Moon *et al*., 2018; Song & Gao, 2018). Many consumers prefer inexpensive products, and generally, they are more sensitive to price than to the greenness of a product (Li *et al*., 2019). We would expect manufacturers to select according to perceived consumer preference, and thus when the market sensitivity to price increases, we anticipate that participants will select contract A, offering the cheaper product. Conversely, when the market sensitivity to greening increases, we anticipate more participants will select contract B, offering the greener product. The above logic leads us to hypothesise that:

H5a: An increase in price sensitivity in the market is positively associated with the selection of the contract with the lower level of sustainability (i.e., contract A with less expensive final products).

H5b: An increase in greening sensitivity in the market is positively associated with the selection of the contract with a higher level of sustainability (i.e., contract B with greener final products).

Concerning cultural values, we aim to assess if individualism influences the support for environmentally-related actions in sustainable contract selection. Individualism is one of the most studied cultural dimensions, particularly in marketing and psychology (Hornikx & O'Keefe, 2009). It measures how individuals value their interests and place them ahead of those of a group, namely, family, friends, and colleagues. The literature suggests that collectivism is positively associated with the propensity to support sustainability initiatives

(Parboteeah *et al*., 2012), that collectivists are more likely to take pro-environmental actions than individualists (Dunlap & Liere, 1984; Moon *et al*., 2016), and environmentally active groups have a larger membership of collectivists (Semenova, 2015). Videras *et al*. (2012) showed a positive association between pro-environmental behaviours and social ties with family or co-workers. Some studies suggested that compared to collectivists, individualists are less willing to engage in climate change actions (Xue *et al*., 2016; Xiang *et al*., 2019). Kang *et al*. (2016) showed that there is a negative association between individualism and CSR activities in the tourism and hospitality industry. Similarly, Dogan and Ozman (2019) revealed that participants with interdependent self-construal (how connected and interdependent they feel to others) showed higher interest and intention in buying hybrid electric cars compared to individualists. Waldman *et al*. (2006) showed that managers from countries that value collectivism value most aspects of a firm's CSR activities in their decisions. The preponderance of literary evidence suggests that individuals with a higher level of collectivism will select the contract with a higher level of sustainability (i.e., contract B).

H6: The contract that offers products with higher energy efficiency (i.e., contract B) is more likely to be selected by collectivist participants compared to their individualist counterparts across all conditions.

As another cultural dimension, we investigate the linkage between uncertainty avoidance and sustainable contract preference. UA addresses the individual's comfort in dealing with ambiguous situations (Hofstede, 2001), and people with a high UA establish rules to moderate their exposure to diverse opinions, while those with a low UA feel less anxiety in uncertain situations and are more tolerant of different opinions (Hofstede, 2001). The literature has reported mixed results about the link between engaging in sustainable initiatives and UA. A high level of UA is shown to cause a weak commitment to take sustainability initiatives (Vachon, 2010) and resistance to innovation (Shane, 1995; Lee &

Herold, 2016) which is the foundation of many sustainability practices (Vachon, 2010). This negative correlation is explained by the high cost and uncertain benefits of sustainability initiatives (Slawinski & Bansal, 2015). On the flip side, there may be a positive association between UA and willingness to engage in sustainability initiatives because of avoiding the regulation costs of environmental inaction (e.g., Kacperczyk, 2009; Kang *et al*., 2016; Kim *et al*., 2018; Miska *et al*., 2018). We aim to explore this dimension at the individual level within the SSC context. Since the contracts in our experiment have different levels of uncertainty in terms of market demand, the individual's UA may serve as a psychological deterrent to selecting a sustainable contract. Contract B requires a higher range of investment to satisfy more energy efficiency with greater baseline market demand variability, and thus, we hypothesise that:

H7: Uncertainty avoidance is negatively associated with the selection of the contract with the higher level of sustainability (i.e., contract B), such that participants with a higher level of UA are more likely to select contract A across all conditions.

As the final psychological determinant of propensity to adopt sustainability practices, we investigate long-term/future orientation. This refers to the tendency of individuals or societies to prioritize long-term success, establish long-term plans to achieve goals, and value long-term results rather than short-term ones (House *et al*., 2002). Future orientation is shown to have a positive association with supporting corporate sustainability practices (Parboteeah *et al*., 2012; Miska *et al*., 2018). Future-oriented individuals are more focused on the benefits that sustainability has to offer for future generations (Parboteeah *et al*., 2012) as opposed to past-/present-oriented individuals who value immediate payoffs. Research shows that future-oriented people display more propensity toward pro-environmental behaviour (Milfont *et al*., 2012; Parboteeah *et al*., 2012) and that reducing/moderating immediate concerns triggers sustainable behaviour (Arnocky *et al*., 2014). Following this research trail, we expect a higher

propensity of future-oriented participants to select contract B due to its substantive contribution to environmental sustainability.

H8: Selecting contract B is positively associated with the level of future orientation of individuals, such that participants that show higher future orientation are more likely to select contract B across all conditions.

One of the most critical inventory decisions a procurement manager makes is the order quantity. Like all decisions, inventory decisions may also be affected by the attitudes of decision-makers. Thus, we examine the ordering behaviour of individuals under both contracts. In line with the definition of the newsvendor model, ordering too much under stochastic demand causes leftovers, and ordering too few leads to lost sales. The literature demonstrates that the actual inventory decision of the individuals deviates from the expected profit-maximising quantity, and there are non-mutually exclusive reasons to explain this. Following the concept of the pull-to-centre effect (Schweitzer & Cachon, 2000), which implies that actual orders are between the expected profit-maximising quantity (Q^*) and the mean of demand distribution (μ), we expect to observe the same behaviour in our experiment. The literature also suggests that for products with higher profit, decision-makers tend to under-order, while they show an over-ordering behaviour for products with lower profit (Schweitzer & Cachon, 2000). Since contract A has a higher expected profit, we expect to see under-ordering for this contract and over-ordering behaviour for contract B.

H9: While experimenting with outcomes for contracts A and B, participants order a higher quantity under contract B with a lower expected profit and order lower quantities under contract A with a higher expected profit.

4.3.3. Experimental Design

4.3.3.1. Game Setup and Procedures

Using a 2×2 experimental design, we manipulate two main variables: the sensitivity to greening and the sensitivity to price with the conditions shown in Table 14. To represent different market behaviours, these variables have two levels –'low' (L) and 'high' (H) - to form four different conditions. Condition 1 (LP, LG; P, and G stand for sensitivities to price and greening, respectively), Condition 2 (HP, LG), Condition 3 (LP, HG), and Condition 4 (HP, HG).

TABLE 14 - Experimental Design

Conditions	Low sensitivity to price (β)	High sensitivity to price (β)
Low sensitivity to greening (α)	Condition 1: (β) = 4 ; (α)= 1.5	Condition 2: (β) = 6 ; (α)= 1.5
High sensitivity to greening (α)	Condition 3: (β) = 4 ; (α)= 4	Condition 4: (β) = 6 ; (α)= 4

The values of sensitivities provided in Table 14 are used to characterise four different market conditions. Since all products are considered sold, CO_2 emission abatement is based on the units produced; however, it is higher for contract B because the products contribute to a higher CO_2 abatement (abatement is $2*Q_A$ & $3*Q_B$, i.e. 50% greater for B). The rebate is \$10 per tonne of CO_2 abatement. The production cost, the wholesale price, and the retail price before greening investment are \$250, \$300, and \$500, respectively. The demand follows a uniform distribution which is a common distribution form in SC literature (see Davis *et al*., 2014; Chow *et al*., 2015; Zhang *et al*., 2016; among others). The market demand has an average of 1,100 units/items for both contracts, and participants are provided with an estimate of the demand for both contracts by sharing information about the range in which demand fluctuates ($300 \leq D \leq 1{,}700$). These ranges are hard limits on the production quantity range for both contracts. However, demand in each round is unknown, with two sources of variability: market response to price and greening. We ensured our parameter settings yielded significant differences between the conditions using *Monte Carlo* simulation to mimic participant responses in our experiment (*@Risk* simulation software from the *Palisade* package). A summary of the specifications of the two contracts is provided in Table 15:

TABLE 15 – Contracts' Specifications

Greening Investment	Total CO_2 emission abatement	Average market demand	Market demand uncertainty
Greening investment in contract B > Greening investment in contract A	Contract B > Contract A	Contract A = Contract B	Contract B > Contract A

We applied a within-subject design and exposed each participant to all conditions to control for potential individual differences. We randomized the order of the conditions to control for the *order effect*. To account for individual differences, the survey included questions on demographics (i.e., age, gender, country of birth). The experiment included detailed instructions, along with a couple of calculation examples, to get the participants familiar with the decision-making process and their tasks. A comprehension test with seven questions was required before completing the experiment. Those who failed to correctly answer all questions were asked to reperform the comprehension task or withdraw from the experiment. Four of the participants withdrew from the experiment at this stage. The experiment had two steps: 1) all participants, assuming the role of a manufacturer, selected between two contracts, A & B, and 2) all participants chose their production quantity.

The actual market demand, total CO_2 abatement, rebate, and net profit were shown to the participants after completing these two steps. After exploring ten rounds for each condition, participants are asked to submit their final/overall choice of contract A or B based on the aggregated statistics for each contract they explored and to explain the reason for this selection.

4.3.3.2. Software and Participant Pool

Due to the restrictions caused by COVID-19, a face-to-face laboratory experiment was not possible; thus, we designed an online experiment using a Python-based framework called oTree (Chen *et al.*, 2016). The instruction and screenshots of the experiment are provided in Appendix 3 As a common practice in the literature, our participant pool was undergraduate

students (a combination of first, second, and third-year students), with an age range of 18-29, enrolled in a management course at a large Australian university (Zhang *et al*., 2016; Davis & Hyndman, 2018; Castañeda *et al*., 2019; Johnsen *et al*., 2021). The BOM literature shows that in laboratory experiments, these participants performed similar or even better than older managers (Cooper *et al*., 1999; Bolton *et al*., 2008) and were recruited through an online panel. Each session lasted for about 30 minutes, and the participants were compensated with credit points as the unit mark on completing the experiment and also extra credit points based on their performance.

4.4. Statistical Analysis and Experimental Results

4.4.1. Descriptive Analysis

We recruited 180 participants; however, we used 161 cases in the final analysis after checking for completeness and consistency. The sample included 89 females, 79 males, and 3 participants who preferred not to mention their gender. The exclusion of those non-attending to experimental conditions was based on the failure in the attention check question (e.g., I like working in a team. Please respond with “agree”) and the lack of variance in the contract selection across treatments, without any given explanation in the final debrief question.

4.4.1.1. Measures

To incorporate the three cultural dimensions: individualism, UA, and time orientation (Hofstede, 2001), we applied validated scales. We used a 16-item scale developed by Triandis and Gelfand (1998) and commonly used in cultural studies (Biddlestone *et al*., 2020), to measure individualism, with two dimensions of collectivism and individualism. Participants rated the extent to which the items described them. There were eight statements measuring individualism (e.g., "I'd rather depend on myself than others" & "It annoys me when other people do better than I do"), and eight statements measuring collectivism (e.g., "If a co-worker gets a prize, I would feel proud" & "I feel good when I cooperate with others"). To measure

UA, we applied a modified version of Hofstede's (1984) scale with seven items developed by Jung (2002), which was shown to be a better fit for individual-level analysis (Jung & Kellaris, 2004). Examples of statements from the UA test are: "I don't like ambiguous situations" and "I feel stressed when I cannot predict consequences".

Also, we used a 14-item scale by Joireman *et al*. (2012), a modified version of the future-time orientation scale developed by Zimbardo and Boyd (1999). This scale is comprised of two subscales that are scored reversely, one concerning immediate outcomes and the other concerning future outcomes. Participants were asked to provide their agreement level with some statements in the first category (present orientation), such as "I only act to satisfy immediate concerns, figuring the future will take care of itself", and "my convenience is a big factor in decisions I make or the actions I take". They were also asked to rate the extent to which they are concerned for future outcomes through some statements such as "I consider how things might be in the future, and try to influence those things with my day-to-day behaviour" and "My behaviour is generally influenced by future consequences". All the measures were scored on 5-point Likert scales (1 = "Not at all characteristic of me", 5 = "Entirely characteristic of me", or 1 = Strongly disagree; 5 = Strongly agree). The utilised measures are provided in Appendix 3.

4.4.1.2. Validating the Applied Measures

Factor analysis was applied to understand the structure of the constructs in this context and create summaries that were used as predictors in the models. Exploratory factor analysis (EFA) using the Alpha Factoring method and Direct Oblimin rotation was first applied. In analysing individualism, we excluded the items with low communality (i.e., "When another person does better than I do, I get tense and aroused"), and the EFA on the remaining items was undertaken (total mean = 2.8, SD = 0.31). We also excluded one question from the

collectivism measure ("I feel good when I cooperate with others") to continue the analysis with the items that were consistent with the pre-defined variable (total mean = 3.55, SD = 0.35). The analysis of UA confirmed an acceptable level of variance explained in the items suggesting that the measure captures distinct aspects of UA among individuals (total mean = 3.7, SD = 0.66). Also, future orientation under the subscale of present time showed an acceptable level of variance (total mean = 2.86, SD = 0.61); however, two of the items under the future time subscale were removed due to low communality ("When I make a decision, I think about how it might affect me in the future" & "I think it is better to perform a behaviour with important distant consequences than a behaviour with important immediate consequences") and the EFA on the remaining items was undertaken (total mean = 3.76, SD = 0.54).

4.4.2. Multivariate Analysis of Variance (MANOVA)

We continued the analysis by evaluating the potential gender differences in attitudinal measures. For this purpose, a one-way MANOVA was conducted on the three latent scores of individualism, UA, and future orientation. Considering these three scales simultaneously, the analysis indicates that there is a significant difference between males and females with Wilk's $\lambda = 0.91$, $p = 0.001$, partial $\eta^2 = 0.095$. The assumption of homogeneity of variance was tested using Levene's test: for individualism ($F(1, 159) = 0.224$, $p = 0.637$), for uncertainty avoidance ($F(1, 159) = 0.245$, $p = 0.621$), and for future orientation ($F(1, 159) = 0.171$, $p = 0.68$). The results also showed a significant difference on 'individualism', $F(1, 159) = 4.35$, $p = 0.039$, partial $\eta^2 = 0.027$ with females (M= 2.89) scoring slightly higher than males (M=2.79). There was also significant difference in UA, $F(1, 159) = 8.76$, $p = 0.004$, partial $\eta^2 = 0.052$ with females (M= 3.85) scoring higher than males (M=3.55), indicating a higher level of uncertainty tolerance among males in this cohort.

In the coming sections, we deploy an arsenal of methods to analyse the "choice of contract", starting with a descriptive analysis of population proportions, continuing with a multiple linear regression to investigate how participants explored contract outcomes, followed by logistic regression to evaluate the final choice of contract, followed by a multilevel analysis to illuminate the relationship between exploration and final contract choice. We conclude this section by analysing the ordering behaviour using a latent growth model (LGM).

4.4.3. Analysis of Contract Choices

4.4.3.1. Descriptive Analysis

We examined the contract selection within/across the market conditions presented in Table 14. We have two data sets to support our descriptive analysis. The first data set is size N= 40×161 =6,440 observations, presented in Figure 13. This corresponds to 10 observations over 4 conditions to yield 40 observations per 161 experimental participants. This dataset reflects how the participant chose to explore the space of possible outcomes for each contract before making their final decision. It also demonstrates how they utilised the scarce resource of 'allowable attempts' in the experiment to support their final decision. We call this "exploration impulse", which we define as the tendency to explore one contract more than the other. The exploration impulse does not reveal the actual contract preference, as this comes from the second data set, which is size N= 4×161=644 observations, presented in Figure 14. The second data set reveals the actual contract preference of participants after they exhausted their exploration attempts.

Within all conditions and considering all rounds, there was approximately a similar frequency of contract selection, with contract A at 48.5% and contract B at 51.5%. As illustrated in Figure 13, contract A (the less green contract) has the highest frequency in condition 2, where the price sensitivity is high and sensitivity to greening is low. Conversely,

the propensity to explore contract B is higher in condition 3, with high sensitivity to greening and low price sensitivity.

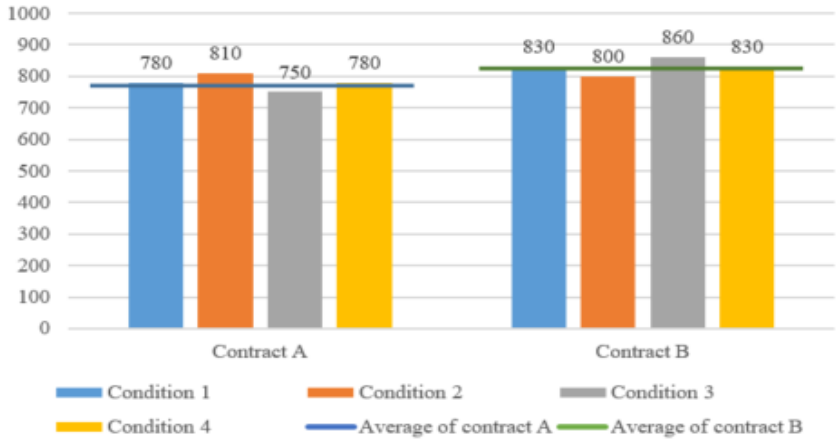


FIGURE 13 - Frequency of Contract Choice within Conditions (Exploration Impulse)

To analyse how participants explored the contract space, we used the normal approximation to the binomial to discern differences in population proportions concerning how frequently they explored Contract A *vs* Contract B outcomes. Because the experiment is designed such that each market condition allows ten attempts to explore either A or B, we expect to observe one of the following two behaviours: 1) An unbiased exploration strategy that would evenly distribute the available attempts between contracts A and B, regardless of the market conditions. Thus, we test the null hypothesis P(A)-P(B)=0, where there is no difference between the proportion of attempts allocated to contract A or B, 2) Alternatively, given that contract A offers a higher expected value across all conditions, we posit that a profit-maximiser individual selects contract A more frequently compared to B to achieve higher profit and improve their performance (P(A)>P(B)). Table 16 reveals that only under market condition 2 (high sensitivity to price and low to greening) the population showed no a priori preference (bias) for exploring either contract. While condition 2 did yield a nominally higher proportion to contract A (A=810, B=800), it was not significantly different from B.

TABLE 16 - Test of Population Proportions of Exploration Impulse

Condition	A	B	P(A)	P(B)	P(A)-P(B)	Z	p-value	More heavily explored Contract
1	780	830	0.484	0.516	-0.031	-1.246	<0.001	B
2	810	800	0.503	0.497	0.006	0.249	0.31	none
3	750	860	0.466	0.534	-0.068	-2.741	<0.001	B
4	780	830	0.484	0.516	-0.031	-1.246	<0.001	B
Total	**3,120**	**3,320**						

In all the other conditions, participants chose to explore outcomes related to contract B at a significantly higher rate than contract A. We interpret this result as an unconscious tendency (bias) in the overall population to explore a contract with more favourable greening outcomes more rigorously and thoroughly than exploring a contract with more favourable profit outcomes. What motivates such behaviour? We reserve this discussion for later.

We now turn our attention to the second data set to examine the actual contract preferences in our experiment using the same method as above. Considering the actual final choice of the contract, we tested the population proportion of the final contract choice to see if the frequency of contracts is compatible with that in earlier rounds. As the results in Table 17 show, the proportions of contract A are not statistically significant in any of the conditions.

TABLE 17 - Test of Population Proportions of the Final Choice

Condition	A	B	P(A)	P(B)	P(A)-P(B)	Z	p-value	More heavily selected Contract
1	84	77	0.52	0.48	0.043	0.552	0.54	none
2	87	74	0.54	0.46	0.081	1.025	0.85	none
3	85	76	0.53	0.47	0.056	0.709	0.66	none
4	82	79	0.51	0.50	0.019	0.236	0.30	none
Total	**338**	**306**						

However, as illustrated in Figure 14, a higher selection of contract A as the final choice was observed (52% and 48% selections of contracts A and B, respectively), which suggests the exploration impulse that we observed does not carry through to the final contract selection.

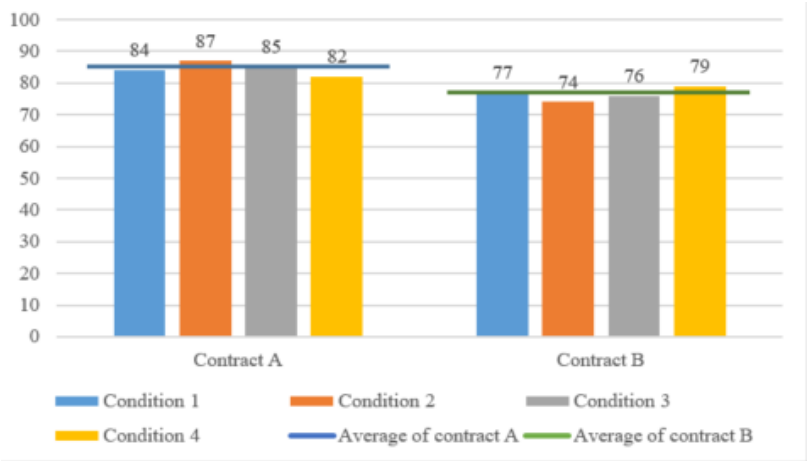


FIGURE 14 - Frequency of Contract Choice as the Final Choice

In explaining this mismatch between the chosen contract within the conditions (in 10 given attempts) and the actual final choice of contract, we refer to the concept of the "green gap" that we discussed earlier in this document (Kollmuss & Agyeman, 2002). We conclude that similar to the "green gap" behaviour of the consumers, participants in our study seem to 'head fake' being socially responsible. Social desirability bias is the over-emphasis of the responses that are deemed to be socially desirable instead of choosing what is aligned with their true feelings/thoughts (Grimm, 2010). This bias is more pronounced in socially sensitive areas such as religion, politics, and the environment (Grimm, 2010). The tendency towards selecting the greener contract in exploratory rounds and selecting the more lucrative contract as the final choice can be an indicator of "social desirability bias" in which participants easily find an acceptable baseline profit in contract A and then allocate the rest of their time/attempts to try to see if B can outperform A with respect to profit (but also adding more social benefit). However, ultimately as their final choice, they choose to maximise profit while meeting 'some' but not all of their social/sustainable goals by selecting contract A.

4.4.3.2. Multiple Linear Regression

We tested a multiple linear regression model to analyse the exploration impulse, with the proportion of time respondents selected contract B being the response variable. As we

aggregated the data of contract selection, we made some modifications to the demand variable by calculating the average demand and changing the scale to make it comparable to other variables. The observed correlations between the independent variables (IVs) (< 0.5), the tolerance index (> 0.8), and variance inflation factors (VIF) (< 3) confirmed the absence of multicollinearity in the model. The parameter estimates with corresponding significance levels are reported in Table 18.

TABLE 18 - The Parameter Estimates of Multiple Linear Regression

	B	Std. Error	Beta	t	Sig.
Sensitivity to Price	-0.085	0.048	-0.068	-1.760	0.079
Sensitivity to Greening	0.071	0.038	0.072	1.841	0.066
Uncertainty Avoidance	-0.038	0.075	-0.020	-0.505	0.614
Individualism	-0.479	0.165	-0.118	-2.902	0.004*
Future time Orientation	0.328	0.112	0.118	2.932	0.003*
Mean Demand Scaled (*100)	0.111	0.047	0.092	2.372	0.018*
Gender	0.018	0.101	0.007	0.174	0.862

*significant at α=0.05 level, ** significant at α = 0.001 level

Preliminary analyses were performed to ensure there were no violations of model assumptions (e.g., normality and linearity in parameters). In terms of model fit, a significant regression equation was found ($F(7,636) = 3.805$, $p < 0.001$) with an adjusted R^2 of 0.61 and an R^2 of 0.64, suggesting that 64% of the variation is explained by the listed factors. The results indicate a statistically significant association between the choice of contract and demand, individualism, and future time orientation. Also, the two explanatory variables (i.e., sensitivity to price and greening) add marginally significant explanatory power to the choice of contract. The results suggest that with each unit increase in sensitivity to price, the selection of the more sustainable contract (contract B) decreases by approximately 8.5%. Also, the selection of contract B increases by 7.1% when sensitivity to greening in the market increases by one unit. This confirms both H5a and H5b, in which a higher selection of contract B is expected when the market is more sensitive to greening compared to price. In support of H6, the results show that less individualistic respondents are more likely to choose Contract B, and the increase by one unit in individualism is associated with a reduction in the proportion

of selecting the greener contract by 48%. There is no evidence to support H7 regarding the relationship between the selection of a greener contract and the level of an individual's UA. However, H8 is supported as the results show that one unit increase in the future-orientation attitude of individuals increases the selection of contract B by 33%. Also, with higher demand, the proportion of the selection of contract B increases by 11%. Clearly, individualism and future orientation weigh heavily on participants' exploration impulses, as observed from their relative effect sizes and statistical significance compared to other variables in the model.

4.4.3.3. Logistic Regression

We continued our analysis by running logistic regression, which evaluates the final choice of contract. The results of the analysis of predictors with their significance levels and odds ratios are reported in Table 19. Initially, the absence of multicollinearity was confirmed by observing correlations between predictors (<0.5), tolerance index (>0.8), and VIF lower than 3. The measures indicated a good fit (Hosmer-Lemeshow p = 0.459, χ^2 = 7.743, degree of freedom (df) = 8); with the overall prediction accuracy of 62.1%, while predicting 72.8% contract A and 50.3% contract B, more than 25% above the classification by chance.

TABLE 19 - Parameter Estimates of Binary Logistic Regression

	B	S.E.	Wald	Sig.	Exp(B)
Sensitivity to Price	0.700	0.204	11.835	0.001**	2.014
Sensitivity to Greening	0.915	0.341	7.189	0.007	2.497
Greening Sensitivity by Price Sensitivity	-0.219	0.067	10.654	0.001**	0.803
Exploration Impulse (selecting Contract B)	0.498	0.082	36.767	<0.001**	1.646
Uncertainty Avoidance	-0.212	0.129	2.674	0.102	0.809
Individualism	0.155	0.287	0.292	0.589	1.168
Future Orientation	-0.257	0.197	1.698	0.193	0.773
Mean Demand_scaled (*100)	0.051	0.021	5.908	0.015*	1.053
Gender	-0.192	0.175	1.199	0.273	0.826

*significant at α=0.05 level, ** significant at α = 0.001 level

Based on the parameter estimates, there are main effects for the two explanatory variables such that the selection of contract B increases with an increase in sensitivity to greening (B= 0.915, p = 0.007, Exp (B) =2.497) and price sensitivity (B= 0.70, p < 0.001, Exp

(B) =2.014), however, the latter shows an opposite direction to the predicted direction in H5a. An interaction effect tests if the effect of sensitivity to price on the contract selection depends on the level of sensitivity to greenness, and the results are significant, indicating that the higher the sensitivity to greening, the more negative the effect of sensitivity to price on the selection of contract B becomes, and vice versa. This confirms the direction of the impact of the two explanatory variables that were used to support H5. We also included the selection of contracts in rounds (within conditions) into our model to test if the frequency of the exploration of one contract can predict the final choice. The result suggests a statistically significant association between these two variables, meaning that an increase in selecting contract B within the conditions (in rounds) increases the likelihood of selecting contract B as the final choice (B= 0.498, $p< 0.001$, Exp (B) =1.646). The results also show that one unit increase in the demand's average increases the preference over contract B (B= 0.051, $p = 0.015$, Exp (B) =1.053). As shown in Table 19, gender is not significant when it comes to explaining the choice of contract. Also, similar to the linear regression model on aggregate responses, UA cannot predict the selection of contracts which means that there is no evidence to support H7.

4.4.3.4. Multilevel Analysis

A multilevel model integrated the exploration impulse and the final contract choice. We used a two-level model given the structure of the data (individual choices for exploration impulse nested within a person). However, the variance in the final choice attributable to the individual represents only 9.1% of the total variance, and the variance in the exploration impulse ascribable to the individual features is 38.9%. We conclude from this that the insufficient variation may be due to a combination of social desirability displayed by several respondents and a joint decision process of contract and quantity. Individuals with zero variance in the final choice and the exploration impulse were excluded from the multilevel

analysis. In level 1 of this analysis, only attributes of the experimental design were included, while in level 2 attitudinal attributes and socio-demographics were considered. The models were tested/estimated using the lavaan and lme 4 packages in R, and the results are presented in Table 20.

TABLE 20 - Parameter Estimates of Levels 1 and 2 in the Multilevel Analysis

Level		Variable	Estimate	S.E	z-value	P(>|z|)
1	Exploration Impulse (Selecting Contract B)	Sensitivity to Price	-0.089	0.092	-0.965	0.334
		Sensitivity to Greening	0.064	0.157	0.409	0.683
		Interaction effect of Sensitivities	0.001	0.031	0.047	0.962
		Mean Demand scaled (*100)	0.089	0.041	2.186	0.029
	Choice of B	Exploration Impulse	0.107	0.022	4.926	<0.001
2	Choice of B	Gender	0.034	0.140	0.24	0.81
		UA	-0.018	0.104	-0.174	0.862
		Individualism	-0.472	0.229	-2.061	0.039
		Future Orientation	0.336	0.155	2.163	0.031

In this model (χ^2= 39.316, df = 4, p < 0.001); although the sensitivities to greening and price are not statistically significant in explaining the choice of contract at the individual level, the sign of the parameter estimates confirms the positive and negative association between the choice of contract and sensitivities to greening and price. Similarly, the results of level 2 confirm the findings of the linear regression model at the aggregate level with a positive association between selecting the greener contract and future orientation (p = 0.031) and a negative association with individualism (p = 0.039).

4.4.4. Order Quantity Behaviour

To test H9, we have undertaken several analyses. We begin by calculating the expected profit-maximising quantity based on normative theory. Following the newsvendor model, a stochastic demand with a uniform distribution between [300 & 1,700], a mean of 1,100, and the indicated production cost, wholesale price, and the salvage value for the orders larger than the demand, the optimal quantity is F(q) = 1/1,400 (q* - 300), where F(q) is the critical ratio which is equal to (C_u / C_o+ C_u), where C_u and C_o are underage (the cost of not having enough inventory) and overage costs (the cost of ordering too much inventory),

respectively. For contracts A and B, the Q* is equal to 1,406 and 1,560. We analysed the initial order decision, which shows an under-ordering behaviour for both contracts and across all conditions with average quantities of 927, 1,014, 1,049, and 1,018 for conditions 1 to 4, respectively. In Figure 15, we plotted the average Q of participants in 10 rounds of each condition. The initial order is the lowest in condition 1 where both sensitivities to greening and price are the lowest. A low-order pattern was confirmed under both contracts through a t-test where the mean of Q under contract A (Mean = 1,037, SD= 430.22) was statistically significant at the 0.05 level of significance (t= -47.90, df=3,120, p <0.001) from the test value, 1,406. *The* mean of Q under contract B (Mean = 1,056, SD= 434.6) was also significantly different at the 0.05 level of significance (t=-66.77, df=3318, p <0.001) from the test value, 1,560. We analysed the mean anchor bias (from the expected mean demand) and insufficient adjustment towards the optimal quantity (Tversky & Kahneman, 1974).

The average Q under contracts A and B are 1,037 and 1,056, respectively. Considering 1,100 as the average demand in the experimental design, the average order under both contracts is very close to the mean demand, confirming the presence of anchoring. Figure 15 suggests that participants started very low under contract A (Q_1 mean = 852), and they increased their order towards the mean demand (Q_{10} mean = 1,064). Conversely, under contract B, the participant decisions on Q start at a higher level compared to contract A (Q_1 mean = 997), and they adjusted their Q by the average of 1,193 in round 10 across all conditions. Despite the identified impact of profit on quantity in the literature (Schweitzer & Cachon, 2000), the inventory behaviour under both contracts was below the Q* even when considering the higher expected profit of contract A. Thus, H9 is not supported. This behaviour, however, is consistent with the risk aversion behaviour in ordering proposed by Eeckhoudt *et al*. (1995), where decision-makers order less than the normative benchmark.

Also, the higher quantity under contract B can be explained by its higher contribution to CO_2 reduction.

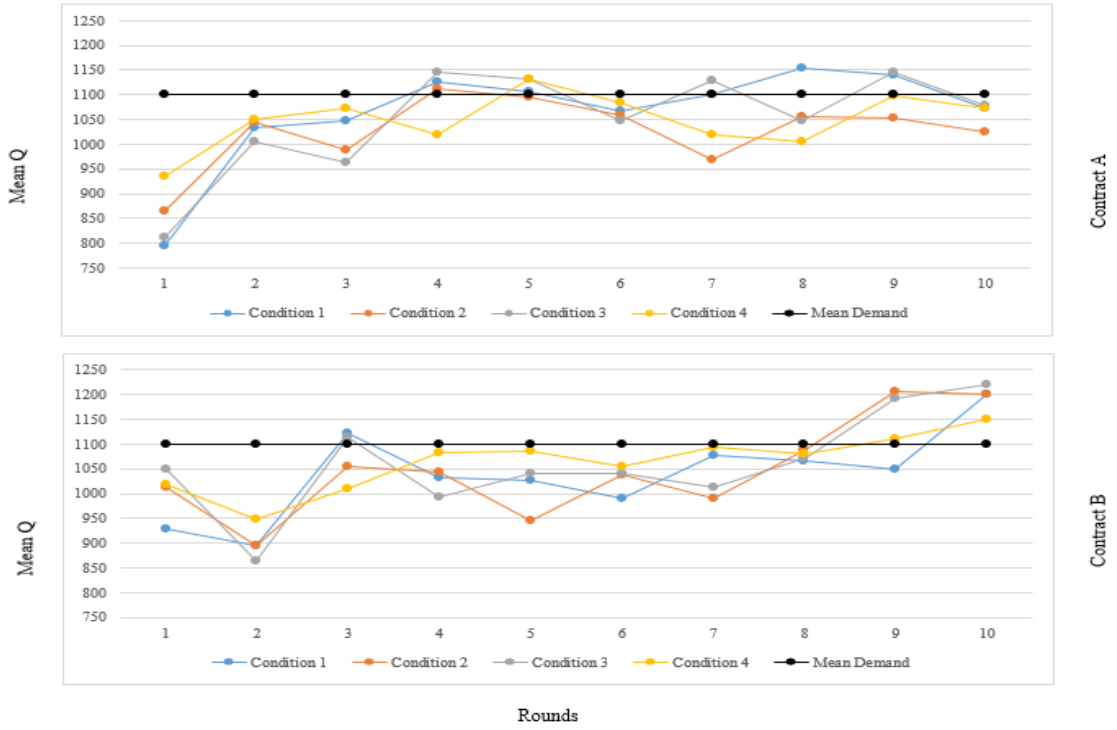


FIGURE 15 - Average Production Quantity Decisions

Finally, we applied LGM to examine the within-subject differences in ordering behaviour over time (changes in ordered quantity) by revealing the influential factors on intra-individual changes (Duncan & Duncan, 2004). The linear growth models provide mean intercepts and slopes of the developmental trajectories. The general model (RMSEA= 0.041, the Tucker–Lewis index (TLI) = 0.905, and the comparative fit index (CFI) = 0.919, χ^2= 168.372, df = 81, $p < 0.001$) showed that a higher initial Q leads to a decrease in Q over the rounds by 0.2 units ($p < 0.001$). The results show that the UA can explain the initial inventory decision, such that participants with higher UA start their orders lower by 2.7 units than those with lower UA ($p=0.035$). Also, we analysed the ordering behaviour by controlling for conditions (RMSEA= 0.045, TLI= 0.891, and CFI= 0.907, χ^2= 427.626, df = 324, p <0.001). Estimates of the quantity's intercept and slope in each condition are reported in Table 21.

TABLE 21 - Intercept and Slope of the Model Grouped by Conditions

Conditions	Condition 1	Condition 2	Condition 3	Condition 4
Intercept-Quantity	0.060	0.153	0.091	0.015
Slope-Quantity	0.039	0.205	0.081	0.090

The analysis of each condition shows that in condition 2 (high price sensitivity and low green sensitivity), individuals with lower uncertainty tolerance have a lower initial order quantity by 5.4 units (p=0.019) which supports the expected attitude of this group to be more cautious given the market uncertainty. Also, price sensitivity negatively impacts the rate of order quantity over rounds by 0.6 units (p=0.02) which means that higher sensitivity to price decreases Q over time, which is intuitively expected (full results can be made available in a supplementary file).

Analysis of Q in condition 4 suggests that when the market is characterised by high sensitivities to price and greenness, future orientation can explain the quantity rate, such that higher future orientation is associated with higher Q over rounds (regression coefficient = 0.013; p=0.069). This finding is aligned with H8, where we posited that future-oriented individuals are more concerned about sustainability and greening matters, and since both contracts produce green products, the higher the production, the higher the contribution to CO_2 reduction.

We also analysed the ordering behaviour with gender as moderator (RMSEA= 0.05, TLI= 0.864, CFI= 0.884, χ^2= 293.83, df = 162, p < 0.001) and the model suggests that a higher level of future orientation among males increases the initial Q by 5 units (marginally significant p =0.084). Also, a one-unit increase in collectivism among males causes a decrease in the rate of Q over time by 1.1 units (p = 0.074). This is counter-intuitive as, based on the literature, there is a positive association between collectivism and pro-environmental actions (Parboteeah *et al*., 2012; Xiang *et al*., 2019; Moon *et al*., 2016; Dogan & Ozman, 2019). However, this finding can be explained by the risk-aversion behaviour of the collectivists compared to their individualist counterparts (Ashraf *et al*., 2016; Mourouzidou-Damtsa *et al*.,

2019). Similar to the analysis of conditions, the analysis of the behaviour of female participants shows that a one unit increase in uncertainty avoidance decreases the initial Q by 3.6 units ($p = 0.051$). Also, those with a higher level of future orientation increase their Q over rounds by 0.8 units ($p = 0.085$) which, as explained earlier, is aligned with the predicted behaviour described in H8.

4.5. Conclusion and Future Research Directions

Our research contributes to the understanding of the impact of market uncertainty, driven by the price and greenness of the products, on contract selection and ordering behaviour. Although there is extensive literature on the consumer side in the sustainability context, this concept is less examined from the SC agents' perspective, leaving unanswered questions for practitioners and researchers. The results of our research show that the decision-maker is more likely to select a contract that produces more energy-efficient products when the market is more sensitive to the products' greenness rather than their price. In addition to the aggregate level, we ran an individual-level analysis accounting for individuals' attitudinal behaviour, mainly individualism, future orientation, and UA. The experimental results confirmed the positive association between future orientation and the selection of the greener contract, while individualists tend to select the less green contract. Also, a negative correlation between UA and the selection of the contract with a higher level of sustainability was found. Analysis of the ordering behaviour showed that despite the impact of profit on Q in the literature, the order quantity under both contracts is below optimal, which indicates a risk-averse ordering behaviour at the aggregate level. An anchoring effect to mean demand is observed when the market has a high price sensitivity and low greening sensitivity. The intra-individual analysis shows that a higher initial Q leads to a decrease in the Q over the rounds. The within-subject analysis reveals that UA, future orientation, and collectivism can be

predictors of quantity when different sensitivities to greening and price are presented in the market. We provided a summary of the supported/unsupported hypothesis below in Table 22.

TABLE 22- Summary of the Results of the Hypothesis Testing

Hypothesis		**Variable** (The association between contract selection and the variable)	**Test Result**	**Method(s)**
H5	H5a	Price Sensitivity	Supported	Linear/logistic Regression
	H5b	Greening Sensitivity	Supported	
H6		Individualism	Supported	Linear Regression/ LGM
H7		UA	Not Supported	Linear/logistic Regression
H8		Future orientation	Supported	Linear Regression/ LGM
H9		Q considering Profit	Not Supported	LGM

Our study shows that implementing green practices can be influenced by market characteristics, and it suggests that in a more environmentally friendly market, the likelihood of selecting a greener contract increases. Also, the pro-environmental behaviour of decision-makers, embedded in the selection of green contracts, can be motivated by personal characteristics. This suggests that disregarding personal characteristics could result in a blurred notion of sustainability. One of the important implications of our study is providing a better understanding of the underlying drivers of SC operating systems which leads to improved precision in providing targeted management interventions. As an example, by realizing the suboptimal decisions by the individuals (due to cognitive shortcomings), an effective procedure and system can be deployed in organisations to control psychological distortions.

From a practical point of view, our research showed that individuals may not always exhibit profit-maximising behaviour. Some individuals may select a pro-environmental contract with lower profit instead of a contract with higher profit and less contribution to CO_2 emission reduction can be of favour to some individuals. Understanding this concept can help managers to increase the acceptance rate of a contract by screening their counterparts' behaviour and market demand when the former unpacks the subjective decision-making and the latter emphasizes the external factors impacting the decisions. Given this, managers may

consider designing a portfolio of contracts, any of which suitable for a specific agent and market. Despite the high price of pro-environmental products, offering a contract with greener products can be favourable to a market that is green conscious. Also, the positive (negative) association between future orientation (individualism) and the selection of greener contracts may be considered by managers to improve contract performance.

Our research provides a better understanding of the behaviour of decision-makers in different markets; however, we also acknowledge the limitations of our research which can potentially lead to future research avenues. Our study did not investigate de-biasing techniques to mitigate behavioural biases. We did not a priori hypothesize about the exploration impulse that we reported on because we observed it after our data collection. Nonetheless, it is an interesting phenomenon that warrants further study, particularly as it relates to social desirability bias and green gap concepts discussed herein. No regulatory factors were imposed on contracts; however, legal requirements such as CO_2 abatement target levels per annum may influence decisions. Finally, we isolated the individuals and excluded the impact of external organisational factors such as company strategies in sustainability practices, which can be considered in future research.

Appendix 3

Instruction

You are about to participate in a decision-making experiment. In this experiment, there are 4 conditions with 10 repeats of the whole experiment.

All participants will receive **2 credit point** providing the successful completion of the experiment. Please note that if you are among **the top 20 best performers** with respect to the **average profit across all 4 conditions**, you will be given **2 extra credit points** after the completion of the data collection at the end of this week and you will realize this by May 25th. Please note that the selection of contract at the end of 10 rounds in each condition doesn't impact your performance.

In this experiment, you will be assigned the "Manufacturer" role. In each attempt, you are required to 1) decide on selecting between two contracts for a year, and 2) decide on the quantity to produce for the year.

Task 1) Contract Selection

The terms and conditions of the two contracts are the same, however, under each contract, you produce a product (laptop) with different specifications following the application of different green technologies. Under contract A, the green technology is simpler and requires a lower amount of investment compared to contract B. However, the final improved green product is less energy efficient with shorter battery life than the green technology used in contract B. Contract B requires a higher amount of investment compared to contract A, as it uses a more complicated and expensive green technology to produce more energy-efficient laptops with longer battery life than the green technology used in Contract A.

Based on the amount of greening investment in each contract (the amount of investment is already set), the amount of carbon emission reduction, the wholesale price, and the retail price will be shown to you.

Wholesale/retail price

Wholesale price and retail price will increase based on the amount of investment. The higher the investment, the higher the retail/wholesale price. Consequently, contract B has higher wholesale and retail prices compared to contract A.

Carbon emission reduction

Purchasing energy-efficient laptops by consumers reduces carbon emission. Therefore, each sold laptop has a positive impact on the environment. However, this impact is higher for products of contract B as they are more energy-efficient.

Carbon reduction contract A (tonne)= 2* Production QuantityCarbon reduction contract B (tonne)= 3* Production Quantity

Task 2) Production Quantity

After selecting either of the contracts, you are required to determine the production quantity. This should be decided in a way that considers the impact of demand uncertainty. The market demand for both contracts is uncertain but with the same average market potential for both contracts. However, market demand for contract A is less uncertain than contract B (i.e. A has less variation than B). For example, in a two-month period, contract A may observe 18 and 22 as the actual demand, while

contract B observes 15 and 25 as the actual demand. Notice that the average demand for both contracts is 20, but the range of values for contract B is greater.

Leftovers

If you produce less than the market demand, you miss the opportunity to make a higher profit. However, if your production is larger than the market demand, the leftovers will be sold at half-price. Suppose that the wholesale price is $1000. If you produce 100 laptops and the demand is 80, there are 20 leftovers. Then 80 laptops are sold at $1000 and 20 laptops are sold at $500 at the end of the season.

Outputs

Market demand

In the experiment, the average market potential will be given to you, however, market potential varies according to **sensitivity to price** and **sensitivity to the level of the greenness of the products**.

For example, in a market where sensitivity to greenness is higher than sensitivity to price, the higher greening investment will expand the market demand because consumers are more willing to pay the premium price. However, in a market where sensitivity to greenness is lower than sensitivity to price, the surge in market demand by higher greening investment is not as significant because consumers are less willing to pay the premium price.

Rebate

Based on the contribution to carbon emission reduction, the manufacturer will be given a rebate by the government (in dollars) which means the higher the Carbon emission reduction, the higher the rebate. Your rebate is $10 for each tonne of carbon emission reduction. For example, if the total carbon emission reduction is 500 tonnes, your rebate would be $5000.

Profit

Profit increases by higher demand (i.e. more sales), and a higher rebate. It decreases by the increase in greening investment. Your profit will be calculated using the equation below:

Profit = Revenue - Production Cost - Greening Investment + Rebate

Revenue = (Min (Demand & Production Quantity) * Wholesale price) + (leftovers (if any) * (50% * Wholesale price))

Production cost = Production Quantity * Production cost for one unit

A summary of your individual decision outcomes is shown to you at the end of each repeat of the experiment including the details of the market demand, Carbon reduction, rebate, and your profit.

Summary of the Game

In a nutshell, in each repeat, you are required to 1) select one of the contracts for a year, and 2) determine the quantity to produce for the year.

Summary of contracts

Greening Investment	Total Carbon Emission Reduction	Average Potential Demand	Market Demand Uncertainty
Contract B > Contract A	Contract B > Contract A	Contract A = Contract B	Contract B > Contract A

Example

Suppose that you are provided with the following initial information about the two contracts.

Information	Contract A	Contract B
Production Cost	$250	$250
Average Market Potential	1000	1000
Production Quantity Range	300-1700	300-1700
Greening Investment	$35,000	$68,000
Wholesale Price	$412	$456
Retail Price	$594	$630

Suppose that you select contract A, and produce 1000 units. After making your decision, the following table will be shown to you and you will realize the actual demand, Carbon reduction, rebate, and net profit.

Final outputs (A)	Market demand	819
	Carbon reduction (tonne) (2* production quantity)	**2,000**
	Rebate (10* Carbon reduction)	$20,000
	Profit = (min(Demand& Production Quantity)* wholesale price) + (leftovers * (0.5*wholesale price)) - (Production quantity * production cost) - greening investment + Rebate	**$110,019**

With the same information, if you select contract B, and produce 1000 units, your results will be as follows:

Final outputs (B)	Market demand	709
	Carbon reduction (tonne) (3* production quantity)	**3,000**
	Rebate (10* Carbon reduction)	$30,000
	Profit = (min(Demand& Production Quantity)* wholesale price) + (leftovers * (0.5*wholesale price)) - (Production quantity * production cost) - greening investment + Rebate	**$102,011**

Note: To ensure a full understanding of the experiment, now, you take a comprehension test with 7 questions based on the current instruction. You are able to proceed with the experiment provided that you answer all the questions correctly.

Comprehension Test

1. Which contract offers higher carbon reduction?
    a) Contract A
    b) Contract B
    c) Equal

2. Which contract offers products with higher energy efficiency?
    a) Contract A
    b) Contract B
    c) Equal

3. Which contract has a more volatile market demand?
    a) Contract A
    b) Contract B
    c) Equal

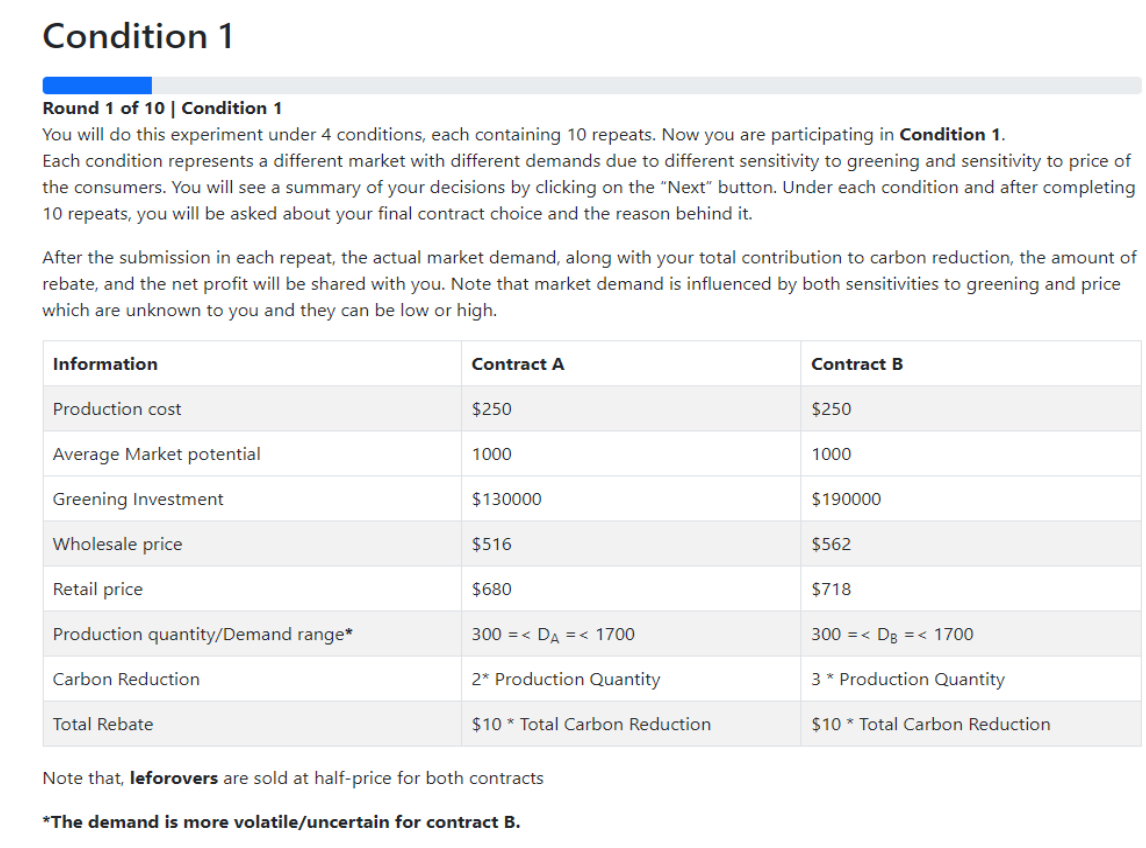
4. Which contract requires a higher amount of investment to make the products green?
    a) Contract A
    b) Contract B
    c) Equal

5. Which contract has a higher average potential market demand?
    a) Contract A
    b) Contract B
    c) Equal

6. Is market demand known to you?
    a) Yes
    b) No

7. What is the impact of greening investment?
    a) Increase in retail price
    b) Increase in wholesale price
    c) Increase in the carbon emission reduction
    d) All the above

Screenshots of the Game



Condition 1

Round 1 of 10 | Condition 1

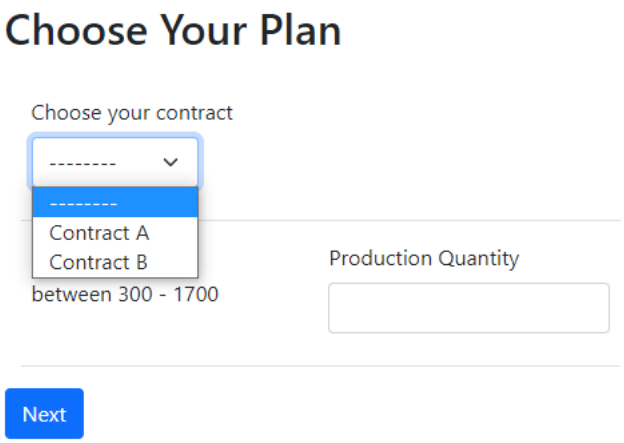
You will do this experiment under 4 conditions, each containing 10 repeats. Now you are participating in **Condition 1**.
Each condition represents a different market with different demands due to different sensitivity to greening and sensitivity to price of the consumers. You will see a summary of your decisions by clicking on the "Next" button. Under each condition and after completing 10 repeats, you will be asked about your final contract choice and the reason behind it.

After the submission in each repeat, the actual market demand, along with your total contribution to carbon reduction, the amount of rebate, and the net profit will be shared with you. Note that market demand is influenced by both sensitivities to greening and price which are unknown to you and they can be low or high.

Information	Contract A	Contract B
Production cost	$250	$250
Average Market potential	1000	1000
Greening Investment	$130000	$190000
Wholesale price	$516	$562
Retail price	$680	$718
Production quantity/Demand range*	300 =< D_A =< 1700	300 =< D_B =< 1700
Carbon Reduction	2* Production Quantity	3 * Production Quantity
Total Rebate	$10 * Total Carbon Reduction	$10 * Total Carbon Reduction

Note that, **leforovers** are sold at half-price for both contracts

***The demand is more volatile/uncertain for contract B.**



Choose Your Plan

Choose your contract

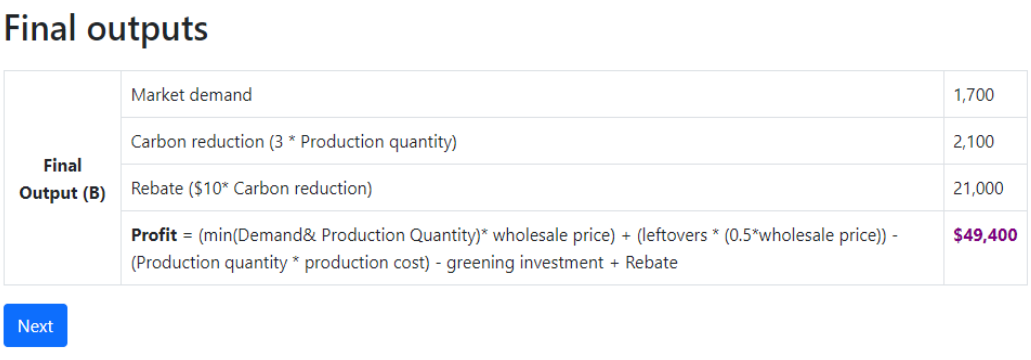
-------- (Contract A, Contract B)

between 300 - 1700

Production Quantity

Next

Final Output Shown to Participants after each Round



Final outputs

Final Output (B)	Market demand	1,700
	Carbon reduction (3 * Production quantity)	2,100
	Rebate ($10* Carbon reduction)	21,000
	Profit = (min(Demand& Production Quantity)* wholesale price) + (leftovers * (0.5*wholesale price)) - (Production quantity * production cost) - greening investment + Rebate	**$49,400**

Next

Summary of Decisions Shown to Participants after 10 Round

Summary

Round	Contract Choice	Production Quantity	Actual Demand	Total CO2 reduction (tonne)	Profit
1	Contract A	450	1187	900	-$1300
2	Contract B	700	1700	2100	$49400
3	Contract A	1500	917	3000	$148586
4	Contract B	500	450	1500	-$33050
5	Contract B	900	1550	2700	$117800
6	Contract B	1100	400	3300	-$10500
7	Contract A	1200	817	2400	$114386
8	Contract B	1500	950	4500	$168450
9	Contract A	1500	1087	3000	$192446
10	Contract A	1700	1052	3400	$189016

Next

Final Question Asked after round 10

Debrief question:

A summary of your choices in condition **1** is provided in the table below. Considering this and based on what you have done, if you were asked to select one of these two contracts as your final choice, what would be your decision?

	Profit				CO2 Reduction			
	Min	Max	Average	Standard Deviation *	Min	Max	Average	Standard Deviation *
Contract A	$-1,300	$192,446	$128,627	79,376	900	3,400	2,540	984
Contract B	$-33,050	$168,450	$58,420	84,898	1,500	4,500	2,820	1,154

* The standard deviation is a measure of the amount of variation or dispersion of a set of values.

Please briefly explain why?

Next

Tests to Measure Individual Behaviours

Test 1 (individualism)

For each of the following statements, please indicate whether you STRONGLY AGREE, MODERATELY AGREE, are UNSURE, MODERATELY DISAGREE, or STRONGLY DISAGREE with it:

1. I rely on myself most of the time. I rarely rely on others
2. I'd rather depend on myself than others

3. I often do my own thing
4. My personal identity, independent of others, is very important to me
5. I feel good when I cooperate with others
6. To me, pleasure is spending time with others
7. The well-being of my co-workers is important to me
8. It is important to me to maintain harmony in my group
9. If a co-worker gets a prize, I would feel proud
10. Competition is the law of nature
11. Winning is everything
12. When another person does better than I do, I get tense and aroused
13. Family members should stick together, no matter what sacrifices are required
14. It is my duty to take care of my family, even when I have to sacrifice what I want
15. Parents and children must stay together as much as possible
16. It is important to me to respect the decisions made by my groups

Test 2 (Uncertainty Avoidance)

For each of the following statements, please indicate whether you STRONGLY AGREE, MODERATELY AGREE, are UNSURE, MODERATELY DISAGREE, or STRONGLY DISAGREE with it:

1. I prefer structured situations to unstructured situations.
2. I prefer specific instructions to broad guidelines
3. I tend to get anxious easily when I don't know an outcome
4. I feel stressed when I cannot predict the consequences
5. I would not take risks when an outcome cannot be predicted
6. I believe that rules should not be broken for merely pragmatic reasons
7. I don't like ambiguous situations.

Test 3 (Future Orientation)

For each of the following statements, please indicate how characteristic this of you is by selecting STRONGLY AGREE, MODERATELY AGREE, UNSURE, MODERATELY DISAGREE, or STRONGLY DISAGREE:

1. I consider how things might be in the future, and try to influence those things with my day to day behavior
2. Often I engage in a particular behavior in order to achieve outcomes that may not result for many years
3. I only act to satisfy immediate concerns, figuring the future will take care of itself
4. My behavior is only influenced by the immediate (i.e., a matter of days or weeks) outcomes of my actions
5. My convenience is a big factor in the decisions I make or the actions I take
6. I am willing to sacrifice my immediate happiness or well-being in order to achieve future outcomes

7. I think it is important to take warnings about negative outcomes seriously even if the negative outcome will not occur for many years.
8. I think it is more important to perform a behavior with important distant consequences than a behavior with less important immediate consequences.
9. I generally ignore warnings about possible future problems because I think the problems will be resolved before they reach a crisis level.
10. I think that satisficing now is usually unnecessary since future outcomes can be dealt with at a later time.
11. I only act to satisfy immediate concerns, figuring that I will take care of future problems that may occur at a later date.
12. Since my day-to-day work has specific outcomes, it is more important to me than behavior that has distant outcomes.
13. When I make a decision, I think about how it might affect me in the future.
14. My behavior is generally influenced by future consequences.

CHAPTER 5

General Discussion

To review my original aim, this thesis set out to investigate the selection between SC contracts through a behavioural lens. The growing literature in BOM confirms the importance of incorporating a behavioural perspective into the analysis of operational issues, and it shows how and to what extent the decision-makers' behaviour influences the selection of contracts in the SC. The studies of this thesis broaden the horizon of literature for BOM researchers moving forward. In this final chapter, I discuss the theoretical and practical implications of my work. Then, I conclude the thesis by discussing the limitations of this thesis and directions for future research in this domain. The contributions of the thesis are indicated in sections 5.1 and 5.2 of the thesis and **Table 23** provides a summary of both theoretical and practical contributions.

TABLE 23 – Theoretical and Practical Implications of the Thesis

	Theoretical Contributions	Practical Contributions
Chapter 2	**1.** Providing a theory-driven taxonomy of the behavioural factors influencing decisions in the context of SC coordination mechanisms **2.** Adopting a combination of techniques to mitigate the possible biases in text analysis	**1.** Selection of a contract can be a subjective matter by decision-makers without engaging in a detailed assessment of the expected profit of contract alternatives
Chapter 3	**1.** Incorporating behavioural factors into analysing the selection between long-term vs. short-term contracts **2.** Providing further evidence for the impact of cultural factors on decisions **3.** The use of different scales to elicit risk attitudes and cross-validation of the lottery task and the self-reported domain-specific scale **4.** Applying LGM, which is a less-utilised methodology in BOM, to investigate the trajectories of order decisions and contract selection over time	**1.** Managers can improve the desirability of either long-term or short-term contracts by carefully monitoring the market and designing the contract parameters accordingly **2.** Managers should create a go-to portfolio of contracts from which they can choose the contract that best suits a particular supplier/agent by taking into account market specifications **3.** For risk-tolerant and individualist SC agents and under market demand uncertainty, if the selection of a long-term contract is desired, a less risk-averse retailer should be selected **4.** Despite the potential negative impact of the high price of products on market demand, managers would benefit from offering a greener contract when the market is more inclined toward using greener products **5.** Managers should note that individuals who exhibit more concern for the future are more likely to select a greener contract, as opposed to those with a high level of individualism being more reluctant to select a greener contract **6.** Managers should strive to design strategies to induce the social desirability of the contract partner if the selection of a greener contract is intended
Chapter 4	**1.** Investigation of the management commitment to implementing environmental and social practices and its drivers **2.** Providing further evidence for the impact of cultural factors on decision-making **3.** Applying LGM, which is a less-utilised methodology in BOM, to investigate the trajectories of order decisions and contract selection over time	

5.1.Theoretical Implications

My research offers a distinct contribution to the notion of selection of contracts in the SC and reveals conducive factors to contract performance rooted in behavioural and market factors. The current thesis contributes to the literature on BOM, particularly the performance of SC contracts, in several ways.

First, the SLR synthesises and categorises the literature based on the applied behavioural decision theories. Other reviews in operations management either had a general approach to examine and classify the studies in all operational contexts (Schorsch *et al*., 2017; Fahimnia *et al*., 2019) or adopted a more granular and analytical approach without exploring the behavioural perspective (e.g., Li & Wang, 2007; Arshinder *et al*. 2011; Chauhan & Singh, 2018). By contrast, in chapter 2, I provided a theory-driven taxonomy of the behavioural factors influencing decision-making in the context of SC coordination mechanisms that were not addressed in the existing literature, as a result of which a holistic conceptual framework was established by unifying the literature-informed critical concepts.

Second, I put forward the impact of a less-examined behavioural perspective in BOM, that is, cultural factors. Drawing upon the well-established theoretical framework by Hofstede (1984), this thesis broadens the scope of the antecedents of contract performance within the existing literature by providing further evidence for the impact of cultural factors on decision-making. Also, accounting for cultural dimensions, along with the risk attitude in chapter 3, provided a more comprehensive understanding of the impact of critical behavioural factors on sourcing strategies and buyer-supplier interaction. Several studies have highlighted the importance of considering the impact of cultural factors in the context of the buyer-supplier relationship (see Gray & Massimino, 2014; Özer *et al*., 2014; Ribbink & Grimm, 2014; Eckerd *et al*., 2016, among others) and many of them used the country scores to categorise the

individuals in terms of the cultural factors. However, the literature suggests that the attribution of these scores to individuals may be unfitting because individuals do not necessarily represent their national culture (McCoy *et al*., 2005). Thus, unlike the common practice in the literature, I measured these attitudes at the individual level in chapters 3 and 4, which provides a more refined micro-level explanation of the findings. Also, analysing and measuring the behavioural biases of individuals directly was indicated as an "important opportunity for future research" (Davis, 2014, p.338). Thus, by measuring and investigating the behavioural attitudes of individuals directly, through validated scales, rather than applying models at the country level, this research advances the exploration of the impact of cultural factors in the selection of SC contracts within BOM.

Third, my empirical study in chapter 3 contributes to the performance of long-term *vs*. short-term contracts and the trade-off investigation by bringing the perspective of the decision-makers to the field that has been dominantly studied analytically to date (Cohen & Agrawal, 1999; Seifert *et al*., 2004; Li *et al*., 2009; Talluri & Lee, 2010; Hong *et al*., 2014; Shi & Feng, 2016). My research in this chapter elucidated the impact of behavioural factors and uncertainty driven by price and market demand to challenge the theoretical findings. I incorporated behavioural factors to provide evidence for the actual performance of these contracts when human decision-makers are involved and presented several findings, some of which contradict the previous analytical studies and hence highlight the importance of intensifying the empirical work in this field.

Fourth, this thesis extends the literature by bringing a new perspective to the field of SC sustainability. In chapter 4, I discuss the selection of green contracts from the standpoint of an SC agent. Although there is extensive literature on analysing sustainability practices from a consumer's point of view (mostly in the realm of the marketing discipline, e.g., Kollmuss & Agyeman, 2002; Govindan *et al*., 2014), the investigation of the management commitment to

implementing environmental and social practices and its drivers are less examined in BOM. Motivated by the dearth of studies examining this issue, I investigated the concerns about the lack of commitment to sustainability initiatives by managers in organisations (e.g., Kiron *et al*., 2017; Biswas *et al*., 2018). Research in chapter 4 reconciles the analytical and behavioural approaches, with the aim to ascertain the extent to which the market sensitivities to price and green products affect the decision-makers' preference over two green contracts while accounting for cognitive factors originating from individualism, future orientation, and uncertainty avoidance. In doing so, I was able to provide evidence of the importance of exploring behavioural and market-related factors in analysing the decision-makers' behaviour, which represents a notable contribution to the literature.

Fifth, the use of different scales to elicit risk attitudes in chapter 3 suggested that utilising self-report scales in measuring the behavioural attitudes of individuals may provide more robust findings. The cross-validation of the lottery task (Holt & Laury, 2002) and the self-reported domain-specific scale (Weber *et al*., 2002) confirmed that using descriptive scales with narratives in which the participants can declare their behaviour/attitudes directly may prevent errors in reports of arithmetic-oriented scales due to the potential calculation difficulty. Thus, I propose that scholars may want to use this finding to improve the robustness of the study designs.

Finally, this thesis extends the existing literature methodologically through the application of some unique approaches. First, I combined three approaches in SLR to comprehensively synthesise the literature. While traditional qualitative analysis is prevalent in reviewing the literature, I adopted a combination of techniques to mitigate the possible biases in text analysis. By coupling qualitative content analysis with a computational (automated) analysis to develop text-to-data metrics and expert elicitation, cross-validation of the findings and complementary insights are generated. Also, the use of software in the literature reviews

was limited mainly to network and co-citation analyses. However, I used a unique approach to validate the findings of the automated content analysis by interviewing prolific authors in the field. The analysis benefited from their input regarding enhancing the comprehensiveness and robustness of the findings. I propose that this methodological approach provides a foundation for future research to undertake a comprehensive analysis of the literature by incorporating the engagement of external scholars. Further, in empirical studies in chapters 3 and 4, I applied LGM, which is a less-utilised methodology in BOM, through which I investigated the trajectories of order decisions and contract selection over time. This method served to predict the changes in decisions through the longitudinal dataset that I had collected over experimental rounds. The application of this method enabled me to reveal the influential factors on intra-individual changes to highlight the inter-individual differences rather than limiting the analysis to the aggregate level of the dataset.

5.2. Practical Implications

This thesis yields insight into contract selection practices for managers and organisations. A key question in analysing contract performance is 'what can managers do to better predict the selection of a particular type of contract and increase the probability of acceptance of the offered contracts?' The findings of my research provide direction to reach potential answers to this question. The contribution of this thesis serves practitioners who wish to design a contract for acceptance, providing a solid understanding of the trade-offs between economic risk and sustainability risk. Further, using these findings, managers can develop more sophisticated sourcing strategies by offering different contract types to potential contract partners. All studies in this thesis argue how the performance of an SC contract and ordering decisions are tied to individual heterogeneity and different approaches in evaluating contracts, which are also driven by environmental factors, particularly market status. The findings of the studies in this thesis entail several implications for managers, and there seem to be different

ways through which practitioners can make use of the findings. The individual heterogeneity prevents me from proposing recommendations that hold universally; however, I provide general recommendations in the following paragraph, followed by more specific implications.

First, the findings of this thesis demonstrate that relying on theoretical models can overlook some important perspectives that can impact the performance of contracts. Thus, it may be necessary to investigate the influential behavioural factors deeper before designing/offering a contract for/to another contract party. The results suggest that there is no optimal universal contract for individuals when it comes to environmental and behavioural factors, and trade-offs must be analysed in the presence of the behavioural perspective and by considering exogenous factors, such as market demand volatility. The findings suggest that the selection of a contract can be a subjective matter by decision-makers without engaging in a detailed assessment of the expected profit of contract alternatives. Translating this into practice, managers must recognise the drivers of decisions and consider them in designing and evaluating the SC contracts to have successful SC plans and improve SC performance. This emphasises the importance of screening contract parties before commencing a contractual relationship. Hence, I propose that a decision support system (DSS) can effectively improve the decision-making process through systematic market segmentation. DSS applications are critically important to facilitate decision-making and help managers make informed decisions. Design and implementation of effective decision-support tools for different SC agents offer increased profitability, enhance the effectiveness of contractual arrangements, and lead to improvement in SC performance.

Second, following the results of my study in chapter 3, managers should think carefully about the contract term structure. Most industries are subject to customer demand instability and price volatility, and in analysing the performance of long-term and short-term contracts, I demonstrated that two contracts with the same expected profit do not necessarily have the same

performance and market conditions, and individual heterogeneity drives the selection of contracts. Managers can improve the desirability of either long-term or short-term contracts for retailers by carefully monitoring the market and designing the contract parameters to satisfy the potential impact of exogenous factors. Specifically, if the market demand demonstrates high uncertainty along with high price volatility, the likelihood of the selection of a long-term contract by retailers decreases, which may signal the other SC party to be more focused on offering short-term contracts under these circumstances. Thus, managers need to adjust the design of the contracts based on market conditions.

Third, I propose that procurement professionals create a go-to portfolio of contracts from which they can choose the contract that best suits a particular supplier/agent taking into account market specifications, rather than keeping one single approach concerning the contract's time frame. My research indicates that individuals with different characteristics would prefer a particular type of contract. For risk-tolerant and individualist SC agents and under market demand uncertainty, the chance of selecting a long-term contract increases. Thus, if the selection of a long-term contract is desired, a less risk-averse retailer should be selected. Conversely, if the targeted SC agent is risk-averse, the likelihood of selecting the short-term contract increases, which helps managers to make informed decisions in setting contractual parameters for different target contract partners based on behavioural differences. Also, my study in chapter 3 demonstrated that individualists tend to initially order a high quantity due to overconfidence, but the order quantity decreases with an accelerating rate over time. In practice, this finding can help managers decide about the contract features pertaining to permitted changes in order quantity. Changes in order quantity can often be costly to operations and inventory managers, and it is particularly important to make informed decisions about the contract features with realistic expectations of how individuals behave in different phases of a contract.

Fourth, many companies are in the process of greening their products due to several motivations coming from external stakeholders, competitive benefits of sustainability, or ethically and inspiring self-determination (Aguinis & Glavas, 201; Hsu *et al*., 2013; Schrettle *et al*., 2014). My thesis indicates that there is no one-size-fits-all approach to improving the performance of green contracts, and several factors need to be taken into account to enhance the robustness of these contracts' performance. Changing the design of a contract by carefully monitoring the market status with respect to the market sensitivities to greening and the product price would benefit the managers. As I propose in chapter 4 of this thesis, despite the potential negative impact of the high price of products (when utilising environmentally friendly initiatives) on market demand, managers would benefit from offering a greener contract when the market is more inclined toward using greener products. Also, a market with consumers sensitive to price and less willing or able to pay a premium for green products might dampen the likelihood of the selection of this contract by the manufacturer, thus, shifting to a contract that produces less environmentally friendly products yet contributes to CO_2 abatement, but with a lower price that may have higher possibility of selection by the manufacturers.

Fifth, the analysis of the individual attitudes in chapter 4 confirms the necessity of designing green contracts considering the individual heterogeneity to improve the performance of these contracts. Managers should note that due to the positive association between future orientation and the selection of greener contracts (as reported in this research), individuals who exhibit more concern for the future are more likely to select a greener contract, as opposed to those with a high level of individualism being more reluctant to select a greener contract. From a practical standpoint, managers may consider the supply from those with less individualistic attitudes and greater concern for the future to increase the chances of entering a contract that is structured to support the production of more environmentally friendly products. With respect to ordering decisions, managers should also consider that the personal attitudes of decision-

makers influence their decisions such that a higher level of future orientation causes ordering higher quantities over time because of their bigger contribution to CO_2 abatement. These considerations help managers to take advantage of or counteract behaviours driven by individuals' attitudes or demand-related factors and consequently enhance the robustness of contracts to these potential factors.

Finally, an important insight derived from my study is the presence of "social desirability" bias. In operations management, the biases are not always a liability and can be treated as an asset, assisting in improving channel performance (Katsikopoulos & Gigerenzer, 2013). In order to achieve an efficient relationship with a contract partner, if the goal is to increase the likelihood of the selection of a greener contract, in addition to the market status, I propose that the "social desirability" bias of the individuals should be taken into account. Managers should strive to design strategies to induce the social desirability of the contract partner if the selection of a greener contract is intended. Setting the contractual terms not only may benefit the SC agents, but it may also benefit society by producing more energy-efficient and environmentally friendly products.

5.3. Limitations and Future Research

With an emphasis on how the literature can be advanced upon this work and to guide future research, my focus in this section is on the *broader limitations* of my studies in this thesis, given that the specific limitations associated with each study are already discussed in the relevant chapters. While my thesis makes contributions to the literature and practice, there are several opportunities for future research, and this work can be extended in several directions.

The first limitation is that interactive connection and negotiation between SC agents and how it influences the contract design/selection are unexplored. Undoubtedly, insights can be drawn from the current setting and by focusing on the behaviour of one SC agent only, yet,

these insights could be enriched by considering the dynamic interaction between contract parties. In my studies, I assumed that the contractual terms offered by the other SC agent are fixed throughout the decision-making process; however, an interactive conversation and negotiations usually occur that impact the received responses from the other agent and the final design/choice of a contract. Embedding negotiation between contract partners can be an extension of this work, which warrants further examination. Using human decision-makers for both sides of the negotiation (in a dyadic SC) instead of having a computer agent in a laboratory experiment is a way that scholars can employ to further test this conjecture.

Second, the structure used in all studies in this thesis is a dyadic channel with one supplier and one buyer. Few studies are using a multi-echelon network in both experimental and analytical studies in the literature (e.g., Van Der Rhee *et al*., 2010; He & Zhao, 2012; Shao *et al*., 2020; Tao *et al*., 2020), with many of them focusing on inventory decisions and the bullwhip effect (e.g., Wu & Katok, 2006; Zhao & Zhao, 2015). In addition to using multi-level serial SC for future research, another possible extension is considering the effect of competition among contract parties. Although it was outside of the scope of my thesis, investigating the notion of competition by considering multi-players (multiple suppliers/retailers) can be another direction for future research in this field (Anderson *et al*., 2021). This setting is mostly used to analyse social preferences and fairness concerns (e.g., Davis & Hyndman, 2018; Nie & Du, 2017; Tao *et al*., 2020); nevertheless, other behavioural factors such as the impact of different bargaining power within a channel on the contract performance and individuals' decisions could be investigated.

Third, to achieve external validation and to extend my study, future research may examine the robustness of these results by conducting field experiments in real-world settings. As pointed out in different chapters, decisions may be affected by several other external variables that are difficult to execute in laboratory experiments and require field study. Also,

the impact of the industry type is unexplored, and scholars can investigate the role of industry type on the performance of the contracts. Complementing the findings of laboratory experiments by examining the actual decisions of managers (while isolating them from the external factors) also can represent a step towards validating the use of students in laboratory experiments as a common practice in the literature. Utilising a case study approach can also improve the experimental studies' external validity.

Fourth, my work analyses individual decisions and not group decisions at the organisational level. This is an open issue to investigate, particularly for large enterprises that are not necessarily dependent on individuals, and their decision-making process goes a long way. Thus, to get a comprehensive understanding of this field, it is incumbent to research the selection of contracts in SCs from an organisational perspective, having individuals or groups as the unit of analysis. Some other variables might warrant further investigation in exploring the selection of contracts at the organisational level. For example, including the administrative burden of selecting different contracts and the operational expenses in the model can expand the experimental setting.

Fifth, in all the studies in this thesis, the main source of uncertainty is demand, while the other way to look at this area is by considering supply uncertainty with the effect of possible disruptions along with stochastic demand. Another important source of supply uncertainty is political instability, which has a serious impact on operational processes and is worthwhile to be incorporated into the models and examination of the SC contracts.

Sixth, similar to how social desirability bias functions in decision-making, moral licencing bias can also be considered in the selection of contracts. This bias discusses how the analysis of past moral behaviour by individuals may impact their future immoral decisions (Monin & Miller, 2001). In the context of green SC contracts and by considering multi-period interactions between the buyer and supplier, the impact of this bias on the selection of the

contract over the periods can be investigated. Since the existence of this bias is confirmed in the consumer's behaviour (Mazar & Zhong, 2010), it may be a worthwhile consideration in future contract design/selection studies.

Finally, as I indicated earlier in practical implications, the application of the findings in the design and implementation of interactive DSSs is an interesting and practically-rewarding direction for future research. Apart from the technical aspects of DSS design, it would be interesting to understand the situation upon which the DSS and human decision-makers should co-exist to enhance the performance of the operating systems. It stands to reason that the more complex the contract design, the greater the potential benefit from the use of a DSS to augment human decision-making. In addition, a fruitful avenue for research could be the investigation of different types of training incorporating the behavioural biases of the individuals. Research shows that the consistency of the memory structure and learning a problem-solving strategy facilitates the learning process (Pei & Reneau, 1990). This implies that the behavioural perspective of individuals should be considered in training programs to improve the efficiency of the learning process. However, it warrants research to explore this matter properly.

5.4. Conclusion

In summary, this thesis set out to examine the selection of SC contracts through a behavioural lens and explicates the behavioural factors driving the choice of contract. A systematic literature review in chapter 2 identified the research gaps and discussed the common behavioural decision theories in this field. The results warranted research on SC contracts considering both a time frame and a sustainability perspective.

In chapter 3, where the first empirical study is reported, I examined decision-makers' preferences between long-term and short-term contracts in the presence of stochastic demand and wholesale price variability while accounting for behavioural factors. Through laboratory experiments, it was found that the risk attitude and individualism of decision-makers

significantly support their choice of contract. Besides, market conditions can also drive the choice of contract when influential parameters in the market are present at significantly different levels. Through my experimental study in chapter 4, I investigated the performance of two green contracts in an uncertain market, when the demand uncertainty is driven by the sensitivities to price and greenness of the products. The impact of three cultural factors, namely uncertainty avoidance, future orientation, and individualism, was analysed as well, indicating that the pro-environmental behaviour of decision-makers, embedded in the selection of green contracts, can be motivated by personal characteristics.

This thesis provides direction to understand how and to what extent the decision-makers' behaviour influences the selection of contracts in the SC. The findings of this work demonstrate how selection of a SC contract and ordering decisions are linked to individual heterogeneity. A universal finding of all studies is that theoretical models may overlook some real-world perspectives and behavioural factors should be incorporated into analyses to provide a comprehensive understanding of the operations issues. Whilst theoretical models attempt to identify an optimal choice, decision-makers may have different preferences driven by their behaviours that leads to subjectively selecting contracts irrespective of their financial perspective. From a real-world perspective the findings of the thesis emphasise on recognising the decision drivers to improve SC performance. Given the importance of behavioural factors in decision-making, undertaking a screening process prior to any contractual relationships seems to be a necessary act for managers.

The results of the experimental study in chapter 3 shows that decision-makers were not indifferent between two contracts with the same expected value with respect to the profit. The decisions were driven by the risk attitude and individualism of the individuals. Also, external factors such as the level of demand uncertainty and price volatility were influential on decision-making.

The results of the second experimental study confirmed that individuals may not always be profit maximisers and the more lucrative contract is not always the individuals' choice. Given the specifications of the investigated contracts, economic and sustainability trade-off should be both investigated. Cultural factors such as future orientation, individualism, and uncertainty avoidance were analysed and the first two were proven to be influential on individuals' decisions.

Via three distinct studies, this thesis provides evidence for the impact of behavioural biases and market conditions on the decisions of individuals in the SC. Through understanding the performance of SC contracts, I hope this thesis and its findings pave the way for future research in BOM and act as a foundation for further investigation in this field.

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