Sustainable Agri-Food Supply Chains: Consumer Demand and Company Sourcing Practices

by

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Abstract

Agri-food supply chains link food production to processing, trading, distribution, and consumption across the globe. However, food production can have severe environmental and social impacts. Rising societal awareness of issues regarding supply chain sustainability both promises opportunities for and assigns responsibilities to companies involved in the supply chain. Companies may seek to win new customers by selling certified sustainable goods. They may also implement other sustainable sourcing practices (SSPs) besides certification to manage their suppliers' sustainability performance. This dissertation presents three studies that address some knowledge gaps about consumer demand for certified sustainable products and companies' sustainable sourcing practices, with new findings drawn from large-scale, real-world datasets.

While survey-based research indicates that consumer demand for certified sustainable goods is large, this is not reflected in actual market demand. This gap suggests that either the demand predictions were incorrect, or that the marketing strategies used in the real world failed to tap into the potential demand. The first and second studies of this dissertation (Chapter 2 and 3) evaluate different marketing strategies by examining the actual market demand for certified Fair Trade and organic coffee based on consumer purchases at grocery stores across the US. Both studies use discrete choice models with random coefficients to characterize consumer demand in terms of consumers' willingness-to-pay, price sensitivity, and substitution behavior.

The first study compares the demand for Fair Trade, organic, and dual-label Fair Trade and organic coffees, focusing on consumers who bought some certified coffee (9.3% of all coffee consumers). In aggregate, consumers (i) preferred products that were both Fair Trade and organic to products that were only Fair Trade or only organic, and (ii) showed equal preference between

single-label Fair Trade and organic products. The results encourage companies that are choosing between the labels to invest in both Fair Trade and organic labels instead of just one.

The second study compares consumer demand for premium-priced and regular-priced Fair Trade and organic coffees relative to conventional (unlabeled) coffee. The study found that consumers were more sensitive to the prices of both premium and regular certified coffee than to the prices of their conventional counterparts. Even consumers who spent most of their coffee budget on premium certified coffees were more likely to choose the regular conventional category over the regular certified category in response to an increase in the price of their preferred premium certified coffee. Companies making and selling certified products would need to do more than matching prices and using sustainability certification labels to increase their market competitiveness in a traditional retail setting dominated by conventional products.

Companies want to know what SSPs other companies are using to inform their own strategies. Stakeholders, such as governments and non-profit organizations, need to know the prevalence of different SSPs used by companies in multiple supply chain stages to understand the development of sustainable supply chain in an industry. The third study (Chapter 4) addresses these knowledge gaps by examining the mixes of SSPs used by 171 companies in the palm oil industry. The study determined how "hands-on" or "hands-off" the companies are, and how the companies' SSPs depend on their supply chain stages—retailers, manufacturers, or processors and traders (PTs). Hypotheses about the relationship between companies' SSPs and their supply chain stages were based on theories commonly applied in sustainable supply chain management. Regression analysis was applied to data on companies' SSPs collected from their websites and reports in 2018. The two most popular practices were certification and supplier code of conduct. On average, companies used two hands-off practices regardless of supply chain stage. In contrast, companies used fewer hands-on practices on average the more downstream their supply chain stage was, decreasing from PTs, to manufacturers, and then to retailers. The variations agree with what is expected from theory. The results highlight the prevalence of hands-off practices and that the PTs likely lack hands-on support from their downstream customers. Stakeholders are recommended to collaborate and invent solutions that can provide more support to PTs and more upstream suppliers.

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[1] Written in Chinese convention, the first terms in my parents' names are their surnames, and the rest are their given names.

Contents

Chapter 1

Introduction

1.1 Motivation

Agri-food supply chains link food production to processing, trading, distribution, and consumption across the globe. Unfortunately, food production can have negative environmental and social impacts, such as widespread deforestation, destruction of local communities and wildlife habitat, and worker exploitation (Amnesty International, 2016; Carlson et al., 2017; Greenpeace International, 2018; Mason & McDowell, 2020). Calling for change, international and national governance organizations, journalists, activists, academics, and individuals pressure companies to address the sustainability challenges embedded in their supply chains (Kingo et al., 2020; Lambin et al., 2020; Thorlakson, 2018).

The rising societal awareness of supply chain sustainability issues both promises opportunities for and assigns responsibilities to companies involved in the supply chain (Seuring & Muller, 2008). Companies may seek to win new customers with goods produced more sustainably. Market and academic researchers have found, through surveys and laboratory experiments, that many consumers prefer products that support social justice and the environment (Auger et al., 2003; Buell & Kalkanci, 2019; Hainmueller et al., 2015; Newholm & Shaw, 2007; Porter & Kramer, 2006).

To showcase their production credentials to end-consumers, many companies apply third-party social and environmental certification labels on their products (Cerri et al., 2018; Seyfang, 2005). However, despite the findings from surveys on market demand for sustainable products, the real market demand is less than expected (Vermeir & Verbeke, 2006). This phenomenon is well known and is commonly dubbed the "intention-action gap" by Vermeir and Verbeke (2006). The gap between survey-based findings and real market demand could be because respondents give socially desirable and biased responses (Hainmueller et al., 2015; Lehmann & Sheffi, 2020). The gap also suggests that consumers' preferences regarding products with sustainability certifications are not well understood. Understanding consumer preference with market demand data can provide more information for companies choosing the type and number of certification labels to invest in, if at all.

Critics highlight the ineffectiveness of certifications in addressing key sustainability issues (Carlson et al., 2017; Weber, 2011) and companies found that certifications do not always protect them from supply chain risks (Poynton, 2015; Thorlakson, 2018). As a result, companies are motivated to implement other practices besides certifications to manage their suppliers' environmental and social impacts (Rueda et al., 2017; Thorlakson et al., 2018). There are many possible practices. Based on our conversations with practitioners[1], companies often need guidance to identify what mixes of practices they should implement.

Although there are many strategies and innovations companies can use to manage supply chain sustainability issues, challenges remain. Companies are still exploring ways to harness actual or perceived consumer demand for sustainable products (Delmas & Colgan, 2018; Sheffi

[1] The practitioners include executives and professionals of industry associations, multinational manufacturer of consumer-packaged goods, and food service chains.

& Blanco, 2018). Both companies and their stakeholders need to understand why certain companies adopt some practices and not others, and consequently, what the implications are for the supply chain actors and the industry (León-Bravo et al., 2019a; Ponte, 2019).

This dissertation presents three studies in Chapters 2, 3, and 4 that address some knowledge gaps in consumer demand and firms' SSPs by analyzing large-scale datasets in domains typically explored with case studies, surveys, and lab experiments. The results offer new insights based on real-world data that inform both companies and stakeholders about how to address the aforementioned challenges in managing supply chain sustainability.

1.2 Background and Research Questions

The first two studies (Chapters 2 and 3) in this dissertation examine the demand for coffee that was labeled Fair Trade and organic, currently the two most widely used and popular certification labels on food products in supermarkets (Fair Trade America, 2016; Organic Trade Association, 2018). Fair Trade certification programs promote sustainable economic, social, and environmental development by improving producer capacity and profit distribution in commodity markets that source from marginalized producers and workers, especially in the Global South (Arnold et al., 2020; Moore, 2004). Organic certification programs support sustainable crop and livestock production practices, such as conservation of resources and banning synthetic pesticides or genetically-modified inputs (Browne et al., 2000; McEvoy, 2016; Yiridoe et al., 2005). While consumers consider buying Fair Trade as an act of altruism toward other people, they consider buying organic primarily for their own health and secondarily for protecting the environment (Magnusson et al., 2003; Schleenbecker et al., 2018; Zander & Hamm, 2010). Coffee is chosen for the two studies because Fair Trade and organic options were available in many stores, and hence the dataset offers many observations for analysis.

Comparing the demand for products with different labels would show which label or combination of labels performed better in the market. It can also illuminate the core motivations driving consumers to buy certified products. Existing papers comparing consumer preferences for Fair Trade and organic products with either one or both certification labels (see Section 2.2.1) were all based on surveys with hypothetical purchasing scenarios, and their findings are inconsistent. The first study in this dissertation seeks new findings based on purchase data, which describes the items individual consumers bought, the prices they paid, and the prices of the other options that were available to them at the store when they visited. The research question is: How different are consumer demands for Fair Trade, organic, and dual-label Fair Trade and organic (DLFTO) coffees?

Comparing the market performance of certified and conventional products can inform pricing and marketing strategies for both types of products. Through a field experiment with Fair Trade bulk coffee[2], Hainmueller et al. (2015) found that consumers did not treat all Fair Trade products similarly: The demand for higher-priced Fair Trade coffee was less price-elastic than the demand for lower-priced Fair Trade coffee. The second study in this dissertation seeks to understand consumers' behavior towards premium- and regular-priced Fair Trade and organic (FTO) products (both single- and dual-label options) in the consumer packaged-goods market. The study also compares the behaviors of all consumers against the consumers who spent most of their coffee budget on the FTO options. The research questions in the second study are: To what extent are regular and premium FTO products competitive against conventional products (i) in the aggregate market and (ii) within segments of core consumers who spend most of their

[2] These coffees were not packaged but kept in bulk containers. Consumers would transfer the amount they wanted to buy from the bulk containers to smaller containers.

coffee budget on FTO products? What do core FTO consumers' substitution behaviors reveal about the importance of certification in their choices?

The third and last study examines the sustainable sourcing practices (SSPs) company use besides certification. These practices are private and non-governmental practices to improve the social and/or environmental management of their suppliers' activities (Thorlakson et al., 2018). The SSPs commonly used by companies in agri-food industries include supplier code of conduct, third-party standards, and supplier assessment and training (Rueda et al., 2017; Thorlakson et al., 2018).

Research can guide companies to identify suitable SSPs and help stakeholders, who encourage companies to address sustainability issues in their supply chains, to learn which practices are more prevalent and why. A wealth of literature, composed of case studies and literature reviews, addresses the conditions that influence companies' choice of which SSPs to use (Formentini & Taticchi, 2016; Jeppesen & Hansen, 2004; Pagell et al., 2010; Rueda et al., 2017). However, these studies primarily focused on manufacturers (León-Bravo et al., 2019b; Villena, 2019; Zorzini et al., 2015). The final study of this dissertation seeks to determine the SSPs used by companies from different stages of the supply chain and the relationship between their SSPs and their stages. The palm oil industry serves as an example of an agriculture industry that has been under intense scrutiny by civic society for many years. To obtain a representative view of the industry, the study examines the practices used by 171 companies as disclosed in their websites and reports. The last question is: How do the mixes of sustainable sourcing practices used by companies in the palm oil industry vary with their supply chain stage?

1.3 Dissertation Description

The remainder of this dissertation presents the first, second, and third study in Chapters 2, 3, and 4, respectively. Each of these chapters has its own introduction, literature review, methodology, results, and discussion.

Addressing the first research question, Chapter 2 compared consumers' demand for Fair Trade, organic, and DLFTO bagged coffee. The analysis focused on consumers who have purchased certified coffee at least once (9.3% of all coffee consumers) and used purchase data from 2014 to 2016. Controlling for the variety of products offered, the average willingness-to-pay (WTP) for DLFTO coffee was approximately 20% higher than that for single-label coffees. DLFTO coffee also attracted more price-inelastic demand and was a more attractive substitute for conventional (unlabeled) coffee than single-label coffees. The average WTP, demand price elasticity, and substitution attractiveness for single-label Fair Trade and organic coffees were not significantly different. The results suggest that in aggregate, consumers (i) preferred products that were both Fair Trade and organic to products that were either only Fair Trade or only organic, and (ii) showed equal preference between single-label Fair Trade and organic products.

Chapter 3 presents the second study, which compares consumers' demand for premium and regular FTO Keurig K-Cup coffee relative to conventional Keurig K-Cup coffee. The coffees were categorized into four groups based on their certification labels and prices: Premium or Regular Conventional, and Premium or Regular FTO. Demand was measured in terms of price sensitivity and substitution behavior in the entire market and in segments of core consumers who spent most of their coffee budgets on FTO coffees. The analysis used purchase data from 2016. The modeling approach is similar to that described in Chapter 2. Most consumers were more likely to substitute both kinds of FTO products for conventional products than the other way

around. Even consumers who were insensitive to Premium FTO coffee prices were more likely to pick Regular Conventional coffee than Regular FTO coffee as their second choice. The results suggest that even core FTO market segments are not firmly committed to certified products. Companies making and selling certified products would need to do more than matching prices and using sustainability certification labels to increase their market competitiveness. Potential alternative options are discussed.

Chapter 4 presents the third study, which examines companies' approaches to sustainable sourcing of palm oil and palm derivatives. The study framed hypotheses about the number and proportion of hands-on and hands-off sourcing practices companies use in relation to their supply chain stages—retailers, manufacturers, or processors and traders (PTs)—in the palm oil industry. Hypotheses about companies' SSPs and their supply chain stages were framed based on three theories: stakeholder theory, transaction-cost economics, and resource-based view. These three theories relate external stakeholder pressure and supply chain factors to firms' activities. The public self-disclosure reports of 171 companies in 2018 were analyzed and tabulated. Nine commonly-disclosed SSPs were categorized as "hands-off" or "hands-on" based on buyer involvement associated with the practice. The relationship between firms' mixes of SSPs and their supply chain stages was analyzed with regression controlling for other company characteristics. The variations agree with what is expected from theory. The PTs and manufacturers with brands familiar to end-consumers used more hands-on SSPs than the other manufacturers and most retailers in count and proportion. In contrast, hands-off practices were commonly adopted by firms regardless of their supply chain stages. The most popular hands-off and -on practices identified from the data were external certification and supply chain tracing, respectively. The results highlight the prevalence of hands-off practices and that the PTs likely

lack collaborative, risk- and cost-sharing support from their downstream customers. The chapter concludes with suggestions of ways to support the PTs.

The final chapter, Chapter 5, summarizes the implications from the findings of the three studies, discusses research limitations, and suggests future research directions.

Chapter 2

Consumer Demand for Fair Trade, Organic, and Dual-label Coffees

2.1 Introduction

As of 2020, companies can choose from as many as 457 eco-labels to prove the sustainability of their brands and products (Ecolabel Index, 2020; Sheffi & Blanco, 2018). Manufacturers and retailers can use these labels to assure their consumers that their supply chain processes meet the criteria required to gain the label (Boström et al., 2015; Cerri et al., 2018; Sheffi & Blanco, 2018). The myriad of certification labels addresses a wide range of sustainability issues, such as consumer-centric (e.g., food safety), social-justice focused (e.g., reducing poverty), or environmentally focused (e.g., no pesticides) (Grunert et al., 2014; Janßen & Langen, 2017). Consumers' preferences for certified products can depend on their perception of the certification programs (Janßen & Langen, 2017). Understanding which sustainability claims motivate customers to buy can help firms choose specific certification labels to invest in for their products.

The two most widely used and popular certification labels on food products in U.S, supermarkets are Fair Trade and organic (Fair Trade America, 2016; Organic Trade Association, 2018). The number of Fair Trade certified products in mainstream markets nearly doubled in 2015, reaching more than 35,000 (Fair Trade America, 2016). Organic

options are available in over 75% of all product categories in supermarkets in the US as of 2018 (Organic Trade Association, 2018).[1]

However, the Fair Trade and organic market share remains small in the US (Pickett-Baker & Ozaki, 2008). In 2016, only 5% of coffee beans volume sold were Fair Trade, and only 5.5% of food dollar sales were organic (Fair Trade America, 2016; Organic Trade Association, 2018). Despite research finding market demand for Fair Trade and organic products, the real market demand does not match up. This phenomenon is well known and is commonly dubbed as an "intention-action gap" (Vermeir & Verbeke, 2006). The gap between survey-based findings and real market demand may be because the respondents give socially desirable and biased responses (Hainmueller et al., 2015; Lehmann & Sheffi, 2020). However, the gap between field experiment findings and real market demand suggests that the potential and limits of supply chain sustainability certification to increase product competitiveness are not fully understood.

Consumers state that their main reason for buying Fair Trade products is to support the producers and reduce poverty (Annunziata et al., 2019; Grunert et al., 2014; Schleenbecker et al., 2018).[2] Surveys and interviews indicated that health and safety concerns are the main drivers for buying organic products while altruistic reasons, such as environmental protection and animal welfare, are secondary (Cicia et al., 2009; Magnusson et al., 2003; Schleenbecker & Hamm, 2013). The degree to which consumers are attracted to the certification labels also depends on their awareness and attitudes towards the certifications (Annunziata et al., 2019; Campbell et al., 2014; Grunert et al., 2014; Hughner et al., 2007;

[1] A product category includes all the products offering the same general functionality (e.g., frozen dessert and sunscreen).

[2] Although Fair Trade now takes a most holistic perspective to sustainability by including social, economic, and environmental criteria in their assessments (Arnold et al., 2020; Fair Trade America, 2016), the above-cited and relatively recent surveys indicated that consumers still considered Fair Trade as a program for social development.

Yiridoe et al., 2005). Fair Trade and organic certification programs address different sustainability issues in food production, and consumers' perceptions of them vary. Thus, the value of the two certification labels may vary considerably from one person to another (Schleenbecker et al., 2018; Schleenbecker & Hamm, 2013).

Many existing papers have compared consumers' preference for Fair Trade and organic products with either or both certification labels (see Section 2.2.1). However, they are all based on surveys with hypothetical purchasing scenarios, and their findings are inconsistent. The inconsistency could be related to differences in survey designs and survey vulnerability to response bias (Hainmueller et al., 2015; Kotler & Keller, 2011; Lehmann & Sheffi, 2020). Therefore, this study contributes new evidence in the value of certification for consumer behavior based on actual purchase behavior (of bagged coffee) to the existing literature. The research question is: *What are the differences between consumer demands for Fair Trade, organic, and dual-label Fair Trade & organic (DLFTO) coffees based on actual purchase data?*

The results of this study shed light on consumers' heterogeneous preferences for Fair Trade and organic products. The analysis focused on consumers purchased at least one bag of certified coffee (9.3% of the sample population) between 2014 and 2016. This chapter presents the first study to compare consumers' preferences for certified Fair Trade and organic products using consumer purchase data. This study contributes to the literature of (i) consumer sustainability purchasing behavior (Delmas & Colgan, 2018; Vermeir & Verbeke, 2006; Young et al., 2010), (ii) ecolabeling (Cerri et al., 2018; Grunert et al., 2014; Loureiro & Lotade, 2005; Van Loo et al., 2015), and (iii) supply chain sustainability strategy (Bateman et al., 2017; Boström et al., 2015; Martí & Seifert, 2013; Seuring & Muller, 2008).

2.2 Literature Review

2.2.1 Consumer Preference

Nine previous studies have compared consumers' preference for organic and Fair Trade products. All studies were based on survey-based choice experiments, primarily in Europe and the US, with one South American study. In general, the conclusions are inconsistent; there are studies supporting each possible comparison outcome.

Two studies reported that some consumers were willing to pay more for organic products than for Fair Trade. Garcia-Yi (2015) found that randomly sampled residents in the middle- and high-income Peruvian neighborhoods would pay two times more for organic than they would for Fair Trade chili peppers. Akaichi et al. (2016) found that French consumers randomly recruited outside retail stores would pay roughly a 50% higher price premium for organic than for Fair Trade bananas.

Four studies found that most consumers were willing to pay more for Fair Trade than for organic products. Alphonce et al. (2015) found that Norwegians randomly recruited in a university town would pay an average of 16% more for organic and 32% more for Fair Trade than they would for conventional dried fruits. Basu et al. (2016) found that German undergraduates would pay premiums for Fair Trade and organic coffees and that the premium for Fair Trade was 13% higher than organic. Loureiro and Lotade (2005) reported that supermarket customers in the US would pay a 37% higher premium for Fair Trade than for organic coffee. Rousseau (2016) found that Belgian respondents, primarily undergraduates, would pay a premium for Fair Trade but not for organic chocolate.

Two studies found that consumers treat organic and Fair Trade labels similarly. Didier and Lucie (2008) found that French consumers were insensitive to organic and Fair Trade labels on chocolates and were more concerned about price and taste. Maaya et al. (2018)

found that Belgian consumers, mainly students in a master's degree program, would pay a similar premium for Fair Trade and organic coffees.

When comparing DLFTO versus Fair Trade or organic products, the consensus is that consumers are willing to pay more for DLFTO products than for Fair Trade or organic products. Zander and Hamm (2010) found that adding Fair Trade labels to organic milk increased European consumers' willingness-to-pay. Basu et al. (2016) found that German undergraduates were willing to pay as much as 25% and 38% more for DLFTO coffee than for single-label Fair Trade and organic coffees, respectively.

These studies were based on experiments in hypothetical settings, which were vulnerable to respondents giving socially desirable and biased answers (Hainmueller et al., 2015; Kotler & Keller, 2011). Examining what consumers actually purchased in grocery stores may provide more realistic insights on consumer preference.

2.3 Method

2.3.1 Measuring Market Demand

Market demand is commonly assessed with willingness-to-pay (WTP), price sensitivity, and substitution behavior (Ben-Akiva et al., 2019; Berry S., 1994; Guadagni & Little, 1983; Nevo, 2007). Consumers' WTP is the maximum price that consumers would pay for a product (Varian, 1992). Price sensitivity refers to consumers' responsiveness to price changes (Kamakura & Russell, 1989; Kaul & Wittink, 1995). Price sensitivity is measured with own-price elasticities: the change in demand in response to an infinitesimal change in price (Hainmueller et al., 2015; Sharp & Dawes, 2001). Substitution behaviors reveal what consumers perceive as the second choice, or best substitutes, for each product category (Berry S., 1994; Bordley, 1985). Substitution behavior is measured with the percent market demand shift (Capps & Dharmasena, 2019; Sethuraman & Srinivasan, 2002). The hypotheses for the relative attractiveness of the categories were constructed using these three measures.

2.3.2 Hypotheses

Existing studies found evidence for three types of consumer preferences: organic favored over Fair Trade, Fair Trade favored over organic, or equal preference for either certification. The literature on consumer behavior offered possible explanations for each of these preferences.

Many practitioners and researchers observed that most consumers, including conscientious ones, were more concerned about their personal benefits than the environmental and social impacts of consuming a product. Marketing research found that most consumers would neither pay a higher price nor accept lower product performance to support social causes (Barone et al., 2000; Young et al., 2010). Through extensive interviews with executives and literature reviews, scholars concluded that consumers are mainly drawn to sustainable products for personal benefits (Delmas & Colgan, 2018; Sheffi & Blanco, 2018). When ranking important coffee attributes, consumers often ranked Fair Trade and organic below taste and functionality-related attributes, such as brands, flavors, and caffeination (Mintel, 2017; Van Loo et al., 2015).

These observations are aligned with a theory of human needs that is commonly applied in marketing. Maslow's Hierarchy of Needs asserts that individuals prioritize their needs in the order of their safety and health, sense of belonging, self-esteem, self-actualization, and transcendence (Maslow, 1943, 1969). Conventionally, marketers believe that the ability to appeal to a more primal driver in the hierarchy can determine a campaign's success (Kotler & Keller, 2011). If some consumers perceive and value organic products to be healthier or safer, they would prefer organic for it would appeal to their primal motivation to ensure health and safety. To value Fair Trade products, consumers would have to either be in the state of transcendence, where they would act altruistically; or of self-actualization, where they would enjoy the sense of “warm-glow” for consuming products that helps other

people. Given that organic products could appeal to more primal needs than Fair Trade products could, it follows that consumers would likely prefer organic to Fair Trade products.

There are certain conditions under which Fair Trade could be preferred over organic. Some studies reported that consumers did not buy organic food because they were satisfied with the health and safety level of non-organic food (Rousseau, 2015; Yiridoe et al., 2005). For these consumers, the predominant quality associated with organic food could be its environmentally friendly component. Value-based environmental psychology found that it is easier for people to sympathize with other people than with the environment or animals (Schultz, 2000; Stern & Dietz, 1994). Consumers also expressed more concern about labor issues than environmental issues in coffee and chocolate supply chains (Grunert et al., 2014; Rousseau, 2015). If some consumers do not perceive or value the personal benefits from organic food, it would be expected that they would prefer Fair Trade over organic.

Consumers may value both certifications similarly. They may not be concerned with the specific sustainability issues addressed by the certification programs and/or may not discern the differences in Fair Trade and organic certifications. In a US survey, around 40% of respondents incorrectly answered that organic food production permits synthetic pesticide and genetically modified inputs (Campbell et al., 2014). European studies also reported consumer confusion about organic criteria (Alphonce et al., 2015; Janßen & Langen, 2017; Magnusson et al., 2003). Delmas et al. (2018) found that only 20% of US coffee consumers correctly understood organic criteria. The percentage was even lower for other eco-labels, including Fair Trade.

These perspectives suggest that the comparison of consumer preference for organic vs. Fair Trade coffees may not be clear cut. For hypothesis testing, this study hypothesizes that most consumers do not have strong preferences for one label over another and frame three null hypotheses:

Hypothesis 1a: The average WTP for single-label Fair Trade and organic coffees are equal.

Hypothesis 1b: Demands for single-label Fair Trade and organic coffees are equally price-sensitive.

Hypothesis 1c: Single-label Fair Trade and organic coffees attract the same level of substituting demand from (i) DLFTO and (ii) conventional coffees.

Evidence that does not support the above hypotheses would indicate consumers' preference for Fair Trade or organic coffee.

To compare single-label coffee with the DLFTO coffee, it was assumed that Fair Trade and organic are considered positive attributes for coffee based on previous field experiment results (Buell & Kalkanci, 2019; Hainmueller et al., 2015).[3] The fundamental economic rationale that "more is better" (Pindyck & Rubinfeld, 2004) suggests that products with DLFTO certification labels would be preferred over products with only Fair Trade or organic certification label. Therefore, this study proposes the alternative hypotheses that the DLFTO coffee category outperforms single-label Fair Trade and organic coffee categories.

Hypothesis 2a: The average WTP for DLFTO coffee is greater than for Fair Trade coffee.

Hypothesis 2b: The demand for DLFTO coffee is less price-sensitive than for Fair Trade coffee.

Hypothesis 2c: DLFTO coffee attracts more substituting demand from (i) organic and (ii) conventional coffees than Fair Trade coffee.

Hypothesis 3a: The average WTP for DLFTO coffee is greater than for organic coffee.

[3] According to field experiment results, supply chain sustainability attributes on coffee, such as Fair Trade and organic, improve consumers' impression and product sales. Hainmueller et al. (2015) showed that adding Fair Trade certification labels to self-serve bulk coffees[3] increased their sales by approximately 8%. Buell et al. (2019) found that transparency into environmentally sustainable coffee production increased consumers' probability of purchasing over generic brand marketing by 45.85%.

Hypothesis 3b: The demand for DLFTO coffee is less price-sensitive than for organic coffee.

Hypothesis 3c: DLFTO coffee attracts more substituting demand from (i) Fair Trade and (ii) conventional coffees than organic coffee.

These hypotheses were analyzed with methods similar to Lee and Bateman (2020).

2.3.3 Data

The analysis drew information from three input datasets: retailer scanner data, consumer panel data, and product certification label data collected from an internet archive of product websites. The retailer scanner and consumer panel data sets were retrieved from Nielsen Consumer data repository (Kilts Center for Marketing, 2020).[4] The retailer scanner data included the weekly sales and weekly revenue-weighted average prices for each product at each store. Retailers compiled and shared this data with the company. Consumer panel data refers to purchase data from a panel of consumers. The data included information such as the product purchased, the price paid, when, and where. The consumers submitted the data by scanning the barcodes of their purchased items with scanning devices provided by the company. The data provider used stratified proportionate random sampling to identify a sampling frame representative of the US population and recruited the panel consumers by mail and email from online vendors.

The presence of product Fair Trade or organic labels was checked on the manufacturer's website from January of 2016 using the Internet Archive Wayback Machine (Internet Archive, 2019; Keurig Green Mountain, 2016). Products that carried official third-

[4] Researcher(s) own analyses calculated (or derived) based in part on data from Nielsen Consumer LLC and marketing databases provided through the NielsenIQ Datasets at the Kilts Center for Marketing Data Center at The University of Chicago Booth School of Business. The conclusions drawn from the NielsenIQ data are those of the researcher(s) and do not reflect the views of Nielsen. Nielsen is not responsible for, had no role in, and was not involved in analyzing and preparing the results reported herein.

party certified organic and Fair Trade labels were considered as certified coffee.[5] The labels found on the products are shown in Figure 2.1.[6]

Figure 2.1. Official Organic and Fair Trade labels

Information in the three datasets was merged to construct the environment under which the consumers purchased their coffee, with the consumer panel data as the main dataset. Figure 2.2 shows the database structure. The retailer scanner data were merged with the consumer panel data by the store-week the consumer was observed buying a product. The label data were merged with the retailer and consumer datasets by product identity.

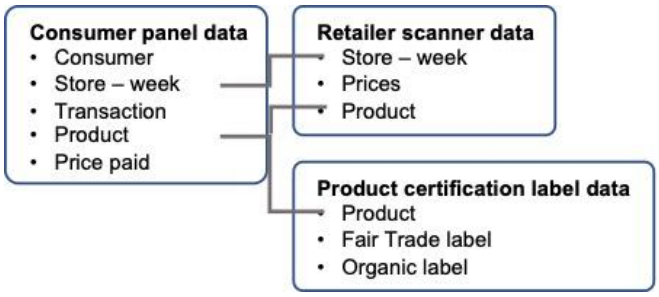

Figure 2.2. Database diagram

The consumer panel and retailer scanner data included records of bagged coffees for 154 weeks, from 2014 to 2016, was used for analysis. Only caffeinated and unflavored coffee products that came in 10 to 16 oz pack sizes were included in the analysis to reduce the

[5] United States Department of Agriculture (USDA) awards the organic label. Fair Trade USA awards the first two equivalent Fair Trade labels from the left, and the Fairtrade Labelling Organizations International awards the third label.

[6] The United States Department of Agriculture awards the organic certification label. Fair Trade USA awards the first two Fair Trade certification labels, and Fair Trade International awards the third. The two Fair Trade awarding bodies have slight differences in their Fair Trade certification requirements, and it was assumed that consumers did not differentiate between the two labels.

effects of differences in product function and taste on the results.[7] The input datasets captured records of 1,447 products meeting these filtering criteria. These products accounted for 67.6% of bagged coffee revenue at grocery stores.

The merged dataset was further summarized such that each observation described the purchase transaction of a bag of coffee. The selected coffee products were split into four categories: Fair Trade, organic, DLFTO, and conventional. The dataset included the consumer (code), the prices of and the number of alternative products available (i.e., assortment size) in each of the four categories, and the category selected by the consumer. The price of the selected category was the price the customer paid. Otherwise, the category price was taken to be the average of the products in the category available at the store that week. This type of combined dataset is often used to analyze consumer behavior in market research (Bucklin et al., 2006; Guadagni & Little, 1983; Gupta & Chintagunta, 2006; Kamakura et al., 2008; Krishnamurthi & Raj, 1991). Since the bags were in varying pack sizes, the coffee prices were converted to $/cup, assuming a standard .4 oz of coffee per cup (Hainmueller et al., 2015). Out of an initial 69,422 observations, only 28,273 were at stores offering all four categories.

We focused on the consumers who had purchased at least one bag of certified coffee and excluded the remaining consumers who did not purchase certified coffees. Only consumers who had purchased certified coffees provide information on the conditions that discourage or encourage consumers to buy certified coffees. These consumers were similar to the excluded consumers in terms of age, education level, and income, but they purchased

[7] From a business perspective, coffee products that are caffeinated/decaffeinated, flavored/unflavored, and in small/large bag sizes (*e.g.*, 1 lb *vs.* 3 lb) serve distinct markets (Guadagni & Little, 1983; Mintel, 2017; National Coffee Association of USA, 2018; Urban et al., 1984). Moreover, certified coffees were rarely offered decaffeinated, flavored, and in big bag sizes. 10 to 16 oz pack sizes were the most common on store shelves.

more coffee than the excluded consumers (12.17 ± 0.84 *vs.* 5.62 ± 0.15 bags). Compared to the general US census population, these consumers had similar average annual income and household size but were older and had more education than the general population.[8] All 5,998 of their observed purchases, inclusive of conventional coffee purchases, were kept.

Lastly, transactions where any category had aggressive promotions making them cheaper than $0.1/cup were excluded. The resulting dataset consisted of 5,631 observations of bagged coffee purchases by 493 households at 523 stores from 43 states across the US.

2.3.4 Demand Model

A discrete choice model with random coefficients in the WTP space was used to represent consumer behavior. WTP space specification captures the heterogeneity in consumer preference in a more straightforward way to interpret and provides WTP estimates within tighter and more reasonable ranges (Scarpa et al., 2008; Train & Weeks, 2005). This method also allows us to measure substitution behavior that varies by category (Allenby & Lenk, 1994; Nevo, 2007), which is essential for our analysis. This section derives the WTP-space specification.

The linear specification of consumer *n*'s utility for choosing category *i* at instance *t* is (Equation 1)[9, 10]

$$u_{int} = -\tau_n p_{int} + \alpha_{in} + \phi \ln s_{int} + e_{int} \qquad (1)$$

The first term captures the effect of category price p_{int}. The price coefficient τ_n varies by the consumer, and each consumer has the same price coefficient for the entire period.

---

[8] See Appendix A.1 for details on sample demographic characteristics and how they compare to the excluded consumer panel and the US census population demographic characteristics.

[9] Instance *t* should have *n* in the subscript to denote the shopping instances of individual *n*, but the subscript is excluded for simplicity of notation when possible.

[10] Other specifications where the categories had different price coefficients and demographic characteristics were considered. The model estimations either did not converge or did not fit as well as the model in Equation 1. Goodness-of-fit was assessed in terms of McFadden R^2 and loglikelihood ratio tests. See Appendix Table A. 2 for a summary of estimation results.

Specifying τ_n as a variable allowed us to capture heterogeneity in consumers' price elasticities (Ben-Akiva et al., 1993; Berry S., 1994). The alternative-specific constants α_{in} capture individual consumers' preferences towards product characteristics that are systematically different between categories, such as Fair Trade and organic certifications.

The term s_{int} is the assortment size of category *i* at consumer *n*'s shopping instance *t*. The categories' assortment sizes varied by observation because the consumers could visit different stores in different weeks. Assortment size is added because consumers have stated in the past that they do not buy certified products because stores offered few certified options (Hughner et al., 2007; Magnusson et al., 2003).[11] Adding assortment size into the model ameliorates the aggregation bias introduced when the products were grouped into categories (Ben-Akiva & Lerman, 1985; Kitamura et al., 1979).

The error term e_{int} accounts for random variations due to unobserved factors, and it was assumed to have a zero mean and follow an extreme value distribution. It has a variance of $\mu_n^2(\pi^2/6)$, where μ_n is a scale parameter that varies for each consumer.

The model specification in the WTP space was obtained by dividing all terms in Equation 1 by μ_n, and by moving τ_n out of the first three terms (Equation 2),[12]

$$u_{int} = \frac{\tau_n}{\mu_n}(-p_{int} + \frac{\alpha_{in}}{\tau_n} + \frac{\phi}{\tau_n} ln\, s_{int}) + \varepsilon_{int} \qquad (2)$$
$$= \zeta_n(-p_{int} + w_{in} + \lambda_n\, ln\, s_{int}) + \varepsilon_{int}$$

where ε_{int} is a type-one extreme value, independently and identically distributed with constant variance $\pi^2/6$.

[11] In general, having more alternative products in a category on store shelves (i.e., a greater assortment size) can increase that category's sales (Curhan, 1972; Frank & Massy, 1970).

[12] The utility is ordinal, and the division does not affect the behavior of the model.

The model was simplified by defining new parameters. The term $\zeta_n = \frac{\tau_n}{\mu_n}$ is a new scale parameter that captures individual-specific preference towards category price, p_{int}. The price coefficient was fixed to -1, and ζ_n was assumed to be independently and identically distributed (iid) from a log-normal distribution to ensure that the utility function reflects that increasing price reduces utility for all consumers (Croissant, 2019; Train, 2009b). The second term $w_{in} = \frac{\alpha_{in}}{\tau_n}$ represents the individual- and category-specific WTP parameters. The category-specific WTP parameter estimates are interpreted as the additional price that a consumer was willing to pay if the categories' prices and assortment sizes were equal. The coefficient λ_n captures individual consumers' WTP for a 1% increase in assortment size. The parameters w_{in} and λ_n were assumed to be normally distributed.

The model was estimated using the Hierarchical Bayesian approach (Scarpa et al., 2008; Train, 2009a; Train & Weeks, 2005) with the package `RSGHB` in R statistical software (Dumont & Keller, 2019) with 800,000 iterations to obtain 20,000 draws: 600,000 for burn-in and 200,000 after convergence, of which every tenth draw was retained. The parameter ζ_n is defined as $exp(\gamma_n)$, where γ_n is a normally distributed variable. The priors of the random coefficients $\{\gamma_n, w_{in}, \text{and } \lambda_n\}$ were specified to be Hierarchical Inverted Wishart distributed. Various uninformative priors were used, and the results were not sensitive to the choice of priors.

Model convergence was tested with the Heidelberg-Welch test and the Gelman and Rubin's convergence diagnostic using the package `CODA` in R statistical software (Plummer et al., 2006). All estimates passed the convergence tests at the 95% level of confidence.[13]

[13] Convergence results for Equation 2 are in Appendix A.3.

2.3.5 Price Sensitivity and Substitution Behavior

Price sensitivity refers to consumers' responsiveness to price changes (Kaul & Wittink, 1995). Price sensitivity is measured with own-price elasticities: the change in demand in response to an infinitesimal change in price (Hainmueller et al., 2015; Sharp & Dawes, 2001). The estimated model specified in Equation 2 was used to predict the percentage change in individual choice probabilities. The price elasticities were calculated at the observed market prices (Bucklin et al., 2006; Guadagni et al., 1983; Sethuraman & Srinivasan, 2002). Specifically, the disaggregate own-price elasticity $\eta_{nt,ii}$ was measured as the average percentage change in the choice probabilities of category *i* for +1% and -1% changes in its average price. The price elasticities were calculated at the observed market prices (Bucklin et al., 2006; Croissant, 2019; Guadagni & Little, 1983; Sethuraman & Srinivasan, 2002).

The aggregated own-price elasticity η_{ii} is the product of the partial differential of the market share of category *i*, M_i, with respect to its price, and the ratio of its price and market share (Equation 3).

$$\eta_{ii} = \frac{\partial M_i}{\partial p_{int}} \frac{p_{int}}{M_i} \tag{3}$$

The market share of alternative *i* is the average choice probability (Equation 4):

$$M_i = \frac{1}{N} \sum_{n}^{N} \sum_{t}^{T} P_{nt}(i_{nt}) \tag{4}$$

where $P_{nt}(i_{nt}) = \frac{e^{u_{int}}}{\sum_{j=1}^{J} e^{u_{jnt}}}$ and *j* represents all choice alternatives.

By differentiating M_i with respect to price and substituting $\eta_{nt,ii}$ in the disaggregated elasticities, the aggregated elasticity η_{ii} becomes a weighted sum of the disaggregated

elasticities (Equation 5). The weight is the normalized choice probability, represented by the fractional term in the equation.

$$\eta_{ii} = \sum_{n}^{N} \sum_{t}^{T} \eta_{nt,ii} \frac{P_{nt}(i_{nt})}{\sum_n \sum_t P_{nt}(i_{nt})} \quad (5)$$

Consumers' substitution behavior was revealed through their second-best choice category (Bordley, 1985; Capps & Dharmasena, 2019), the category that absorbed the majority of the switching demand.[14] Switching demand was measured by the percentage cross-price effect, $\partial W_j / W_j$, the percentage market share that switched from category $\underline{i}$ to $\underline{j}$ due to a price increase in category $\underline{i}$ (Sethuraman & Srinivasan, 2002). The standard errors of the elasticities and cross-price effects were obtained from bootstrapped samples.

2.4 Results

2.4.1 Data Summary

Table 2.1 summarizes the market shares, average prices per cup, and average assortment sizes of the coffee categories. Even though all consumers in the dataset purchased at least one bag of certified coffee, the conventional category had the largest market share (77.7%). The consumers did not buy certified coffee consistently.

The average price of the DLFTO category (0.27 $/cup) was surprisingly lower than the prices of single-label Fair Trade and organic categories (0.29 and 0.33 $/cup). Part of this difference arose from the calculation of the average price, discussed in Section 2.3.3. Based

[14] A popular way to identify substitutes in microeconomics is by using cross-price elasticities. However, it can be misleading (Capps & Dharmasena, 2019; Sethuraman & Srinivasan, 2002). Cross-elasticity captures the responsiveness of the demand for category *j* by dividing the market share shifted from category *i* to *j*, with the original market share of category *j*. If category *j* has a small market share initially, its cross-price elasticity can be large even when the actual market share shifted to it is much lower in absolute value. If cross-price elasticities were used here, then the Premium FTO category would appear to be an attractive substitute; however, it would be misleading to say so.

on Table 2.1, the average price across the observations when a category was selected was lower than the average price calculated across all observations. The difference suggests that consumers tended to buy cheaper or discounted products within the category. Since the DLFTO category was selected more often, its average price in the dataset was lowered. To test if the price difference was solely based on how the average price was calculated, the categories' average prices when they were not selected were also examined. Here, the average prices were not skewed by what the consumers chose to pay, and the average price of organic coffee remained higher than the average prices of the Fair Trade and DLFTO coffees. The most likely reason identified, based on industry expert[15] input and the literature of coffee bean prices (Weber, 2011), was that the organic coffees might be of higher quality than the Fair Trade and DLFTO coffees.

Table 2.1. Summary statistics

Category	FT	ORG	DLFTO	CONV
Market share	161 2.9 %	287 5.1 %	807 14.3 %	4376 77.7 %
Average price per cup across all observations ($/cup)	0.29 (0.05)	0.33 (0.06)	0.27 (0.07)	0.21 (0.05)
Average price per cup across observations where category was selected ($/cup)	0.24 (0.06)	0.30 (0.06)	0.22 (0.08)	0.20 (0.05)
Average price per cup across observations where category was not selected ($/cup)	0.29 (0.05)	0.33 (0.06)	0.28 (0.07)	0.25 (0.02)
Average assortment size	1.77 (1.23)	3.04 (2.19)	4.00 (4.05)	57.78 (17.17)

Standard deviations are in the parentheses. FT = Fair Trade, ORG = Organic, DLFTO = Dual-label Fair Trade and Organic, and CONV = Conventional category.

[15] The Director of Coffee, Tea, and Sustainability of a regional coffeehouse chain in the US.

2.4.2 Estimated Models

The estimated model is shown in Table 2.2. The conventional category was used as a reference; its category-specific WTP parameter was fixed as zero, and the WTP parameters for the other certified categories were estimated relative to it.

Only the average WTP estimate for DLFTO was significantly different from zero. The estimates suggest that consumers were willing to pay an average of 0.10 $/cup more for DLFTO than conventional coffee but not more for Fair Trade or organic than conventional coffee. The evidence supported ***Hypothesis 1a***, which states that the average WTP for single-label Fair Trade and organic coffees are equal (p-value = 0.45).[16] The result also supports ***Hypotheses 2a & 3a***, which state that the average WTP for DLFTO is greater than the average WTP for Fair Trade and organic coffees (p-values < 0.01). The results of all hypothesis tests (some discussed later) are summarized in Table 2.3.

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[16] A related hypothesis is that individual consumers' WTP for organic and Fair Trade is equal. This hypothesis is tested by comparing the model in Equation 1 and a model where Fair Trade and organic constants are restricted to be equal for each individual. The adjusted McFadden ρ^2 are .78 and .73, and the loglikelihoods are -905 and -1093 with 15 and 11 parameters. This result rejects the more restrictive hypothesis that the individual WTP for organic and Fair Trade are equal at the 95% confidence level. This means that individuals had different WTP for FT and ORG, but the population average WTP for the two categories were not significantly different.

Table 2.2. Estimated model

Attribute	**Parameter**	**Average**	**Standard deviation**
Scale parameter	$\ln(\zeta_n)$	1.78 (0.13) **	1.33 (0.13) **
Price ($/10 cup)		Fixed at -1	
FT category	$w_{FT,n}$	0.24 (0.20)	1.14 (0.20) **
ORG category	$w_{ORG,n}$	0.32 (0.22)	1.73 (0.25) **
DLFTO category	$w_{FTO,n}$	0.96 (0.18) **	0.93 (0.16) **
ln(Assortment size)	λ_n	0.44 (0.04) **	0.16 (0.07) **
Adjusted R^2	0.75		
Loglikelihood	-1033		

*Posterior standard deviation in brackets, ** $p < 0.01$, * $p < 0.05$. FT = Fair Trade, ORG = Organic, DLFTO = Dual-label Fair Trade and organic, and CONV = Conventional.*

Table 2.3. Hypothesis test results

		Test result
Fair Trade vs. organic		
Hypothesis 1a:	The average WTP for Fair Trade and organic coffees are equal.	Supported
Hypothesis 1b:	Demands for Fair Trade and organic coffees are equally price-sensitive.	Not supported, Organic beats Fair Trade
Hypothesis 1c:	Fair Trade and organic coffees attract the same level of substituting demand from	
	i) DLFTO coffee	Supported
	ii) conventional coffee	Not supported, Fair Trade beats organic
Fair Trade vs. DLFTO		
Hypothesis 2a:	The average WTP for DLFTO coffee is greater than that for Fair Trade coffee.	Supported
Hypothesis 2b:	The demand for DLFTO coffee is less price-sensitive than that for Fair Trade coffee.	Supported
Hypothesis 2c:	DLFTO coffee attract more substituting demand from _____ than Fair Trade coffee	
	i) organic coffee	Supported
	ii) conventional coffee	Supported
Organic vs. DLFTO		
Hypothesis 3a:	The average WTP for the DLFTO category is greater than that for organic coffee.	Supported
Hypothesis 3b:	The demand for DLFTO coffee is less price-sensitive than that for organic coffee.	Not supported, Organic as good as DLFTO
Hypothesis 3c:	DLFTO coffee attracts more substituting demand from _____ than organic coffee**.**	
	i) Fair Trade coffee	Supported
	ii) conventional coffee	Supported

Hypothesis tests were evaluated at the 95% confidence level.

The estimated standard deviations of the WTP estimates, w_{in} and λ_n, were significant (Table 2.2). Based on the distributions of the individual- and category-specific WTP estimates in Figure 2.3, 74%, 65%, and 94% of the consumers had WTP exceeding zero. These distributions imply that the majority of consumers were willing to pay more for Fair Trade, organic, and DLFTO than for the conventional category if the prices and assortment sizes of the categories were equal.[20]

The prices that consumers were willing to pay for the coffees were widely distributed, and it was especially so for organic coffee. The standard deviation of its WTP was close to six times larger than its average WTP, and it had a long tail to the right. Using a dipping point in the organic WTP distribution that concurred with the 99th percentile of the Fair Trade WTP as a cut-off, a group of organic coffee enthusiasts was identified.[21] Around 10.2% of the consumers' were estimated to be willing to pay more than 0.20 $/cup for organic certified over conventional coffee if all else were equal (Figure 2.3). The organic coffee enthusiasts were slightly but statistically significantly younger than the other consumers (51.1 ± 2.0 *vs.* 55.4 ± .7 years old). The enthusiasts accounted for 216 out of 5631 (3.8%) of the observations. The prices that they

[20] The high WTP estimates for the certified categories do not seem to match up with the observed low market shares in the certified categories. This disparity is because stores offered a small assortment of Fair Trade, organic, and FTO categories and often priced them higher than the conventional category (Table 2.1) instead of all things being equal. For example, the average WTP estimates for single-label Fair Trade and organic were 0.02 and 0.03 $/cup, but they were priced beyond these WTP levels for 83.4% and 87.2% of the observations.[20] In the existing conditions, the actual "premiums" that consumers paid for certified categories over the conventional category were lower than the estimated WTP. Consumers bought Fair Trade, organic, FTO coffees at prices that are -0.00 ± 0.06, 0.05 ± .06, -.03 ± .08 $/cup relative to the conventional category price.

In a counterfactual analysis where all categories are at the same price and with the same assortment size as the certified categories, the conventional category has the lowest market share, the most price elastic demand, and is less attractive than FTO as a substitute (See Appendix A.4). The effect of assortment size is further explored in Section 2.4.2.1.

[21] Results were consistent for any cutoffs with WTP for organic greater than 0.18 $/cup.

would pay for organic coffee were on average 0.06 ± 0.05 $/cup higher than the conventional coffee price (it converts to a 26% premium). The absolute price premiums they paid were significantly higher than the price premium other consumers paid, 0.02 ± 0.07 $/cup (p-value < 0.01). The enthusiasts were also a lot more likely to purchase organic coffee than other consumers. They purchased organic coffee for 72% of their observed purchases, while the others purchased organic coffee for only 2% of the time.

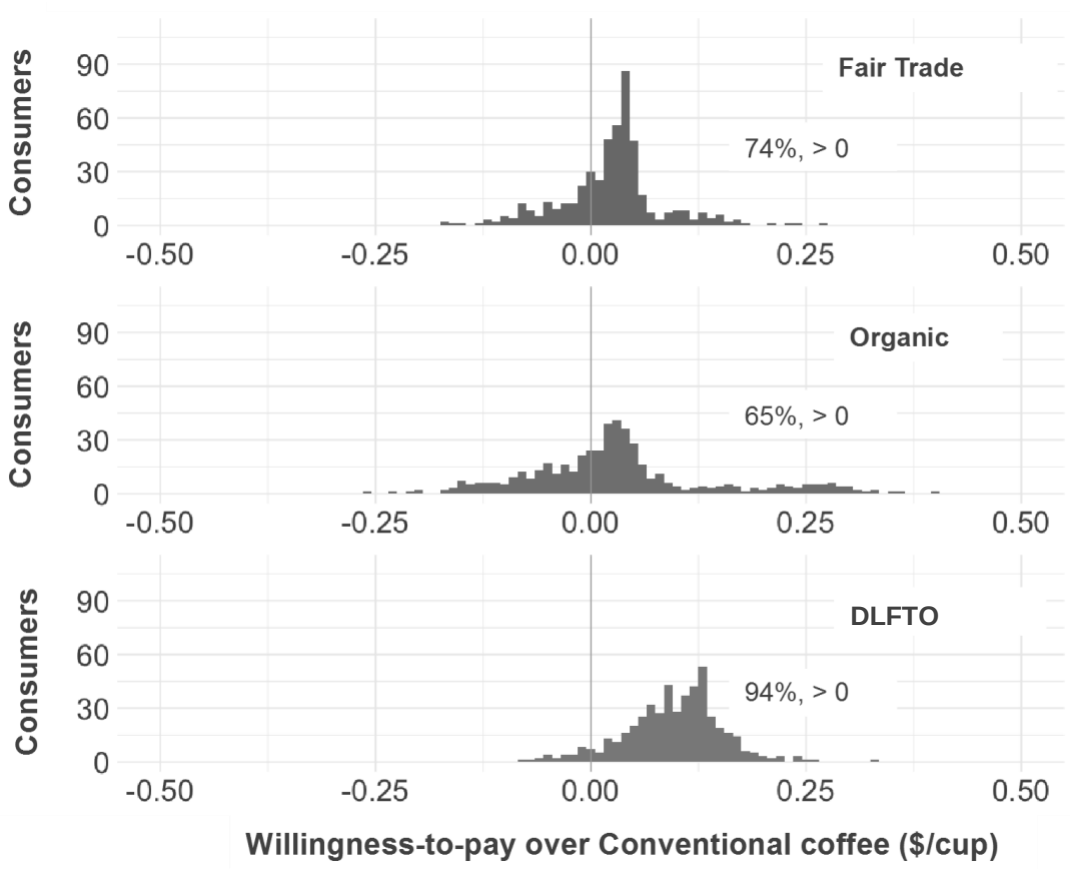


Figure 2.3. Distribution of WTP estimates

Table 2.4 shows the variance-covariance matrix for the WTP estimates. DLFTO and organic WTP estimates had a positive relationship with covariance 0.89 (p-value = 0.07) and correlation coefficient of 0.66. This relationship suggests that the consumers who were more (or

less) willing to pay for organic coffee would also be more (or less) willing to pay for DLFTO coffee.

Table 2.4. Estimated variance-covariance matrix

	$w_{FT,n}$	$w_{ORG,n}$	$w_{DLFTO,n}$	λ_n
$w_{FT,n}$	1.33 (.46) **	*-.15*	*.25*	*-.24*
$w_{ORG,n}$	0.20 (.60)	3.07 (.89) **	*.55*	*.66*
$w_{DLFTO,n}$	0.46 (0.35)	.89 (0.48)	0.90 (0.31) **	*.21*
λ_n	.07 (.09)	.15 (.15)	.08 (.08)	.03 (.02)

Correlations are reported in italics, ** p < .01, * p < .05. FT = Fair Trade, ORG = Organic, DLFTO = Dual-label Fair Trade and organic, and CONV = Conventional.

2.4.2.1 Assortment size effect

The estimate of λ_n (Table 2.2) indicated that a 1% increase in a category's assortment size, holding all other categories' assortment sizes unchanged, would increase consumers' WTP for that category by 0.04 $/cup on average. The logarithm transformation of assortment size suggests that the marginal utility decreases as the assortment size grows.[22] Since the certified coffee categories had much smaller assortment sizes, their assortment-size-related WTP would increase more than that of the conventional category for the same increase in assortment size. Table 2.5 shows that adding a bag of certified coffee to the assortment would increase consumers' WTP more than adding a bag of conventional coffee.

[22] An alternative model with assortment size not transformed has an adjusted McFadden ρ^2 of 0.49 and loglikelihoods -2077. It fits worse than if assortment size is in its logarithm form.

Table 2.5. Change in WTP when the assortment size of the category increases by one product item

	Current assortment size	New assortment size	% Increase in assortment size	Increase in WTP ($/cup)
FT	1.8	2.8	56%	$ 0.033
ORG	3.0	4.0	33%	$ 0.021
DLFTO	4.0	5.0	25%	$ 0.017
CONV	57.8	58.8	2%	$ 0.001

FT = Fair Trade, ORG = Organic, DLFTO = Dual-label Fair Trade and organic, and CONV = Conventional.

2.4.3 Price Sensitivity and Substitution Behavior

Price sensitivity and substitution behavior results for the entire dataset are shown in the first four numerical columns of Table 2.6. The coffee price elasticity estimates fall within the typical ranges of other studies, from slightly below 0 to as low as -7 (Guadagni & Little, 1983; Hainmueller et al., 2015). This section discusses the results of the remaining hypotheses in Section 2.3.2, summarized in Table 2.3.

Before comparing the certified categories, it is worth noting that in existing market conditions, the conventional category was the most price inelastic at -0.38 ± 0.01. The category was also the most attractive substitute (p-value < 0.01 in all t-tests). By offering products at low prices and large variety, the conventional coffee category seems to be the staple of coffee consumers. In contrast, certified coffee demand was price-elastic, suggesting that consumers treated them as substitutable luxury goods.

Table 2.6. Own -price elasticities and percentage cross-price effects

	Percentage cross-price effect											
	Category *j*											
	Entire market				Organic coffee enthusiasts				Other consumers^			
Category *i*	FT	ORG	DLFTO	CONV	FT	ORG	DLFTO	CONV	FT	ORG	DLFTO	CONV
Fair Trade (FT)	-3.322	0.045	0.292	2.984	-5.146	2.036	0.511	2.6	-3.307	0.045	0.293	2.969
	(0.251)	(0.004)	(0.046)	(0.241)	(0.467)	(0.326)	(0.122)	(0.366)	(0.246)	(0.004)	(0.046)	(0.235)
Organic (ORG)	0.027	-1.562	0.304	1.231	0.001	-0.826	0.231	0.594	0.076	-2.900	0.437	2.387
	(0.002)	(0.137)	(0.067)	(0.115)	(0.001)	(0.154)	(0.095)	(0.116)	(0.006)	(0.247)	(0.068)	(0.227)
Dual-label Fair Trade & Organic (DLFTO)	0.053	0.078	-1.446	1.315	0.003	2.659	-6.21	3.549	0.054	0.047	-1.389	1.288
	(0.009)	(0.015)	(0.063)	(0.058)	(0.002)	(1.25)	(1.936)	(1.401)	(0.009)	(0.007)	(0.059)	(0.056)
Conventional (CONV)	0.087	0.060	0.238	-0.385	0.003	1.916	0.806	-2.725	0.088	0.044	0.233	-0.365
	(0.007)	(0.005)	(0.010)	(0.014)	(0.001)	(0.376)	(0.314)	(0.496)	(0.007)	(0.004)	(0.010)	(0.013)

Standard errors are in parenthesis. This table is read row-by-row. For example, in the entire market, when i = Fair Trade, and the Fair Trade category price increase by 1%, its demand will decrease by -3.322 ± 0.251 %. Of which, 2.98 ± 0.241 % of their demand would move to CONV, 0.292 ± 0.046 % to DLFTO, and 0.045 ± 0.004 % to ORG. ^Other consumers are consumers who were not organic coffee enthusiasts.

First is the comparison of the Fair Trade and organic coffee categories. The demand for organic coffee had an own-price elasticity of -1.56 ± 0.14, meaning that for a 1% increase in price, its demand decreased by around 1.56%. The organic coffee demand was less price-sensitive than the Fair Trade coffee demand, which had an elasticity of -3.32 ± 0.25 (p-value < 0.01). The evidence did not support the hypothesis that organic and Fair Trade coffee demands were equally price-sensitive (**Hypothesis 1b**). This finding is surprising since the average WTP estimates for organic and Fair Trade coffees were not significantly different.

We observe that the organic coffee enthusiasts that were identified in Section 2.4.2, with their much larger WTP for organic coffee, drove the inelastic demand for organic coffee. The last eight columns in Table 2.6 show the organic coffee enthusiasts' and the other consumers' price reactions. The organic coffee enthusiasts' demand for organic coffee was rather price-inelastic (-0.83 ± 0.15), while the other consumers' demand was more price-elastic (-2.90 ± 0.25). Organic coffee enthusiasts were also twice more likely to choose DLFTO products as a substitute for organic products than other consumers. However, they still preferred the conventional category as a substitute over the DLFTO category, suggesting that their attraction to organic coffee may not be strongly related to the organic attribute. In contrast, the other consumers' price elasticities for single-label Fair Trade and organic coffees were not significantly different (p-value = 0.24). This observation implies that the demand for single-label Fair Trade and organic coffees was similarly price-sensitive on average for most consumers.

In terms of substitution, when the price of DLFTO coffee increased by 1%, 0.08 ± 0.02% of DLFTO coffee demand switched to organic, and 0.05 ± 0.01% switched to Fair Trade. These demand shifts were not significantly different (p-value = 0.11). This result supported **Hypothesis 1c(i)**, which states that organic and Fair Trade coffees attract the same level of substituting

demand from DLFTO coffee. On the other hand, when the conventional coffee price increased by 1%, 0.09 ± 0.01% of the conventional coffee demand switched to Fair Trade. This demand shift was significantly larger than 0.06 ± 0.01% that switched to organic (p-value > 0.99). The result did not support **Hypothesis 1c(ii)**, which states that organic and Fair Trade coffees attract the same level of substituting demand from conventional coffee.

DLFTO coffee outperformed Fair Trade coffee in attracting less price-sensitive demand and was a more attractive substitute for both the organic and conventional categories. The demand for DLFTO coffee had an own-price elasticity of -1.45 ± 0.06, and it was significantly less elastic than the demand for Fair Trade coffee (p-value < 0.01). The evidence supported **Hypothesis 2b**, which states that the demand for DLFTO coffee is less price-sensitive than that for Fair Trade coffee. DLFTO coffee was also preferred as a substitute for both organic and conventional categories to Fair Trade coffee. When the price of organic coffee increased by 1%, 0.30 ± 0.07% of organic coffee demand switched to DLFTO, which was significantly more than the 0.027 ± 0.002% that shifted to Fair Trade (p-value < 0.01). Similarly, when the price of conventional coffee increased by 1%, more demand switched to DLFTO than Fair Trade (p-value < 0.01). This evidence supported the hypotheses stating that DLFTO coffee is a more attractive substitute than Fair Trade coffee (**Hypotheses 2c(i) & 2c(ii)**).

The demand for DLFTO coffee was not significantly less elastic than the demand for organic coffee (p-value = 0.55). This evidence did not support **Hypothesis 3b**, which states that DLFTO demand would be less price-sensitive than organic demand. When the consumers were split into organic coffee enthusiasts and the other consumers, the other consumers were less sensitive to the prices of DLFTO than of organic coffee (-1.4 ± 0.1 vs. -2.9 ± 0.2, p-value < 0.01) (Table 2.6). As for substitution behavior, DLFTO coffee was more attractive than organic coffee

as a substitute for the Fair Trade and conventional coffees (p-value < 0.01 in both comparisons), supporting **Hypotheses 3c(i) & 3c(ii)**.

The observed preferences for DLFTO coffee (and to a lesser extent, for Fair Trade coffee) over organic coffee could be because DLFTO and Fair Trade coffees were usually cheaper than organic coffee. To determine if this is true, robustness analyses were used to examine the instances where the prices of each pair of product categories {Fair Trade, organic} and {DLFTO, organic} were similar.[23] When organic coffee enthusiasts were included in the analysis, the organic category outperformed both Fair Trade and DLFTO categories. When organic coffee enthusiasts were excluded from the analysis, almost all hypotheses stated in Section 2.3.2 were supported, except that Fair Trade coffee remained slightly more attractive than organic coffee as a substitute for conventional coffee. The result suggests that for consumers who were not enthusiastic about organic coffee, their preferences for DLFTO and Fair Trade coffees persisted even when DLFTO and Fair Trade coffees were priced similarly to organic coffee.

2.5 Discussion

The literature suggests that consumers have heterogeneous preferences for Fair Trade and organic products. However, it is unclear how those preferences translate into actual purchases. This study addresses this knowledge gap by analyzing consumers' actual purchases in grocery stores to understand the relative demand for Fair Trade, organic, and DLFTO coffees.

Most consumers, who purchased at least one bag of certified coffee, preferred DLFTO coffee to single-label coffees. DLFTO coffee outperformed single-label Fair Trade and organic

[23] See Appendix A.5 for more details.

coffees in attracting higher WTP and less price-sensitive demand, and in being a more attractive substitute than the single-label coffees. Their average WTP for DLFTO coffee outweighed single-label Fair Trade and organic by 0.06 $/cup (this translates to a 20% premium over the three categories' average price, $0.33 /cup). Our finding agrees with survey-based studies that found that consumers' WTP for DLFTO products is greater than single-label Fair Trade or organic products (Basu et al., 2016; Zander & Hamm, 2010). This study adds that DLFTO products are likely to outperform Fair Trade and organic products in attracting less price-elastic demand and as substitutes for conventional products. The finding that DLFTO products would attract a broader set of consumers than single-label Fair Trade or organic products is consistent across our purchase data analysis and existing survey-based choice experiments (see Section 2.2.1). Therefore, all current research findings encourage companies interested in attracting this segment of the market to invest in both Fair Trade and organic labels instead of just one.

The second finding is that the demand for single-label organic and Fair Trade coffees, aggregated over most consumers, were similar. Their average WTP for and price sensitivity towards Fair Trade and organic coffees were not significantly different. Consumers' preferences were mild and heterogeneous, and the differences in WTP for each certification label canceled out at the aggregate level. A possible reason is that consumers did not pay attention to or care about the specific sustainability impact of either certification label on coffee products.

A small fraction of consumers (the organic coffee enthusiasts) was more attracted to organic coffee than Fair Trade and DLFTO coffees. These enthusiasts were willing to pay more for and were less sensitive to organic coffee prices than that of all other coffees, including conventional coffee. They also strongly preferred organic coffee as a substitute for all other coffees. They bought organic coffee for 72% of their bagged coffee purchases and paid an

average of 26% premium for organic coffee over conventional coffee. However, the market segment of organic enthusiasts identified in this study (0.9%) is smaller than the organic consumer groups implied by previous survey-based studies, i.e., “French” consumers (Akaichi et al., 2016) and "middle- and high- income" consumers in Peru (Garcia-Yi, 2015). The difference could be attributed to variations in data sources and modeling approaches.

However, the organic coffee enthusiasts' attraction to the conventional category as the second-choice substitute over the DLFTO category casts doubt on whether they have chosen the organic coffees for its organic certification. Perhaps they were more attracted by other unobserved qualities that led to the price premium, such as higher-quality beans (Delmas & Colgan, 2018; Magnusson et al., 2003; Sheffi & Blanco, 2018), and to a lesser degree, its health benefits and its environmental protection aspects. More evidence is needed to show whether organic products could indeed attract price-insensitive customers solely based on being organic.

Many studies found that consumers were willing to pay more for Fair Trade than for organic products (Loureiro et al., 2005; Alphonce et al., 2015; Rousseau, 2015; Basu et al., 2016). We found little evidence supporting this conclusion besides the observation that switching conventional coffee demand tended to substitute for Fair Trade than for organic coffee. The disagreement might be because the surveys had narrow sets of respondents or might have inadvertently influenced their respondents to care more about Fair Trade than organic. For example, the samples of Alphonce et al. (2015), Rousseau (2015), and Basu et al. (2016) were mostly students, and Loureiro and Lotade (2005) described organic only as environmentally friendly without discussing its possible health benefits in their survey.

2.6 Chapter Conclusion

The results of this study suggest that manufacturers and retailers could attract less price-sensitive demand and more substitution from other products using both certification labels instead of just one. The aggregated demand over most consumers did not show one certification label outperforming the another, suggesting consumers did not have strong preferences for specific labels. Firms choosing between one or both labels could use the result from this study to compare the costs of adding a second label and the additional demand and premium (over conventional products) it could bring.

Chapter 3

Consumer Demand for Fair Trade and Organic versus Conventional Coffees

3.1 Introduction

Market and academic research often indicates the presence of a sizable group of conscious consumers who prefer products that are better for social justice and the environment (Auger et al., 2003; Buell & Kalkanci, 2019; Hainmueller et al., 2015; Newholm & Shaw, 2007; Porter & Kramer, 2006). Two recent field experiments indicate that adding supply chain sustainability characteristics to coffees and holding all else equal can improve their sales. Hainmueller et al. (2015) showed that adding Fair Trade certification labels increased the sales of self-serve bulk coffees[1] by approximately 8%. Buell et al. (2019) found that transparency into environmentally sustainable coffee production increased consumers' probability of purchasing over generic brand marketing by 45.85%.[2] However, when consumers ranked the importance of

[1] These coffees were not packaged but kept in bulk containers. Consumers would transfer the amount they want to buy from the bulk containers to smaller containers.

[2] This significant increase in purchase probability found by Buell et al. (2019) can be explained by their experimental design to control for various product attributes. This study used retailer and consumer data where product attributes were not necessarily equal between the FTO and conventional categories.

various product attributes in surveys, price was more important than sustainability (Bray et al., 2011; Lehmann & Sheffi, 2020). Examples of other important product attributes include taste or style, quality, and loyalty to market-leading brands and products (de Pelsmacker et al., 2005; Du et al., 2011; Johnstone & Tan, 2015).

A handful of studies use sales data to better understand consumer purchase behavior as a function of price and Fair Trade and organic (FTO) attributes in retail settings. Studies focused on markets in the US and Europe found that the demand for FTO products was typically more price elastic than the demand for conventional products, indicating that prices of FTO products should be reduced to increase demand (Alviola & Capps, 2010; Galarraga & Markandya, 2004; Glaser & Thompson, 2000; Lin et al., 2009; Niemi, 2009; Schollenberg, 2012). A US study found that the demand for organic products of consumers with above-median spending on organic products was less price elastic than that of other consumers. However, the demand of the former consumer group was still price elastic (Bezawada & Pauwels, 2013). The previously-mentioned field experiment with bulk coffee suggested that consumers did not treat all Fair Trade products similarly: the demand for higher-priced Fair Trade coffee was less price elastic than the demand for lower-priced Fair Trade and all conventional coffees (Hainmueller et al., 2015).[3] This field experiment implied that customers may be more loyal to higher-priced supply chain sustainable coffees than to lower-priced ones.

A nuanced understanding of consumers' behavior towards FTO products in different price brackets in the Consumer-Packaged Goods (CPG) market can further bring to light the competitiveness of sustainable coffees. The CPG market is a substantial market for many product

[3] The higher-priced Fair Trade coffee accounts for 11% of the bulk coffee market shares.

types offering FTO certified options. For example, CPG accounts for 95% of coffee sales at grocery stores (Driggs et al., 2016).

The goal of this study is to analyze whether premium and regular FTO products are competitive against conventional products in CPG markets using observations of Keurig K-cup coffee purchases by a consumer panel. Using point of sale data from 2016, the coffees were categorized into four groups based on their certification labels and their prices: Premium Conventional, Regular Conventional, Premium FTO, and Regular FTO. Product competitiveness was measured with price sensitivity and substitution behaviors (Porter, 1985) in the aggregate market (i.e., the market as a whole) and in market segments of consumers who spent more on FTO than on conventional coffees. We refer to the latter market segments as *core FTO market segments* following conventions in marketing research (Bezawada & Pauwels, 2013; Kotler & Keller, 2011). We identified two core FTO market segments, one for the Regular FTO coffee and one for the Premium FTO coffee. The key research questions are:

1) To what extent were regular and premium FTO products competitive against conventional products (i) in the aggregate market and (ii) within segments of core consumers who spent most of their coffee budget on FTO products?
2) What do core FTO consumers substitution behaviors reveal about the importance of certification in their choices?

Although consumers' motivations to buy Fair Trade and organic certified products can be different (Loureiro & Lotade, 2005; Schleenbecker et al., 2018), Fair Trade and organic coffees were analyzed together to represent certified sustainable products because most K-cup coffee products carried both certification labels. We evaluate if certified sustainable coffees in different

price brackets were competitive in actual retail settings to provide consumer behavior and business insights.

This study includes contributions to the literature of marketing research (Bezawada & Pauwels, 2013; de Pelsmacker et al., 2005; Glaser & Thompson, 2000; Hainmueller et al., 2015), sustainable consumption (Levi & Linton, 2003; Newholm & Shaw, 2007; Seyfang, 2005), and eco-labeling (Cerri et al., 2018; Howard & Allen, 2008; Loureiro & Lotade, 2005) by further examining consumers' reactions to FTO product in different price brackets.

3.2 Method

There were four main steps to the analysis for this study. First, the data was processed. Second, the core market segments were identified. Third, behavioral models were fitted to the aggregate market and to each core market segment. Fourth, the coefficients from the fitted models were used to calculate consumers' price sensitivity and substitution behaviors. This study measures market demand using willingness-to-pay (WTP), price sensitivity, and substitution behavior as in Chapter 2. This section will provide only information new to this chapter and refer to the previous chapter where appropriate.

3.2.1 Data

While this study analyzed K-Cup coffee purchases instead of bagged coffee purchases, the dataset was created in the same way as described in Section 2.3.3. The certified and labeled K-cup products within the retailers and consumer datasets carried only either the United States Department of Agriculture (USDA) Organic label or the Fair Trade Certified label awarded by Fair Trade USA or both (Figure 3.1).

Figure 3.1. USDA Organic and Fair Trade Certified labels[4]

The dataset included records of single-serve Keurig K-cup coffees for 69 weeks from September of 2015 to the end of 2016. Like the analysis in Chapter 2, to reduce the effects of differences in product function and taste on the results, only caffeinated and unflavored K-cup coffee products that came in either 10- or 12-cup pack sizes, which were the most common sizes on store shelves were included. In all, the input datasets included 49 products provided by ten brands, which accounted for 49.3% of single-serve K-cup coffee revenue in grocery stores.

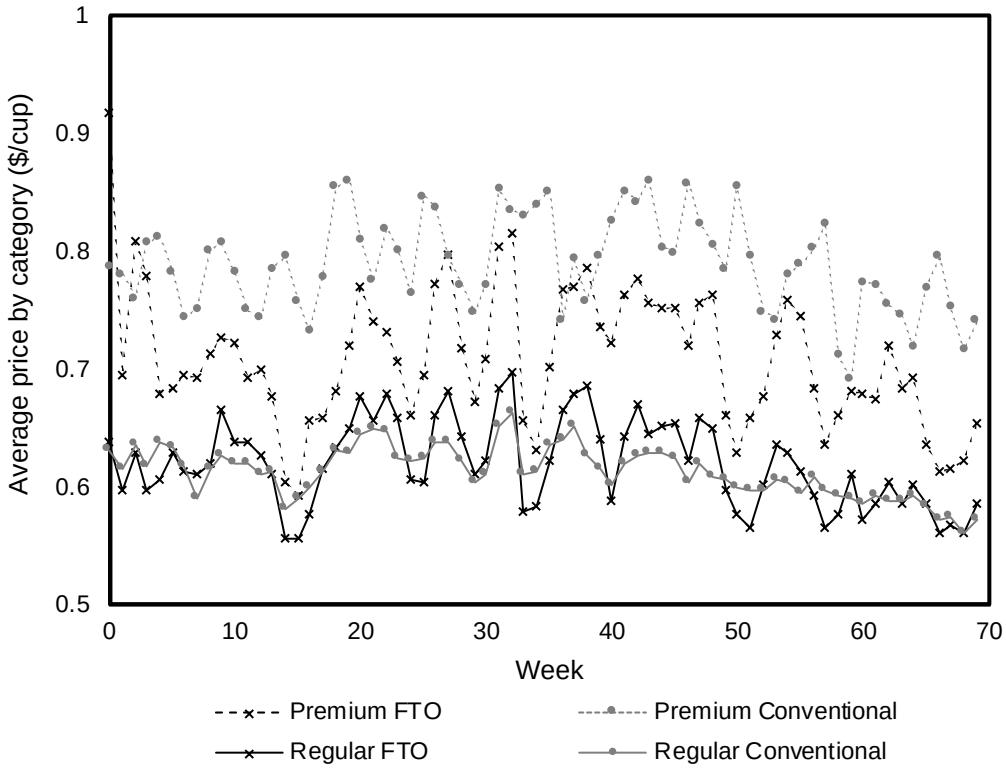
The merged dataset was further summarized such that each observation described the purchase transaction of a box of coffee. Since the boxes were in varying pack sizes, the coffee prices were converted to $/cup, assuming a standard 0.4 oz of coffee per cup (Hainmueller et al., 2015). The combined dataset consisted of 12,789 observations of unit items purchased by 2,938 consumers at 2,074 stores across the US.

To distinguish between FTO and conventional coffees, and between products with regular and premium prices, the 49 products were split into four product categories, namely: Premium Conventional, Regular Conventional, Premium FTO, and Regular FTO. The premium and regular coffees were classified into groups by applying the k-means algorithm with Euclidean distance metric (Hastie et al., 2009) to the weekly prices of each product averaged

[4] There is a wide range of Fair Trade certification labels awarded by different certification bodies with variations in operational requirements, such as farm size (Arnold et al., 2020). Only one kind of Fair Trade label was used on K-Cup products offered in grocery stores in the US in 2014 to 2016. The analysis and interpretations in this study assumed that the differences in Fair Trade programs were not discernable to the consumer.

over all stores. Figure 3.2 shows the weekly prices averaged over all stores for individual products in the top subplot and for the four product categories in the bottom subplot. The line texture indicates the product category. Regular Conventional and Regular FTO coffees had similar prices, while Premium Conventional coffees were slightly more expensive than Premium FTO coffees.[5] There was a mix of roast type and blended or single-origin coffees in each category.

Figure 3.2 Average weekly prices at stores by category



[5] Classifying the products using median and mode weekly prices gave the same result as when average weekly prices were used.

Despite data processing efforts to reduce the influence of factors besides Fair Trade and organic labels, price, and assortment size on consumer choice, there were some systematic differences between the product brands in each category (Table 3.1). For example, based on the year of establishment reported on company websites and annual reports, Premium Conventional and Regular Conventional categories included mostly brands that were established before the 1980s, while FTO categories included products with brands introduced after the 1980s. Premium Conventional product brands had branded coffeeshop presence, and the conventional category brands had higher advertising spending than the FTO category brands.

Table 3.1. Characteristics of brands within the categories

Categories	Brands	Number of branded coffee shops in the US[a]	Years of brand establishment in the US[a]	Advertising spending (1000s)[b]
Premium Conventional	Starbucks	13,172	1966	76,994
	Dunkin' Donuts	9,200	1950	64,225
	Peets	200	1971	995
Regular Conventional	Green Mountain	0	1981	233
	Folgers	0	1850	41,641
	Donut Shop	0	1972	No record
	McCafé	No record	2001	6,778
	Eight O' Clock	0	1859	0
Premium FTO	Green Mountain	0	1981	233
	Laughing Man	0	2015	No record
Regular FTO	Green Mountain	0	1981	233
	Newman's Own Organics	0	2002	2

[a] From company websites and annual reports
[b] Advertising spending includes advertising expenditure across television, radio, magazine, newspaper, internet and outdoor channels (Kantar Media, 2016)

Based on the combined dataset, the total market share of both FTO categories amounted to 14.8% (Table 3.2).[6] The market share of FTO in this dataset was higher than the reported

[6] Market share is the percentage of the total cups sold from a product category in the dataset.

market share for FTO in the US (i.e., 5.5% and 5% for Fair Trade and organic respectively (Fair Trade America, 2016)) because this dataset only included observations at grocery stores that carry all four categories. Notably, there were significantly fewer product options on store shelves from the FTO product categories than from the conventional product categories (p-values < 0.01 in all four tests comparing pairs of FTO and conventional categories). Prices for FTO certified products in the U.S. were priced similarly to conventional products.[7] Premium FTO coffee was cheaper than Premium Conventional coffee. This difference may be because the latter was offered by well-established and highly advertised coffee-chain brands (Table 3.1) that were able to charge a larger premium.

Table 3.2. Summary statistics

	Premium Conventional	Regular Conventional	Premium FTO	Regular FTO
Observed purchases	5169	5726	450	1444
Market share	40.4%	44.8%	3.5%	11.3%
Average assortment size	28.9	33.9	5.7	9.7
	(5.9)	(5.0)	(2.7)	(2.4)
Average price/ $ per cup	0.74	0.58	0.71	0.61
	(0.12)	(0.09)	(0.12)	(0.09)

Standard deviations are in the parentheses.

3.2.2 Market Segments

Consumers were classified using two different methods. They were classified into the segment of the product category that they (1) spent the most on, or (2) bought for more than 50% of their purchased volume. Only consumers with at least three shopping trips in the observed

[7] It appeared to be common for firms to not charge a higher price for certified coffees, especially Fair Trade coffee, in US grocery stores. Besides the observation in this dataset, Hainmueller et al (2015), and Reinstein and Song (2012) also found no price premium charged for certified sustainable coffees in US marketplaces.

period were considered for core segments. The number of consumers in the Premium and Regular FTO core market segments were around 12 and 5 times lower, respectively, than the number of consumers in the corresponding conventional product market segments (Table 3.3). When the consumers were segmented by purchase volume, similar market segment sizes and substantive results were obtained. The results with market segments classified by spending is used for discussion in the results section.

Table 3.3. Number of consumers and observations for each market segment

	Consumers with > 3 shopping trips				Other consumers
Segments	Premium	Regular	Premium FTO	Regular FTO	
Number of consumers (%)	394 (13.4%)	392 (13.3%)	31 (1.1%)	74 (2.5%)	2047 (69.7%)
Number of observations	4143	3715	288	819	3824

3.2.3 Demand Model, Price Sensitivity, and Substitution Behavior

The demand model is similarly specified and estimated as the model discussed in Section 2.3.4. The same model was applied to the aggregate market and in the core market segments. Model convergence was again tested with the Heidelberg-Welch test and the Gelman and Rubin's convergence diagnostic and all estimates passed the convergence tests at the 95% level of confidence.[8] Other explored model specifications are in Table B. 2 in the appendix for a summary of estimation results.

The price elasticities and substitution behaviors were calculated similarly as in Section 2.3.5. The difference here is that the sample was weighted with projection factors from the data

[8] Convergence results are in Appendix Table B. 1

provider such that the consumers were representative of the population.[9] The aggregated elasticity $\underline{\eta_{ii}}$ is a weighted sum of the disaggregated elasticities (Equation 6). The weight, $\underline{r_{n,}}$ is normalized by choice probability, $P_{nt}(i_{nt})$ (Bierlaire, 2017).

$$\eta_{ii} = \sum_{n}^{N} \sum_{t}^{T} \eta_{nt,ii} \frac{r_n P_{nt}(i_{nt})}{\sum_n \sum_t r_n P_{nt}(i_{nt})} \tag{3}$$

3.3 Results

3.3.1 Estimated Models

The Hierarchical Bayesian (HB) estimates are shown in Table 3.4. Regular Conventional coffee was used as the reference in estimation; all other WTP estimates are relative to the Regular Conventional coffee category.[10] We found that the average WTP for the Premium Conventional coffee category was higher than, the average WTP for the Premium FTO category was lower than, and the average WTP for the Regular FTO category was similar to the Regular Conventional category. It suggests that consumers, compared to the Regular Conventional category, preferred the Premium Conventional category, and did not prefer the Premium FTO category. The standard deviations of the WTP estimates are all significant, indicating that consumers' preferences for the categories were highly heterogeneous.

The positive coefficient in Table 3.4 for assortment size means that if the assortment of a coffee category increase by 1%, the consumer would be willing to pay an additional $1.29/10-cups of coffee for the category. This implies that part of the strong preference for conventional

[9] See Appendix B.3 for weighting details. Substantial results were the same with and without weighting. Weighting was only applied when calculating elasticities (Bierlaire, 2017).

[10] The dependent variables for the WTP terms are the indicator variables of the categories. To avoid multicollinearity, one of the indicator variables is omitted from the estimation, and its WTP cannot be estimated.

categories was related to the larger conventional category assortment sizes. On average, there were around 6 and 3 times more Premium and Regular Conventional options than Premium and Regular FTO options, respectively (Table 3.2). Given a hypothetical scenario where the assortment sizes of the categories were equal, the model projects that the market shares of Premium and Regular Conventional and Premium and Regular FTO coffees would be 38.6%, 35.9%, 5.1%, and 20.4% respectively. When compared to the original market shares as listed in Table 3.2, this is equivalent to 1.8% and 8.9% drop in the conventional coffee demand and 1.6%, and 9.1% increase in the FTO coffee demand.

Table 3.4. Estimated mean and standard deviation of coefficients and willingness-to-pay

Attribute	**Parameter**	**Mean**	**Standard deviation**
Scale parameter	$\ln(\zeta_n)$	1.22 (0.07) **	1.26 (0.06) **
Price ($/10 cup)		Fixed at -1	
Premium Conventional ($/10 cup)	WTP_n	1.54 (0.06) **	1.85 (0.07) **
Premium FTO ($/10 cup)	WTP_n	-0.85 (0.07) **	2.18 (0.34) **
Regular FTO ($/10 cup)	WTP_n	0.04 (0.22)	1.30 (0.19) **
ln(Assortment size) ($/10 cup)	λ_n	1.29 (0.17) **	0.76 (0.17) **
Adjusted R^2	0.78		
Loglikelihood	-3101		

Posterior standard deviation in brackets, ** $p < 0.01$, * $p < 0.05$.

Figure 3.3 shows the distributions of the WTP for each category. The distributions for the Premium Conventional and the Premium FTO WTP are wider than that of the Regular FTO. However, the right tail of the Premium FTO includes few consumers. Only 12% of the consumers were willing to pay more for Premium FTO coffee than the Regular Conventional category, whereas 50% of the consumers were willing to do so for Regular FTO coffees. Based on a reasonable assumption that Premium FTO coffee were higher quality than the regular FTO

coffee, certification and price brackets were unlikely to be the reason for consumers' lack of interest in Premium FTO coffee even when price and assortment size were held equal. Other factors (such as brand-specific charcteristics discussed in section 3.2.1) were likely to have influenced majority consumers' indifference towards the category.

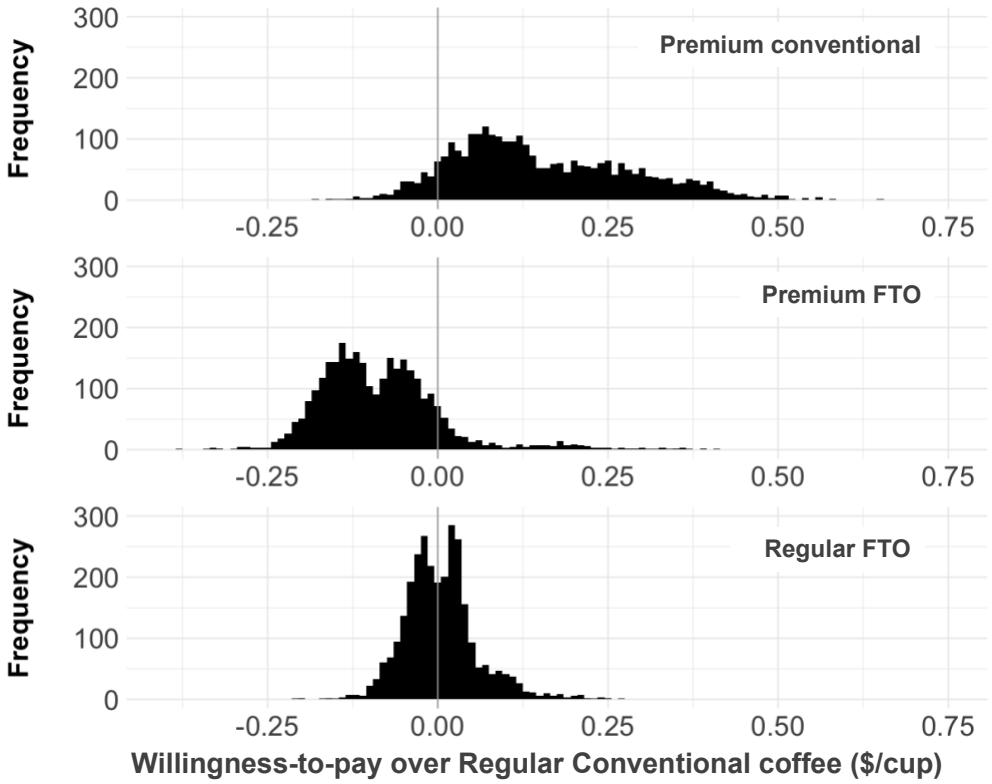


Figure 3.3 Distributions of Willingness-to-Pay over the Regular Conventional category

Table 3.5 shows the covariance matrix for the category WTP and assortment size. The diagonal elements are the variances of the WTPs. The lower and upper off-diagonal elements are the covariances and correlation coefficients. The Premium Conventional and Premium FTO categories have significant positive covariance of 1.58 and correlation of 0.64, implying that consumers with higher WTP for Premium Conventional coffee are also more willing to pay for Premium FTO coffee. The FTO category WTPs are inversely correlated with assortment size,

providing some evidence that consumers with higher WTP for FTO products were less distracted by large assortment size.

Table 3.5 Covariance matrix for category and ln(Assortment size) WTP

	Premium Conventional	Premium FTO	Regular FTO	ln(Assortment size)
Premium Conventional	3.44 (0.26) **	*0.64*	*0.47*	*0.15*
Premium FTO	1.58 (0.63) *	4.89 (1.54) **	*0.45*	*-0.48*
Regular FTO	0.76 (0.38)	1.01 (0.78)	1.73 (0.51) **	*-0.50*
ln(Assortment size)	0.17 (0.28)	0.07 (0.45)	0.23 (0.27)	0.61 (0.27) **

Correlations are reported in italics, ** $p < 0.01$, * $p < 0.05$

3.3.2 Price Sensitivity

Table 3.6 presents the price elasticities and the absolute cross-price effects of the aggregate market and the core FTO market segments defined by spending. All elasticities were significantly different from zero with p-value < 0.05. The estimated elasticities fell within the ranges found in other studies (Guadagni & Little, 1983; Hainmueller et al., 2015).

The demand for Regular FTO coffees was significantly less price-sensitive than the demand for Premium FTO coffees (one-tailed t-test p-value < 0.03) but the absolute difference was small. A 1% increase (decrease) in the price of the Premium FTO coffee would decrease (increase) its aggregate demand by 2.50%, and the same percentage increase (decrease) in the price of the Regular FTO coffee would decrease (increase) its aggregate demand by 2.47%. This result implies that Regular FTO coffees and Premium FTO coffees attracted similarly price sensitive demand.

The demand for both FTO coffees was more price elastic than the demand for both conventional coffees (all four p-values[11] < 0.01). The own-price elasticities for Premium and

[11] Two conventional and two FTO categories are compared against each other in four tests.

Regular Conventional coffees were -1.39 and -1.24, respectively. Products with smaller market shares, like the FTO coffees, typically have more negative price elasticities unless they are highly differentiated and less substitutable (e.g., sensitive toothpaste) (Scriven & Ehrenberg, 2004). These own-price elasticities imply that both FTO coffees were not highly differentiated and were more substitutable than conventional coffee to most consumers.

The own-price elasticities of Premium FTO and Regular FTO within their core market segments were less elastic than in the aggregate market, at -1.81 and -1.43 (Table 3.6). Consumers in the FTO core market segments were less likely than consumers in the aggregate market to switch from their associated FTO coffee (both p-values < 0.01). This result indicates that the core consumer demand was less price elastic than estimated by Bezawada & Pauwels (2013), who found that the price elasticity of core organic consumers' demand for organic coffee was 2.1. This difference in elasticity estimates could be a result of different definitions of core market segment. They classified consumers who purchased above-median organic volume as core consumers, but their classification could have included consumers who bought more conventional products than organic products. In contrast, the definition used here includes only consumers who buy or spend more on FTO than conventional products, and the results show that these core consumers were less sensitive to the prices of their preferred FTO products.

Table 3.6. Own-price elasticities and absolute cross-price effect in the aggregate market and the core FTO market segments

			Category *j*			
			Absolute cross-price effect			
Category *i*	Market share	Own-price elasticity	Premium Conventional	Regular Conventional	Premium FTO	Regular FTO
Aggregate market						
Premium Conventional	5201	-1.39 (0.04)	-71.94 (1.44)	57.9 (1.31)	3.31 (0.25)	10.74 (0.44)
Regular Conventional	5915	-1.24 (0.04)	44.92 (1.02)	-73.05 (1.35)	4.32 (0.31)	23.81 (0.85)
Premium FTO	361	-2.50 (0.20)	2.94 (0.24)	4.82 (0.36)	-9.00 (0.51)	1.24 (0.11)
Regular FTO	1311	-2.47 (0.10)	8.02 (0.31)	23.31 (0.84)	1.1 (0.10)	-32.43 (0.95)
Premium FTO market segment						
Premium Conventional	46	-3.28 (0.64)	-1.54 (0.19)	0.38 (0.05)	1.03 (0.16)	0.14 (0.01)
Regular Conventional	52	-3.55 (0.58)	0.30 (0.04)	-1.83 (0.22)	1.35 (0.2)	0.18 (0.02)
Premium FTO	165	-1.81 (0.33)	1.01 (0.16)	1.69 (0.27)	-2.97 (0.34)	0.28 (0.04)
Regular FTO	24	-2.22 (0.26)	0.11 (0.01)	0.17 (0.02)	0.24 (0.03)	-0.52 (0.06)
Regular FTO market segment						
Premium Conventional	64	-4.18 (0.51)	-2.65 (0.24)	1.19 (0.12)	0.06 (0.01)	1.40 (0.15)
Regular Conventional	195	-3.78 (0.37)	0.96 (0.09)	-7.34 (0.54)	0.12 (0.02)	6.27 (0.51)
Premium FTO	9	-3.99 (0.21)	0.05 (0.01)	0.12 (0.02)	-0.35 (0.05)	0.18 (0.03)
Regular FTO	551	-1.43 (0.13)	1.15 (0.13)	6.55 (0.54)	0.16 (0.03)	-7.87 (0.58)

Standard errors are in parentheses. All elasticities are significantly different from zero with p-value < 0.05.

3.3.3 Category Substitution Behavior

The conventional coffee categories were the most preferred substitutes for all product categories in the aggregate market (all p-values < 0.01) (Table 3.6). When the price of a product category increased, majority of the market share switched to either the Regular Conventional or the Premium Conventional categories, as indicated by the absolute cross-price effect. Consumers of Regular FTO who were expected to be more price-conscious unsurprisingly preferred the Regular Conventional coffee to Premium FTO coffee.

However, even consumers within Premium FTO core market segments were more likely to switch to the Regular Conventional category than the Regular FTO category when both were similarly low-priced. Of the 1.81 Premium FTO purchases that would be diverted, 1.69 and 0.28 of them were absorbed by the Regular Conventional and Regular FTO categories. This difference was significant with t-test p-values < 0.01. Core FTO consumers were likely to compromise FTO attributes in CPG markets even when both higher-priced premium and lower-priced regular FTO options were available.

We found that the demand for FTO products were more price sensitive than conventional products in the aggregate market. However, the core consumers of FTO products were less sensitive to the prices of the FTO products they buy frequently, with price elasticities of -1.43 and -1.81 respectively. Yet, even core consumers who spent more on higher-priced premium FTO products were more likely to choose regular conventional coffee over regular FTO coffee even though both were similarly low-priced. Having identified certain correlations in the data, the next section discusses possible explanations for these behaviors in the following section.

3.4 Discussion

This study examined retail data to characterize consumer price sensitivity and substitution behavior towards premium and regular FTO coffees in the CPG market. In general, most consumers were more sensitive to the prices of premium and regular FTO products than they were to the prices of conventional products. This result implies that most consumers were not particularly attracted or loyal to FTO products. Core premium FTO coffee consumers were less sensitive to the product prices, and thus were loyal to premium FTO products. However, when they choose not to buy premium FTO coffee, they were more likely to switch to conventional coffees than to regular FTO coffee. Since lower-priced regular FTO coffees were available, price was not the only reason that motivated the core consumers to switch from the premium FTO category to the non-FTO categories. We could infer that even the consumers that spent more on FTO coffees would forgo FTO certifications and compromise the ideals of supporting farmers or protecting the environment in favor of other characteristics that the conventional products offer. Since the goal of differentiation is to gain a competitive advantage given the market conditions (Porter, 1985; Sharp & Dawes, 2001), the findings of this study suggest that FTO certifications do not adequately differentiate the products.

Several reasons may explain why FTO products were not competitive despite their prices matching those of the conventional products. We found that there were significantly smaller assortments of FTO coffees than conventional coffees in stores. Using certification labels was not enough to counteract this disadvantage in assortment size. Besides assortment size, FTO products could also be less popular because most consumers do not pay attention to, trust, or fully understand the certification labels (Darian et al., 2015; Pickett-Baker & Ozaki, 2008; Yiridoe et al., 2005), or are not as interested in the sustainability attributes as other product

characteristics (Mintel, 2017; Van Loo et al., 2015). Other factors that may have put FTO products at a disadvantage include their branding and taste (de Pelsmacker et al., 2005; Joshi & Rahman, 2015).

Manufacturers providing FTO products in CPG markets should recognize the threat of substitution from FTO coffees to conventional coffees and the limited influence of FTO labels on their core consumers. Manufacturers should do more than just offer FTO products within the price ranges of conventional products. A combination of the following strategies may increase the competitiveness of FTO products: (1) increasing the assortment sizes of FTO products in stores; (2) investing in educating and marketing to their consumers about the sustainability impact of the labels at the point of choice (Buell & Kalkanci, 2019; Kraft et al., 2018); (3) improving their product and service strategy to provide more compelling direct benefits such as status or quality to the consumers (Delmas & Colgan, 2018); (4) using other types of retail stores and channels that are not yet dominated by conventional brands and companies such as online and direct-to-consumer; and (5) using other sustainability practices such as using post-consumer recycled packaging for the coffee (Boz et al., 2020).

A recent study advised top-tier conventional coffee manufacturers to enter the sustainability label market because they would lose more market share to organic product manufacturers than second-tier conventional manufacturers or house brands would (Bezawada & Pauwels, 2013). However, in comparing the relative competitiveness of FTO and conventional coffees, this study found that regular and premium conventional coffees constituted stiffer competition to each other than the competition from FTO coffees. This was partly because of the limited shelf presence of the FTO coffee relative to the conventional coffee. Moreover, FTO coffee had small market shares. Our findings showed that under the existent market conditions,

conventional product manufacturers would more effectively gain or maintain market share by mainly investing in the existing strengths of conventional products and building their brands rather than to invest in FTO certifications for product labeling.

3.5 Chapter Conclusion

Shopping decisions are multidimensional decisions, and it is a challenge to tap concerned consumers' potential demand for sustainable products. There are many possible strategies to influence consumers to buy sustainable products, but market research is needed to determine which are effective and which are not. Our results suggest that passive sustainability labels have little influence on the competitiveness of products in a traditional retail setting dominated by conventional products. Future studies could explore other marketing strategies to offer further insights on the competitiveness of certified sustainable products.

Chapter 4

Sustainable Sourcing Strategies by Firms Across Palm Oil Supply Chains

4.1 Introduction

Since the early 2000s, companies have been held responsible for using palm oil produced with negative environmental and social impacts (Chaudhari, 2011; Greenpeace International, 2018; Webb, 2016). These companies across different industries and stages of the palm oil supply chain have found themselves on the receiving end of NGO criticisms for their direct and indirect suppliers' social and environmental misconducts (Amnesty International, 2016; Armstrong, 2010; Webb, 2016). One of the most notable activist events occurred in March of 2010 when Nestlé, a large consumer goods company, was targeted by Greenpeace, a non-governmental organization, for using palm oil related to deforestation (Armstrong, 2010; Sheffi & Blanco, 2018; Webb, 2016; Wolf, 2014). Greenpeace released a video portraying an office worker eating Nestle's popular KitKat that turned out to be an orangutan's finger, symbolizing the destruction of palm oil deforestation.

Throughout the 2010s, thousands of companies have participated in multi-stakeholder networks to encourage and support company adoption of standards and practices (Jiang, 2009; Plambeck, 2012; Villena, 2019; Wolf, 2014). The membership of the Roundtable of Sustainable

Palm Oil (RSPO), a multi-stakeholder group promoting the growth and use of sustainable palm oil based on external verified environmental and social standards (Lyons-White & Knight, 2018; Nesadurai, 2017),

[1] grew from 1,000 members in 2012 to 4,000 members in 2018 (RSPO, 2019) and close to 5,000 members in 2021 (RSPO, 2021). In 2010, four hundred members of the Consumer Goods Forum, consisting of manufacturing and retail firms, committed to purchasing only sustainably produced commodities, including palm oil (Taylor, 2019). In 2020, around 1,700 companies in the United Nations Global Compact required their supply chain partners to adhere to sustainability principles (Kingo et al., 2020).

Some companies adopt a range of sustainable sourcing practices (SSP)[2], i.e., private and non-governmental practices to improve the social and/or environmental management of their suppliers' activities (Thorlakson et al., 2018b; World Wide Fund for Nature, 2016a, 2017; Zoological Society London, 2017a). The SSPs commonly used by companies in agri-food industries include supplier code of conduct, third-party standards, and supplier assessment and training (Rueda et al., 2017; Thorlakson et al., 2018b). Practitioners and scholars found that buying firms which use formal standards and proactively collaborate with their suppliers can better improve the buying firms' reputations and their suppliers' sustainability performance (Croom et al., 2018; De Marchi et al., 2013; Gold et al., 2010b; Pilbeam et al., 2012b; Porteous

[1] Besides RSPO, other governance schemes include the Palm Oil Innovation Group, No Deforestation, Peat, and Exploitation Policies, Malaysian Sustainable Palm Oil, and Indonesian Sustainable Palm Oil.

[2] Other terminologies used for sustainable sourcing strategies include procurement practices (Villena, 2019), governance instruments (Pilbeam et al., 2012b), private governance in global value chains (Mayer & Gereffi, 2010), and social management capabilities (Klassen & Vereecke, 2012).

et al., 2015; Poynton, 2015; Zhu & Sarkis, 2007). Even though using a combination of collaboration and standards can be more effective, only some companies take this approach (Akhavan & Beckmann, 2016).

A relevant line of literature explores how buyers address sustainability in their supply chains. Several large-scale surveys mapped the landscape of sustainable practices in the late 2010s (Bateman et al., 2020; Ernst & Young & United Nations Global Compact, 2016; NAEM, 2019; Thorlakson et al., 2018a). Other studies further sought to understand the factors influencing firms sustainable sourcing practices through case studies (De Marchi et al., 2013; Formentini & Taticchi, 2016; León-Bravo et al., 2019b; Pagell & Wu, 2009b; Pullman & Dillard, 2010; Rueda et al., 2017; Villena, 2019), literature reviews (Gold et al., 2010a; Jeppesen & Hansen, 2004; Pilbeam et al., 2012a), and large-scale analyses with companies' self-disclosed data (Akhavan & Beckmann, 2016; Bager & Lambin, 2020; Thorlakson et al., 2018b). Large-scale analysis of many companies' practices presents a representative perspective but is a relatively underexplored approach.

Many of the studies on SSPs adoption focused primarily on manufacturers' practices, with little consideration for firms in other stages (León-Bravo et al., 2019b; Villena, 2019; Zorzini et al., 2015). Only a few recent papers studied individual companies' sourcing strategies in various supply chain stages (Bager & Lambin, 2020; León-Bravo et al., 2019a). For instance, Bager and Lambin (2020) studied scopes of internal sustainability (e.g., in-house carbon footprint and waste targets) and supply chain sustainability policies (e.g., no child labor and zero deforestation) for firms in the coffee industry.

To form a broad and holistic industry view of firms' sustainable sourcing strategies in the palm oil industry, this study examined 171 companies' mixes of SSPs. The goal is to understand

how firms manage their suppliers' sustainability performance and how their management approaches depend on their supply chain stages—whether they are retailers, manufacturers, or further upstream in the supply chain. We use the terms "hands-off or "hands-on" to distinguish practices that require low or high levels of active buyer involvement to make their direct and indirect suppliers' processes sustainable.[3] The main research question under study is: How do the number and proportion of hands-on and hands-off practices used by companies in the palm oil supply chain depend on their stage in the supply chain?

We answer the call of Pagell et al. (2010), Jeppesen & Hansen (2004), and Ketokivi and Mahoney (2019) for scholars to apply stakeholder theory (ST), transaction cost economics (TCE), and resource-based view (RBV) (Section 4.1.1.3) to understand the organization of activities in supply networks. Our findings show the prevalence in the application of hands-off and -on approaches in different supply chain stages. We discuss the implications for the development of sustainable palm oil supply. The insights generated in this chapter about the palm oil industry may also be applied to other agricultural industries which face similar challenges.

4.1.1 Background

4.1.1.1 Palm oil supply chain

The palm oil supply chain has an hourglass shape as shown in Figure 4.1 (Dodson et al., 2020; Lyons-White & Knight, 2018). Countless growers and farmers supply palm fruits that are

[3] Academics and practitioners investigating companies' SSPs distinguished the range practices by the buyer involvement in the supplier's activities. This distinction has been described as "hands-off or -on" (Bager & Lambin, 2020; De Marchi et al., 2013), "external or internal standard or intervention" (Thorlakson et al., 2018), "non-collaborative or collaborative," and "shallow or deep" (Jeppesen & Hansen, 2004). The terms used are aligned with De Marchi et al. (2013) descriptions of the terms. More information on the definitions in existing papers is in Appendix Table C.1.

funneled to a smaller number of mills. Products from the mills, such as crude palm oil and palm kernel, are then passed on to an even smaller number of processors and traders (PTs).[4] The PTs trade and refine the palm products to produce many kinds of oils and derivatives (El-Fegoun, 2015; Hashim et al., 2012). Subsequently, manufacturers use palm oil and palm derivatives purchased from PTs as inputs to their goods, which are sold by numerous retailers, to billions of end-consumers.

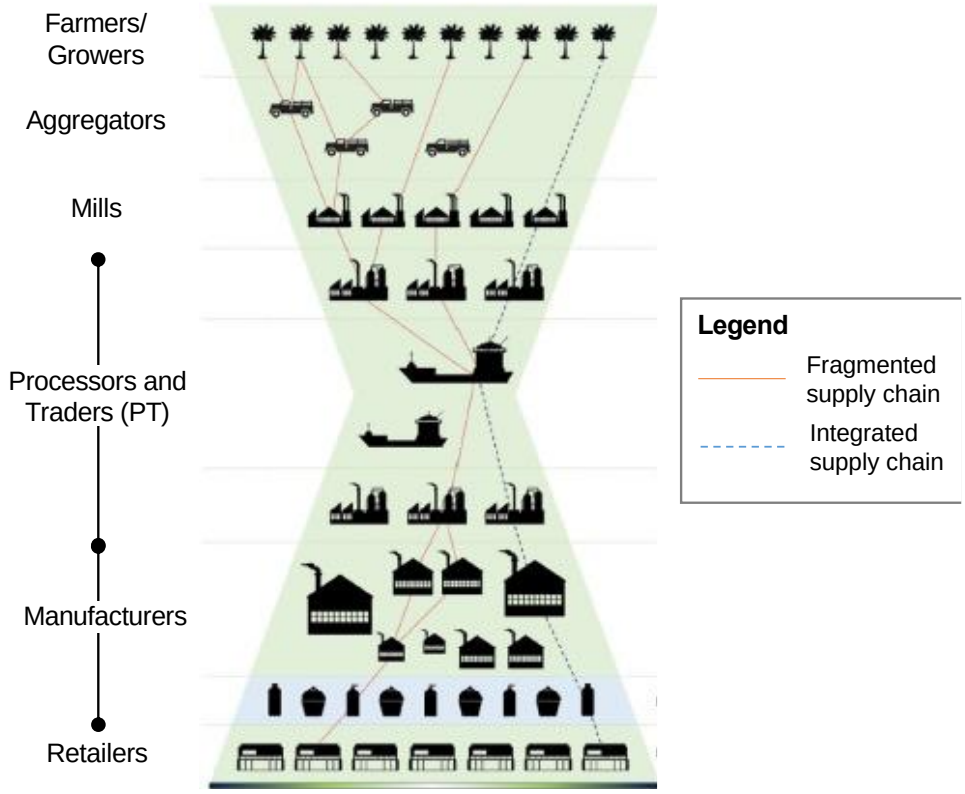


Figure 4.1. Stages in palm oil supply chains. Adapted from Lyons-White & Knight (2018).

[4] According to Dodson et al., 2020, there was 6.8 million ha of oil palm plantations in Indonesia in 2018, 742 mills in 2015, and 78 refineries (operated by producers) in 2017.

The top part of the supply chain is fragmented with different palm fruit sources, many of which are hard to trace. Some PTs partially integrate their upstream supply chain with their own mills and palm oil plantations, though many of them source from independent farmers and aggregators as well (Dodson et al., 2020; Lyons-White & Knight, 2018). PTs have limited visibility and control over these independent suppliers (Leegwater & van Duijn, 2012; Nesadurai, 2017).

Through interviews with PTs, manufacturers, and retailers, Lyons-White and Knight (2018) found that downstream companies' ability to address sustainability issues at the farms and plantations is greatly hindered by supply chain complexity.[5] They describe how this complexity is compounded by many different firms and transactions, information not shared between supply chain actors, cultural differences, and products being mixed and processed into a wide range of derivatives. As expected, supply chain complexity increases exponentially downstream (Leegwater & van Duijn, 2012; Lyons-White & Knight, 2018). The palm product in a single end-consumer item could be a mixture of palm oil from a large shipment, produced by a few dozen palm oil mills, supplied by hundreds of farmers and plantations (Leegwater & van Duijn, 2012).

4.1.1.2 Sustainable sourcing practices

This section describes hands-off and -on practices and summarizes their advantages and challenges in addressing sustainability issues in the palm oil industry. Hands-off practices are characterized by low levels of buyer involvement to make their suppliers' processes sustainable. Hands-off practices often consist of setting standards that suppliers must meet (De Marchi et al., 2013; Pilbeam et al., 2012b). These standards can be defined externally by third-parties or

[5] Supply chain complexity is defined by the numerousness, variety and diversity, interconnections or interactions, opacity of interactions, and dynamics effects (Mitchell, 2009).

internally by the company (Bager & Lambin, 2020; Thorlakson, 2018). Hands-off practices are useful for communicating and clarifying expectations to buyers' stakeholders, especially their suppliers, and allowing buyers to safeguard minimum standards in production processes and reduce reputation risks (Gold et al., 2010b; Hofmann et al., 2014). However, external standards in the palm oil industry, particularly RSPO, have been criticized for compromising sustainability requirements (Lyons-White & Knight, 2018; McCarthy, 2012; Nesadurai, 2017) and for being ineffective in reducing deforestation and labor exploitation (Carlson et al., 2017; Gatti et al., 2019). Internal standards in palm oil have received less research attention than external standards so far. In general, both types of standards can squeeze suppliers to absorb both the risks and the costs to change (Ponte, 2019) and are fallible to compliance gaps (Boström et al., 2015). In recent years, some buyers have begun to take more active roles in influencing their direct and indirect suppliers (The Forest Trust, 2017; Thorlakson et al., 2018b).

Hands-on practices are characterized by high levels of buyer involvement to make their suppliers' processes sustainable. They often take the form of stable and trusting relationships developed with frequent interactions and resource and knowledge sharing (De Marchi et al., 2013; Jeppesen & Hansen, 2004). In general, researchers found that collaborative practices are more likely to improve suppliers' sustainability performance and lower buyers' operating costs than non-collaborative and punitive practices (Gold et al., 2010a; McFadden, 1979; Porteous et al., 2015; Rosen et al., 2001). Some researchers found that using both high and low involvement practices positively and synergistically affects suppliers' sustainability performance (Gimenez & Sierra, 2013; Rosen et al., 2001; Sarkis et al., 2010). Based on practitioners' and researchers' assessments, leaders in sustainable supply chain management are incorporating hands-on in addition to hands-off practices (Bateman et al., 2020; Ernst & Young & United Nations Global

Compact, 2016; Gimenez & Sierra, 2013; Pagell et al., 2010). Some described this trend as firms "going beyond certifications" (Poynton, 2015; Thorlakson, 2018).

Companies can face different levels of external pressures and supply chain complexity in implementing various SSPs, depending on their supply chain stages (Lyons-White & Knight, 2018). The next section introduces relevant supply chain management theories that explains some of the variation in firms' SSPs by their stages in the palm oil supply chain.

4.1.1.3 Supply chain management theories

Stakeholder theory (ST), transaction cost economics (TCE), and resource-based view (RBV) are commonly used to understand sustainable supply chain activities (Carter & Easton, 2011; Zorzini et al., 2015). Jeppesen and Hansen (2004) and Pagell et al. (2010) proposed that these three theories can explain companies' sustainable sourcing practices. We apply ST, TCE, and RBV because they can relate the level of external stakeholder pressure and supply chain factors to firms' activities (Ketokivi & Mahoney, 2020; Santos & Eisenhardt, 2005).

Stakeholder theory postulates that a firm would expand the scope of its businesses to integrate responsibility towards groups and individuals who depend on the firm for their goals or whom the firm depends on for its existence (Freeman et al., 2004; Hörisch et al., 2014). Pressures from external stakeholders, such as non-governmental organizations (NGOs) and investors, can push a firm to act on supply chain sustainability for protecting or enhancing its reputation (Pagell et al., 2010; Thorlakson, 2018) (Table 4.1). Studies found that firms which are consumer-facing (i.e., highly branded or serving-end-consumer)[6], large, public, or serve

[6] According to the Macmillan dictionary, consumer-facing in general means companies that sell goods (or services) directly to end-consumers or produce branded products that end-consumers can recognize. In Thorlakson et al. (2018), they found companies that produce branded products that end-consumer can recognize to be more likely to have at least one practice or have more practices than

European and North American markets face more pressure (Park-Poaps & Rees, 2010) and are more likely to have SSPs than their counterparts (Bager & Lambin, 2020; Thorlakson et al., 2018b).

Transaction cost economics states that companies manage and arrange their exchange relationships to minimize the total cost of governance and production (Ketokivi & Mahoney, 2020; Williamson, 1979). Governance costs include the cost to measure and monitor the suppliers' activities (Pagell et al., 2010; Rosen et al., 2001) and the costs to communicate and develop trust in the buyer-supplier relationships (Weber & Mayer, 2014).

The resource-based view states that each firm has unique resources that the firm allocates to develop capabilities to gain competitive advantage (J. Barney, 1991; J. B. Barney, 2001; Formentini & Taticchi, 2016; Wernerfelt, 1986). Resources include skills, assets, and accumulated knowledge, and firms' capabilities depend on organizational processes to use these resources (J. B. Barney, 2001; Gold et al., 2010b; Peteraf, 1993). Firms that implement SSPs may enhance their reputation and gain an advantage over their market competitors (Gold et al., 2010b; Pagell et al., 2010; Roehrich et al., 2014; Wolf, 2014).

4.1.2 Hypotheses

Stakeholder theory posits that companies' approaches to sustainable sourcing can depend on the pressures from their stakeholders. The stakeholders and the level of pressure each firm faces depend on their characteristics, including their supply chain stage (Bager & Lambin, 2020; León-Bravo et al., 2019b). Companies' pressures to use sustainable palm oil typically originate

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companies without recognizable brands. This result does not imply that the observations hold for the other kind of consumer-facing companies, e.g., retailers, companies that sell goods (or services) directly to end-consumers.

from external stakeholders, such as non-governmental organizations (NGOs), news media, governments, and end-consumers (Chaudhari, 2011; Lyons-White & Knight, 2018; Webb, 2016). It may be expected that downstream firms (in the order of retailers, manufacturers, and then PTs), who face more pressure from these external stakeholders, are more involved in their suppliers' activities than upstream firms as a result. However, the strategic aim is to push upstream suppliers to change (Kingo et al., 2020; Maitar & Skar, 2010).

Firms that are upstream in the palm oil supply chain face multiple sources of pressure to be hands-on. To be part of the RSPO certified supply chain, growers and millers must follow eight principles[7] and numerous sub-criteria to produce certified sustainable palm oil. Meanwhile, downstream companies only have to identify RSPO certificate holders for sourcing palm oil (RSPO, 2018). Some leading manufacturers terminated contracts with their supplying PTs that were revealed by NGOs for violating RSPO standards (Furlong, 2016; Jiang, 2009; Maitar & Skar, 2010; Nash, 2017; Reuters Staff, 2009). The Forest Trust, an NGO, developed the Sustainability Policy Transparency Toolkit (SPOTT) to annually track growers' and PTs' sustainability practices with more than 125 indicators (Melot & Delabre, 2017). In another example, Ceres, a nonprofit organization, recommended PTs disclose more details regarding their palm sources than manufacturers and retailers (CERES, 2017a). We infer that external stakeholders' expectations for firms to use hands-on practices decrease in the downstream stages of the supply chain. The RSPO's and CERES' requirements and recommendations for

[7] The eight principles are (1) commitment to transparency, (2) compliance with applicable laws and regulations, (3) commitment to long-term economic and financial viability, (4) use of appropriate best practices by growers and millers, (5) environmental responsibility and conservation of natural resources and biodiversity, (6) responsible considerations of employees, and individuals and communities affected by growers and mills, (7) responsible development of new plantings, and (8) commitment to continuous improvement in key areas of activity.

manufacturers and retailers, which tend to focus on hands-off practices (e.g., percent of supply certified), also apply to PTs. We infer that stakeholders' expectations for firms to use hands-off practices do not depend as much on the supply chain stages (Table 4.1).

Drawing from TCE, the SSPs that buyers use can depend on the costs to measure and monitor upstream suppliers' activities, transfer knowledge, and establish relationships with the suppliers (Ketokivi & Mahoney, 2020; Rosen et al., 2001; Weber & Mayer, 2014). Hands-on practices usually require a high level of investment, interactions, and commitment to develop trust and share knowledge on a case-by-case basis between buyers and upstream suppliers (De Marchi et al., 2013; Formentini & Taticchi, 2016). Since supply chain complexity and fragmentation increase from the PT stage to the retailer stage, the costs to implement hands-on practices also increase, decreasing the likelihood that downstream companies use hands-on practices (Table 4.1). Conversely, hands-off practices by design leave most of the responsibilities of becoming sustainable on the suppliers (Ponte, 2019). Therefore, the costs and the chances for the buyers to implement hands-off practices may not depend on stages.

Based on RBV, companies' ability to implement SSPs depends on their skills, assets, and knowledge to incentivize and help suppliers and growers change their operation (Carter & Rogers, 2008). The amount and type of resources the companies have vary by their supply chain stage. Companies that are closer to the growers are better positioned with the resources to be more hands-on (e.g., suppliers' identity and locations) than companies further downstream. For example, since PTs have more knowledge about the mills and farms, they can prioritize supplier engagements and be more confident in opening up a channel to receive grievances for their upstream supply chain (Dodson et al., 2020). Another dimension is the concentration or diffusion of resources. Companies further downstream are far from the farms and mills to support them

directly. The assets they could allocate for tracing and working with each supplier in their supply chain are more diffused since they have a wider spread of suppliers than upstream companies (Lyons-White & Knight, 2018). On the other hand, since the hands-off practices place most of the responsibilities on the suppliers (Ponte, 2019), the assets, skills, and knowledge to implement the practices may not depend on the supply chain stage.

Table 4.1. Factors influencing the type of sustainable sourcing practice by supply chain stages

		Sustainable Sourcing Practice	
Theory	Relevant Factor	Hands-on	Hands-off
Stakeholder theory (ST)	External stakeholders' expectations	Expectations for firms to use hands-on practices decrease downstream.	Expectations for firms to use hands-off practices may be independent of their supply chain stages.
Transaction cost economics (TCE)	Measurement and monitoring cost	Costs to use hands-on practices increase downstream.	Cost to use hands-off practices may be independent of supply chain stages.
Resource-based view (RBV)	Asset Skill Knowledge	Resources needed to use hands-on practices decrease downstream.	Resources needed to use hands-off practices may be independent of supply chain stages.

Based on how these influencing factors vary across the supply chain, this study proposes the following three hypotheses. Hypotheses 1 and 2 describe the expected effects of stakeholder expectations, governance costs, and resource availability on the number of practices firms use. There is little information indicating that hands-off practices vary by supply chain stages, so this study hypothesizes no relationship between them. Hypothesis 3 describes the same effects on a firm's mix of SSPs represented by the fraction of hands-on practices out of all practices the firm use.

H1: The number of hands-off practices does not vary across supply chain stages.

H2: The number of hands-on practices decreases downstream of the supply chain

H3: The fraction of practices that is hands-on decreases downstream of the supply chain

4.2 Methods

There are three main steps in the analysis. First, a sample of companies likely to use SSPs was identified. Second, data from the companies' self-disclosure contents was collected. Lastly, the hypotheses were tested with the data.

4.2.1 Data

4.2.1.1 Sample

The sampling goal was to reflect the strategies of a wide range of companies that were likely to use sustainable sourcing practices. We included PTs, manufacturers, and retailers (grocery and foodservice companies) in our analyses, to understand downstream companies' sourcing approaches. Given that no list comprehensively identifies companies with SSPs for palm oil, 275 companies with varied characteristics from NGO reports, Deloitte and Forbes top global company lists[8], and ethical consumer websites (Deloitte, 2017; Ethical Consumer, 2015; Forbes, 2017; Newman, 2017; World Wide Fund for Nature, 2016a, 2017; Zoological Society London, 2017a) were identified. The same types of sources were used in a previous study (Bager & Lambin, 2020) based on the coffee industry. Companies were categorized by their primary function in the supply chain stage. We grouped processers and traders following conventions of NGO reports (CERES, 2017a; Zoological Society London, 2017a) and considering that many PTs have overlapping functions. The retailers and manufacturers in the sample represented more than 10% of global palm oil consumption (World Wide Fund for Nature, 2016b), and the PTs controlled more than 87% of the global trade in palm oil (Nesadurai, 2017).

[8] Companies from Deloitte and Forbes lists are from the consumer goods and foodservice sectors, which are most likely to use palm oil.

4.2.1.2 SSPs information from disclosures

We tabulated data related to the companies' palm oil sourcing practices from their most recent online information (as of January 2018) using content analysis (Berg & Lune, 2012; Hsieh & Shannon, 2005). We first referred to the literature, NGO reports, and five leading companies' disclosures to identify a range of sustainable sourcing practices (CERES, 2017b; Thorlakson et al., 2018a; Zoological Society London, 2017b), and it was revised after reading sixty other companies' disclosures. Companies were assigned binary scores (1/0) for each disclosed SSP (First row in Table 4.2). For example, if a company stated that they have a supplier code of conduct, this would be a score of 1. Information was drawn from 915 documents, including firms' websites, annual reports, and sustainability reports. A majority (96.6%) of the materials were published between 2015 and 2018. At least two coders read each document. Independent coding of documents resulted in 85% agreement and the coders discussed to reach 100% agreement.

Out of the 275 companies, 171 used at least one SSP. Among the other companies, 73 did not have any online information regarding palm oil sourcing, and 13 did not have English information. Six excluded or were working on excluding palm oil from their products, and two stated being RSPO members without mentioning any other practices. Two companies stated that they sourced from RSPO members (but this claim does not imply that they source RSPO certified palm oil). Eight companies made commitments to palm oil sustainability without stating their SSPs. Since this study seeks to understand the kind of SSPs companies uses, the remaining analysis focused on the 171 companies with at least one SSP.

Table 4.2. Data sources and description

Information	Source	Description
Sustainable sourcing practices	Company disclosures	The binary score for each disclosed SSP is 1, 0 otherwise.
Supply chain stage	Company disclosures	Company is PT (1/0), manufacturer (1/0), or retailer (1/0)
Firm size[a]	Company disclosures	Logarithm of the number of employees
Public	Bloomberg.com	Equals 1 if the company is listed as public by Bloomberg.com, 0 otherwise.
High brand value	Reputation institute top 100 and Interbrand top 50 lists of companies (Interbrand, 2017; Reputation Institute, 2018)	Equals 1 if the company is listed with high brand value, 0 otherwise.
Media attention	Dow Jones Factiva Global News Monitoring from 2013 to 2017 (Dow Jones, 2021)	Percentage of articles in major and regional papers, and industry news published in the headquarter country including the keyword “palm oil” that also included "orangutan," "illegal," "logging," "sustainable," "sustainability," "deforestation," "rainforest," "RSPO" or "biodiversity" from 2013 to 2017.

[a]D&B Hoovers was used as an alternative source when data is missing in company disclosures

4.2.1.3 Company characteristics

Other company characteristics related to the intensity of external stakeholder pressures (Section 4.1.1.3) were retrieved from company reports and other data sources as described in Table 4.2. The sample included PTs, manufacturers, and retailers with various firm characteristics (Table 4.3). Retailers were significantly larger in the number of employees than PTs and manufacturers (p-value < 0.01).[9] One-way ANOVA shows that public and highly

[9] Retailers, including grocery stores and foodservice companies, rank among the top ten employers globally (CNN Money, 2012; Fortune, 2020). More discussions on company characteristics are included in Appendix C.2.

branded companies have significantly more employees (p-values = 0.09 and < 0.01 respectively). Even though the Reputation Institute and Interbrand included firms from at least 20 industries in their assessment, none of the PTs were listed as highly-branded.

Table 4.3. Summary statistics

	All	PT	Manufacturer	Retailer
Count	171	50	76	45
Firm size, number of employees	$78 \pm 15 \times 10^3$	$32 \pm 6 \times 10^3$	$32 \pm 6 \times 10^3$	$205 \pm 53 \times 10^3$
Public	104	31	44	29
High brand value	20	0	16	4
Media attention of headquarter country	0.27	0.22 ± 0.01	0.28 ± 0.01	0.29 ± 0.01

4.2.2 Sustainable Sourcing Practices in the Palm Oil Industry

We found that four hands-off and five hands-on practices were common in palm oil supply chains. They were classified based on whether the practices enable the buyers to be more involved in their upstream suppliers' process to become sustainable, as described in the disclosures and the literature (CERES, 2017a; CGF, 2015; De Marchi et al., 2013; Gardner et al., 2019; Gibbon et al., 2008; Jeppesen & Hansen, 2004; Melot & Delabre, 2017; Ponte & Gibbon, 2005; Rueda et al., 2017; Villena, 2019) and in alignment with our definition. Details of the practices are discussed in Table 4.4.

Table 4.4. Descriptions of sustainable sourcing practices and examples of exemplary company adoption

Practice	Definition
Hands-off	
1. External certification	Buy or produce externally certified products.
2. Supplier code of conduct	A document stating buyers' expectations of suppliers' environmental and social performance.
3. Approval process	Assess suppliers for meeting sustainability criteria through reporting or auditing.
4. Contractual requirement	Suspend or exclude suppliers found to not meet sustainability criteria either through NGO and journalist reports or audit results.
Hands-on	
5. Supplier training	Train suppliers to understand and adhere to internal standards.
6. Preferred supplier	Prioritize engagements with suppliers that meet or surpass criteria through incentives such as stable and larger contracts and better prices and payment terms.
7. Supply chain tracing	Report locations of traceable mills, estates, and farms.
8. Grievance mechanism	Provide a platform for stakeholders to file grievances related to activities in the firms' supply chain. Examine the issue and answer the stakeholder who reported grievance.
9. Farmers livelihood improvement	Supporting smallholders in improving their livelihood, e.g., knowledge transfer on increasing farming productivity and sustainability and access to financing and markets.

The hands-off practices are (1) using external certification standards, (2) using a supplier code of conduct, (3) assessing suppliers for meeting expected sustainability-related criteria, and (4) subjecting suppliers to contract termination if they were found inadequate of the criteria. Although data for all kinds of external certifications mentioned (e.g., Malaysian Sustainable Palm Oil and Indonesian Sustainable Palm Oil) were collected, only RSPO certification was adopted by manufacturers and retailers,[10] and only RSPO certification was considered under the

[10] Of the 50 PTs, 32% and 60% disclosed supplying MSPO and ISPO certified palm oil, respectively, and 16% of them disclosed supplying both.

category of Practice (1) in this analysis.[11] While firms applied the terms in practices (2), (3), and (4) to their direct suppliers, some firms would further encourage their direct suppliers to apply the same practices to their upstream suppliers. A firm could pay for auditing its suppliers in Practice (3), but this is the extent of the firm's involvement.

The hands-on practices are (5) supplier training, (6) preferential sourcing, (7) supply chain tracing, (8) grievance mechanism, and (9) various means for farmer livelihood improvement. Practices (5) and (6) were considered relevant to supply chain sustainability even if they applied only to the direct suppliers. Practices (7), (8), and (9) were considered relevant only if they were applied up to or at mill and farm levels, even if the mills and farms are two or more stages upstream.

4.2.3 Hypothesis Tests and Regression Models

We tested the hypotheses using two methods. The first method is a straightforward comparison of the means of the three supply chain stages using one-way analysis of variance (ANOVA). The second approach is with regression models that include control variables. Over-dispersed binomial regression models with a logit link and stated upper bounds (McCullagh & Nelder, 1989; Wand et al., 2001) were used to estimate the expected number of hands-off and hands-on practices. Fractional regression (Papke & Woolridge, 1996) was used to estimate the fraction of hands-on practices out of all practices.

[11] All kinds of RSPO certifications (Book and Claim, Mass Balanced, Segregated, Identity Preserved, and not specified) were considered for all kinds of palm products (palm oil, palm kernel oil, and other palm derivatives) (Leegwater & van Duijn, 2012) in this category. Out of 119 companies disclosing to use RSPO certified palm oil, 32 companies reported using Book and Claim certificates, and 64 companies reported selling or using physical certified palm oil. Forty-six companies did not specify the supply chain model of their palm oil certification.

We specified the regression models as

$$y_i = \beta_j x_{ij} + \boldsymbol{\gamma z_i}$$

where y_i is a latent dependent variable that links the linear model to the observed dependent variables.[12] The subscript *i* index companies. The supply chain stages are represented with binary variables $x_{i,j}$ where *j* indicates PT, manufacturer, or retailer. The term $\boldsymbol{z_i}$ is a vector of control variables, which are other company characteristics commonly found to influence company sustainability practices, as discussed in sections 4.1.1.3 and 4.2.1.3 and Table 4.2. Firm size was measured by the logarithm of the number of employees in thousands.[13] To examine the effect of the correlation between firm size and other control variables (Section 4.2.1.3) on the regression results, regression analyses including and excluding firm size was performed. As none of the PTs were highly-branded, the high brand value dummy variable was multiplied to the retailer and manufacturer binary variables to test for interactions. The coefficients $\beta_j, \boldsymbol{\gamma}$ were estimated.

Hypotheses 1 to 3 were tested using likelihood ratio tests of nested models with the null hypotheses that the coefficients for the supply chain stages are equal. The alternative hypothesis for Hypothesis 1 is two-sided: that the coefficients are not equal. Hypotheses 2 and 3 are one-sided: The coefficients of PTs are larger than those of manufacturers, and the coefficients of PTs and manufacturers are larger than those of retailers. The models were estimated in STATA 16.1

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[12] In the binomial regression models for hypotheses 1 and 2, y_i is an input to a logit link which describes the probability of having one practice as $\pi_i = g^{-1}(y_i) = \frac{e^{y_i}}{1+e^{y_i}}$. The probability for the number of practices adopted follows a binomial distribution with $\binom{N}{n_i} \pi_i^{n_i} (1-\pi_i)^{N-n_i}$, where N is the maximum number of practices that firms can adopt. In the fractional regression model for hypothesis 3, y_i links to the fraction defined by the logit expression $g^{-1}(y_i)$.

[13] Log number of employees has a more statistically significant relationship with the dependent variables than without log.

(StataCorp, 2019) with maximum likelihood estimates. Standard errors, average marginal effects, and 95% confidence intervals were estimated using bootstrap samples (n = 1000).

4.3 Results

This section presents the statistics of SSP adoption and the hypothesis test results. Figure 4.2 shows the fraction of firms using each practice by supply chain stage.[14] The fraction of firms using each hands-on practice decreases from PTs to manufacturers and from manufacturers to retailers, while the fraction of firms using hands-off practices does not vary as much by supply chain stages. Using RSPO certification is the most common practice (80.7%), followed by supplier code of conduct (63.0%), and giving sustainable suppliers preferential treatment is the least common (7.0%).

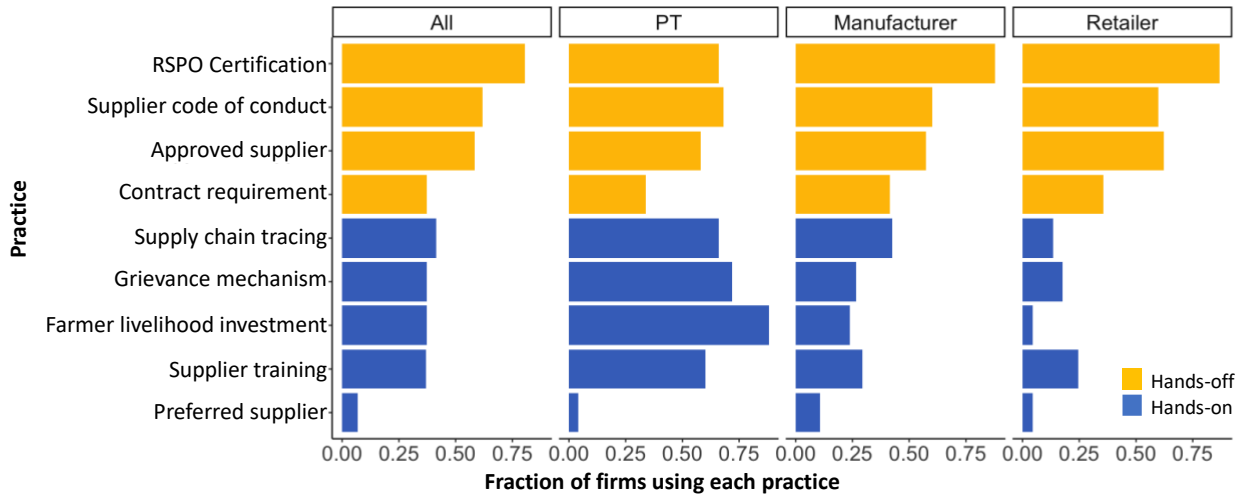

Figure 4.2. Adoption of each sustainable sourcing practice by supply chain stage

Table 4.5 summarizes the number of practices by the supply chain stage. Companies used 2.4 ± 0.1 hands-off practices across all stages, and the average number did not vary significantly

[14] Processors and traders' and Manufacturers' SSPs were for the palm oil in their products, and retailers' SSPs were for their house brand products.

by stage (ANOVA test, p-value = 0.69). On the other hand, both the average number of hands-on practices and the fraction of hands-on practices were significantly different by stages and decreased from PTs to manufacturers and then to retailers (ANOVA test, p-values < 0.01 for the six pairs of comparisons). The tests support the afore-stated hypotheses that the number and fraction of hands-on practices decrease downstream and the number of hands-off practices is independent of supply chain stages.

Table 4.5. Summary statistics of practices

	Average number of practices (Standard deviation)			Fraction of hands-on practices over total number of practices (Standard deviation)	% firms using ≥ 1 of the following kind of practices	
	Total	Hands-off	Hands-on		Hands-off	Hands-on
All	4.0 (0.2)	2.4 (0.1)	1.6 (0.1)	0.32 (0.02)		
PT	5.1 (0.3)	2.3 (0.2)	2.8 (0.2)	0.57 (0.03)	90%	98%
Manufacturer	3.8 (0.3)	2.5 (0.1)	1.3 (0.2)	0.25 (0.03)	97%	61%
Retailer	3.1 (0.2)	2.4 (0.2)	0.6 (0.1)	0.17 (0.03)	98%	49%

Table 4.6 shows the regression results. In Model 1, the coefficients of PT and manufacturer are not significantly different at the 95% confidence level from the zero-coefficient set for retailers. Model 1 supports Hypothesis 1, which states that the number of hands-off practices does not vary by supply chain stage. In Model 2, the PT and manufacturer coefficients are significantly different from that of the retailer, which is set at zero. The average marginal effects indicate that all else being equal, PTs and manufacturers used 2.60 ± 0.28 and 0.73 ± 0.27 more hands-on practices than retailers. The number of hands-on practices of PTs is significantly

larger than manufacturers (p-value < 0.01).[15] The results support Hypothesis 2, which states that the number of hands-on practices would decrease from PT to manufacturer and from the manufacturer to the retailer. Finally, Model 3 shows that the average fraction of hands-on practices that PTs used is 0.45 ± 0.05 larger than retailers. The average fraction of hands-on practices of manufacturers is not significantly different from that of retailers. The confidence interval of their average difference spans from -0.06 to 0.17.[16] This result does not necessarily mean that retailers were equally hands-on as manufacturers because manufacturers used more hands-on practices than retailers in absolute count in Hypothesis 2 and Model 2. Although the results do not support Hypothesis 3, which stated that the fraction of hands-on practices decreases from PTs to manufacturers and from manufacturers to retailers, the results show that PTs are proportionally more hands-on than downstream companies.

The control variables' marginal effects imply that a 10% increase in average firm size and media attention on palm oil sustainability issues in firm headquarter countries are related to 0.02 and 0.26 additional hands-off practices, 0.02 and 0.28 additional hands-on practices. The coefficients for being public- and privately-owned and high brand value in models 1 and 2 are not significant, suggesting that these company characteristics are not related to the number of both types of practices. However, these coefficients are significant when the firm size variable was excluded from the models.[17] It is likely that high brand value and public ownership are

[15] Likelihood ratio tests with all other possible nested models where the coefficients for some or all stages were specified to be equivalent showed that the coefficients were significantly different with p-values < 0.01.

[16] The manufacturer and retailer coefficients' similarity is confirmed with a likelihood ratio test comparing Model 3 with a separate (nested) model, where the manufacturer coefficient is fixed at 0 (p-value = 0.28).

[17] See Appendix Table C. 2 for more results.

positively related to the number of practices, but their correlations with firm size (Section 4.2.1.3) resulted in high standard errors and low statistical significances in their estimated coefficients. Lastly, the estimated coefficients for high brand value variables in models 2 and 3 suggest that high brand value manufacturers had a significantly larger number and fraction of hands-on practices.

In review, hypotheses 1 and 2 are supported by the data and regression results. The results of the three hypothesis tests remained consistent when various combinations of interaction terms were included and when probit link was used instead of logit link.

Table 4.6. Model estimates

Variable[a]	Model 1 Number of hands-off practices			Model 2 Number of hands-on practices			Model 3 Fraction of hands-on practices		
	Coefficient (Std-error)	Average marginal effect (Std-error)	95% Confidence interval	Coefficient (Std-error)	Average marginal effect (Std-error)	95% Confidence interval	Coefficient (Std-error)	Average marginal effect (Std-error)	95% Confidence interval
Constant	-3.22 (0.81)**			-5.26 (1.36)**			-2.29 (0.96)*		
PT	0.43 (0.29)	0.43 (0.42)	[-0.39, 1.25]	2.94 (0.48)**	2.60 (0.28)	[2.04, 3.16]	2.07 (0.35)**	0.45 (0.05)	[0.31, 0.54]
Manufacturer	0.50 (0.28)	0.59 (0.40)	[-0.19, 1 .38]	1.18 (0.52)*	0.73 (0.27)	[0.20, 1.26]	0.32 (0.41)	0.06 (0.05)	[-0.06, 0.17]
Retailer	0			0			0		
Firm size (log employees in 1000s)	0.24 (0.07)**	0.23 (0.06)	[0.12, 0.35]	0.18 (0.09)*	0.18 (0.08)	[0.02, 0.34]	0.02 (0.07)	0.00 (0.01)	[-0.02, 0.03]
Publicly owned	0.30 (0.21)	0.29 (0.20)	[-0.10, 0.69]	0.39 (0.22)	0.37 (0.20)	[-0.02, 0.76]	0.18 (0.21)	0.04 (0.04)	[-0.05, 0.12]
Media attention (%)	2.68 (1.18)*	2.56 (1.11)	[0.40, 4.73]	2.75 (1.27)*	2.66 (1.19)	[0.31, 5.00]	1.18 (1.06)	0.25 (0.21)	[-0.17, 0.67]
High brand value * Manufacturer	0.85 (0.83)	0.64 (0.33)	[0.00, 1.28]	1.19 (0.35)**	1.22 (0.37)	[0.49, 1.94]	1.05 (0.28)**	0.22 (0.06)	[0.11, 0.33]
High brand value * Retailer	-0.10 (2.80)	-0.09 (2.39)	[-4.78, 4.60]	1.17 (2.28)	0.68 (2.17)	[-3.58, 4.94]	0.75 (2.73)	0.12 (0.32)	[-0.50, 0.74]

***: p-value < 0.01, *: p-value < 0.05. [a]Variables are binary unless otherwise stated.*

4.4 Discussion

We conducted a large-scale analysis across actors in the palm oil supply chain to understand how companies in three different supply chain stages use a combination of hands-off and hands-on sustainable sourcing practices (SSPs) to manage their suppliers' activities. We distinguished *hands-off* and *-on* practices based on the extent that the practices enable buyers to be involved in improving the social and environmental management of their suppliers' activities. We found that companies, regardless of their stages, use on average two hands-off practices. The most common hands-off practices were RSPO certified palm products and supplier code of conduct. The number of hands-on practices and the proportion of hands-on practices decrease from processors and traders (PTs) to manufacturers and retailers. The most common hands-on practices for PTs were farmers livelihood investment, grievance mechanism, and supply chain tracing; for manufacturers, the most common practice was supply chain tracing; and for retailers, the most common practice was supplier training.

These observed relationships between firms' hands-off and -on practices and their supply chain stages are congruent with the hypotheses based on stakeholder theory (ST), transaction cost economics (TCE), and resource-based view (RBV) considering the context of the palm oil industry. The results suggest that PTs were the most hands-on because they are the most upstream amongst the three stages. PTs have the most appropriate resources (RBV) to engage on the ground, lowest costs to measure and guide suppliers' sustainability performances (TCE), and high stakeholder expectations to implement hands-on practices at plantations and mills level compared to their downstream counterparts (ST).

Even though retailers are consumer-facing and may gain positive differentiation for having sustainable palm oil in their goods, they use fewer hands-on practices. Based on the

literature review, retailers did not observe much collective pressure from NGOs (ST). They also do not have the necessary resources, information, and skills to incorporate hands-on practices for agri-food commodities (RBV) (Lyons-White & Knight, 2018). The costs for them to closely collaborate with and monitor their upstream suppliers linked to palm oil and derivatives in their products can be too high because of the nature of the palm oil supply chain (TCE). Conversely, hands-off practices can be cheaper to scale and do not require retailers to have as many resources (as hands-on practices) to manage their suppliers. Recent research in the chocolate and coffee industries found that certain upstream suppliers used more sustainability practices and policies than retailers and some manufacturers (Bager & Lambin, 2020; Thorlakson, 2018). This study made similar observations in the palm oil industry, and it further distinguished that hands-on sustainable sourcing practices are more likely to depend on supply chain stages than hands-off practices.

Manufacturers' practices were intermediary to the PTs and the retailers—more hands-on than retailers and less hands-on than PTs—except for high-brand value manufacturers being disproportionately more hands-on. Highly branded firms could be more hands-on than other manufacturers because they face more pressure from NGOs and other stakeholders and because they have more influence over their upstream suppliers' activities through their large stable contracts and collaborations (Jeppesen & Hansen, 2004; Mayer & Gereffi, 2010; Ponte & Gibbon, 2005).

While previous papers stated that consumer-facing companies are more likely to incorporate supply chain sustainability practices (Bager & Lambin, 2020; Thorlakson et al., 2018b), this study found that one definition of consumer-facing—high brand value—is related to firms using many SSPs while the other definition—serving end-consumers—does not. This

result may be a characteristic of the product because palm is usually a minor ingredient in consumer products (Leegwater & van Duijn, 2012; Lyons-White & Knight, 2018). Larger firm size, being publicly-owned, and facing markets with greater media attention to palm oil sustainability issues, are positively related to SSP implementations. This finding agrees with earlier findings (Bager & Lambin, 2020; Thorlakson et al., 2018b). We also found that these factors may not be related to companies using a higher proportion of hands-on practices, suggesting that the drivers and barriers for being proportionally more hands-on may not depend on stakeholder pressure effects related to these variables.

This study answers the calls for large-scale and empirical applications of ST, TCE, and RBV in sustainable supply chain management (Jeppesen & Hansen, 2004; Pagell et al., 2010). This study shows that these theories not only can explain the sustainable sourcing strategies of a handful of exemplary companies (Jeppesen & Hansen, 2004; Pagell et al., 2010; Pagell & Wu, 2009a; Thorlakson, 2018) but also over hundreds of companies across different supply chain stages in one industry.

4.4.1 Practical Implications

Existing literature discusses the sustainability and financial impact of hands-off and hands-on SSPs (See Section 4.1.1.2). This chapter presented how companies' use of the two types of SSPs depends on their supply chain stages. The findings broaden the perspective of the practices' limitations and potential. Although hands-on approaches can address the shortcomings of hands-off practices (Poynton, 2015; Thorlakson, 2018), our findings suggest that hands-on practices may be less accessible to most manufacturers and retailers than to PTs and highly branded manufacturers. It may not be realistic for many downstream companies to adopt some of

the hands-on practices (e.g., tracing to mills and farms) due to the costs and resources required to overcome supply chain complexity.

The finding that companies in the palm oil industry, regardless of their supply chain stage, use on average two hands-off practices, suggests that hands-off practices may be easier for most companies to implement. This study provides evidence to further underline the importance of hands-off practices in terms of their wider spread of adoption. The observation that some PTs have SSPs could be the outcome of downstream companies communicating their expectations for sustainably produced palm oil to their suppliers.

The PTs' position at the "bottleneck" in the palm oil supply chain implies that they play an important role in translating downstream companies' stated expectations into a reality. We infer that PTs may lack hands-on support from their customers based on the understanding that hands-on practices are more effective than hands-off practices (Section 4.1.1.2) and our finding that most manufacturers and retailers mainly use hands-off practices. We suggest that organizations interested in addressing sustainability at the industry level consider building more support and incentives for PTs and other upstream suppliers. Horizontal collaborations between companies in the same supply chain stages and standardizing hands-on (i.e., supportive and proactive) practices with technological innovations would allow more downstream companies support their upstream suppliers become sustainable. An example is Consumer Goods Forum members conducting joint assessments and data collection from their PTs (Bregman et al., 2016).

4.5 Chapter Conclusion

This chapter contributes a large-scale analysis of sustainable sourcing practices in a wide range of companies from multiple stages in the palm oil industry. Specifically, this chapter describes the extent to which companies are hands-on with their suppliers' sustainability

management and how their approaches depend on their supply chain stage in the palm oil industry. It also demonstrates the applicability of stakeholder theory, transaction cost economics, and resource-based views in sustainable supply chain management.

Even though the study identified a set of companies in the palm oil supply chain which claim to have sustainable sourcing practices, the palm oil industry overall remains entangled in labor exploitations and deforestation issues (Carlson et al., 2017; Mason & McDowell, 2020a, 2020b; Smith, 2020). PTs play a critical role in addressing sustainability issues within their supply chains using hands-on practices; however, they may lack necessary incentives and support. Hands-off practices, such as certification, that are more commonly adopted regardless of firms' supply chain stages may be leveraged to support the PTs and further upstream suppliers.

Chapter 5

Conclusion

5.1 Contributions: Potential and Limitations of Sustainable Sourcing Practices

In response to myriad sources of pressure to increase sustainability, companies commit to goals and implement practices to address social and environmental issues in their supply chains. However, perfect solutions for addressing the issues remain elusive (Gardner et al., 2019; Lambin et al., 2020). This dissertation seeks to understand some of the opportunities and limitations of sustainable sourcing practices in agri-food supply chains in terms of generating consumer demand and of firms' adoption of sustainable practices. The primary objective of this dissertation has been to uncover new insights through underexplored large-scale data analysis to inform both companies and stakeholders about consumer demand for certified products and corporate adoption of sustainable sourcing practices (SSPs).

Chapters 2 and 3 presented two studies on consumer demand for certified coffees with Fair Trade and organic labels. The study in Chapter 2 tested consumer preference between personal health benefits from consuming organic products vs. public altruism from buying Fair Trade products. In aggregate, consumers showed an equal preference for single-label Fair Trade and organic coffee. A possible reason is that consumers do not pay attention to or care about the specific sustainability impacts of the products they buy while shopping at grocery stores.

However, it was also demonstrated in Chapter 2 that most consumers preferred products that were both Fair Trade and organic to products that were either only Fair Trade or only organic. Therefore, while consumers may not pay attention to a single *specific* label, they do prefer products with *both* labels. The finding that dual-label Fair Trade and organic products are more likely to attract consumers than single-label Fair Trade or organic products is consistent with existing survey-based choice experiments. Therefore, current research findings encourage companies that are choosing between the labels to invest in both Fair Trade and organic labels instead of just one.

Chapter 3 presented the findings that Fair Trade and organic coffees, including single- and dual-label options, were not competitive against conventional coffee even when they were provided at premium or at regular prices that matched conventional coffee prices. Regular and premium conventional coffees constituted a stiffer competition to each other than the competition from Fair Trade and organic coffees. Modeling results also suggest that Fair Trade and organic coffees have lower market shares than conventional coffee partly because of their limited shelf presence (in the number of unique products offered). Under the existing market conditions, conventional product manufacturers would more effectively gain or maintain market share by investing in conventional products' existing strengths rather than Fair Trade and organic certifications.

Chapter 4 analyzed the relationship between firms' mixes of SSPs (including certification) and their supply chain stage in the palm oil industry. Among companies with SSPs, processors and traders (PTs) and highly-branded manufacturers use more hands-on practices than do downstream actors and common manufacturers; hands-on practices may be too resource-demanding and expensive for many manufacturers and retailers to implement. The strength of

hands-off practices is their ease of adoption. Most companies use a few hands-off practices, with supplier code of conduct and the Roundtable of Sustainable Palm Oil (RSPO) certification being the most popular choices. It could be interpreted that hands-off practices used by manufacturers and retailers have effectively pressured PTs to address palm oil production issues. However, downstream companies using mainly hands-off practices means that PTs may need customers' backing in their endeavors. The next step in addressing sustainability issues in the palm oil industry can be facilitated by supporting PTs through horizontal and vertical collaborations between firms and standardizing hands-on practices.

5.2 Research Limitations

The key challenge with using observation data in Chapters 2 and 3 is that like many other econometric studies, it was not possible to isolate specific brand and product attributes' (e.g., brand familiarity and Fair Trade and organic certifications) impacts on consumer preference (Bezawada & Pauwels, 2013; Glaser & Thompson, 2000; Kiesel & Villas-Boas, 2007). The study assumed that the effects of omitted factors were reduced by taking the average of many products and brands in each category. The results had to be interpreted based on the market conditions for coffee consumer packaged goods in US grocery stores between 2014 and 2016. It remains to be tested whether the results would hold if omitted factors, such as brand familiarity, were controlled.

The limitations in the study presented in Chapter 4 are related to the dataset used. First, a drawback of using company-disclosed data is that its quality depends on the amount of effort those companies put into reporting, the accuracy of their reports, and the language of the content. Nevertheless, company disclosures are the only primary data that document sustainable sourcing practices at scale and that have been applied in prior large-scale studies (Akhavan & Beckmann,

2016; Bager & Lambin, 2020; Thorlakson et al., 2018). Second, many companies and consumers do not demand sustainable palm oil (Lyons-White & Knight, 2018). By focusing on sampling companies with sustainable practices, this study is not representative of the entire palm oil industry. The sampling approach of this study is suitable for understanding the type and multiplicity of SSPs that companies use. Besides palm oil and palm derivatives, future studies can explore companies' SSPs for other commodities. Lastly, this is a cross-sectional analysis, and the observed relationships are correlational rather than causal.

5.3 Future Directions

The novel contributions in Chapters 2 and 3 are the insights into consumers' preferences for Fair Trade and organic products through their actual purchasing habits. Analyzing observational data from retailers and consumers provides a more realistic evaluation of consumers' behavior when opportunities to conduct field experiments are rare.

The method used in these chapters could be transferred if more certified product options become available in the future. Future research could seek to better understand consumer demand for:

i. other certification labels or other sustainability practices, such as using post-consumer recycled packaging for the coffee (Boz et al., 2020),
ii. other types of certified products besides coffee,
iii. certified products in retail stores (e.g., natural foods stores) and channels (e.g., e-commerce) that conventional brands and companies do not yet dominate, and
iv. products with other labels in addition to Fair Trade and organic.

The results from Chapters 2 and 3 also suggest that it might make sense for manufacturers and retailers to increase their assortment of certified products. The model

estimation results showed that product categories with smaller assortment sizes can gain a larger percentage growth in demand than product categories with larger assortment sizes. Given the small assortment size of the certified categories, increasing their assortment size could positively impact consumers' preference more than increasing the conventional category's assortment size. While Bezawada & Pauwel (2013) found this to be true for products with organic certifications, our analysis shows that it could also apply for products with Fair Trade certifications. Future research could develop a method for selecting assortment sizes of Fair Trade and organic products for optimal profit.

Chapter 4 described companies' use of SSPs in the palm oil industry with data collected at one point in time and explained the variations in SSP usage with supply chain management theories. Future work can directly apply the research design in Chapter 4 to other industries. The new industry can be studied alone or compared to the palm oil industry. Another idea is to collect data over multiple periods of time and analyze changes in companies' SSPs over time. Such temporal analysis can examine causal relationships, such as to identify factors that influence the practices.

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A. Chapter 2 Appendix

A.1 Sample characteristics

Table A. 1. Characteristics of consumers in the original dataset (at stores with all four coffee categories) that were excluded versus included in the analysis

	Households included in analysis	**Households excluded**
Number	357	2971
Age	55.3 (0.6)	55.4 (0.2)
Household size	2.49 (0.06)	2.44 (0.02)
Household income (1,000)	75.7 (2.0)	77.2 (0.7)
Income per member	35.0 (1.0)	36.5 (0.4)
Years of education	15.09 (0.09)	14.90 (0.03)

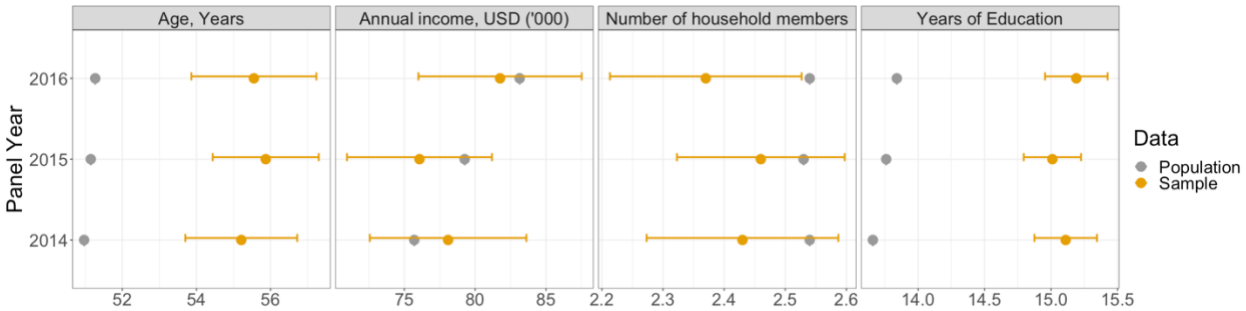

Figure A. 1. Consumer characteristics in the sample versus in population. Population data is retrieved from (Census, 2016).

A.2 Other estimation results

The models in Table A. 2 are estimated in the preference space. Consumer *n* obtains utility u_{int} for choosing category *i* at instance *t*. μ_n assumed to be 1 for estimation purposes (Ben-Akiva & Lerman, 1985). Likelihood ratio tests were used when the models are nested. When comparing two non-nested models, the Cox test is applied when the composite model can be estimated. Otherwise, this study used a test described on page 172 in Ben-Akiva et al. (1985)

and in the next paragraph. All models are run twice with different priors to check for convergence.

Model E, the second-best fit model Table A. 2, was selected because it is easier to interpret the results. It can also be transformed into WTP space specification that improves results interpretation. Although the values are slightly different, the conclusions from comparing the values are the same in models E and F. shows the price elasticity and substitution results from Model F.

Table A. 2. Description and goodness-of-fit measures of other models fitted.

Model	Interpretation of individual consumer behaviors	Description	Convergence	Number of variables	Loglik	Adjusted McFadden $\bar{\rho}^2$	Relevant statistical tests
A	Simplest model where consumers obtain the same utility for each category.	$u_{int} = \alpha_i + \varepsilon_{int}$	Not applicable (used MLE)	3	-4099	0	
B	All consumers share the same preference for prices, assortment sizes, and the same taste for the categories when all else are held equal.	Includes constants, price, and assortment. All parameters are fixed over all consumers. $u_{int} = -\tau p_{int} + \alpha_i + \phi\, ln\, s_{int} + \varepsilon_{int}$	Not applicable (used MLE)	5	-3051	.26	
C	Consumers taste for the categories is a function of their demographic characteristics.	Adds demographic characteristics, age, years of education, and household income per member to Model B.	Not applicable (used MLE)	14	-2939	.28	
D	Consumers perceive coffee prices differently. A cent increase in price have different marginal effect on each consumer.	Starting with Model B, the price coefficient is changed to individual specific. $u_{int} = -\tau_n p_{int} + \alpha_i + \phi\, ln\, s_{int} + \varepsilon_{int}$	Yes	6	-2064	.50	
E	Consumers value aspects of the categories, besides price and assortment size, differently.	Starting from Model D, the constant is changed to individual specific. $u_{int} = -\tau_n p_{int} + \alpha_{in} + \phi\, ln\, s_{int} + \varepsilon_{int}$	Yes	15	-903	.78	
F	Consumers perceive prices of the categories differently. A cent increase in price in each category have different marginal effect on each consumer.	Starting from Model D, price coefficient is changed to be specific to each category too. $u_{int} = -\tau_{in} p_{int} + \alpha_i + \phi\, ln\, s_{int} + \varepsilon_{int}$	Yes	18	-829	.80	
G	Consumers perceive prices of all certified coffee similarly and different from the conventional category.	To simplify Model F, individual-specific price coefficients are restricted to be equal between Fair Trade, organic, and FTO categories.	Yes	9	-1505	.63	
H	Consumers have different preferences for prices and other aspects of each category.	A composite of Model E and F, with individual-specific preferences for the categories all else equal and for the category prices. $u_{int} = -\tau_{in} p_{int} + \alpha_{in} + \phi\, ln\, s_{int} + \varepsilon_{int}$	No	36			
I		To simplify Model H, individual-specific price coefficients are restricted to be equal between Fair Trade, organic, and DLFTO categories.	No	23			

MLE: Maximum Likelihood Estimation

Table A. 3. Own -price elasticities and percentage cross-price effects

	Category *j*			
	Percentage cross-price effect			
Category *i*	Fair Trade	Organic	Dual-label Fair Trade & Organic	Conventional
Fair Trade	-2.968	0.022	0.298	2.648
	(0.232)	(0.005)	(0.038)	(0.223)
Organic	0.021	-1.178	0.31	0.847
	(0.005)	(0.095)	(0.054)	(0.073)
Dual-label Fair Trade & Organic	0.052	0.077	-1.167	1.039
	(0.007)	(0.016)	(0.061)	(0.058)
Conventional	0.109	0.044	0.248	-0.401
	(0.009)	(0.004)	(0.012)	(0.016)

Standard errors are in parenthesis.

A.3 Convergence diagnostics

The Markov chains for estimating the model were tested for convergence using Heidelberg-Welch, and Gelman and Rubin's convergence diagnostics. To pass for convergence, the p-value from Heidelberg-Welch diagnostic should be larger than 0.05, and the upper limit of potential scale reduction factors from Gelman and Rubin's diagnostics must be close to 1. Both these criteria were met, as shown in the following table.

Table A. 4. Convergence diagnostics

	Heidelberg-Welch p-value	Gelman and Rubin's upper confidence limit
$w_{FT,n}$	.32	1.02
$w_{ORG,n}$	.07	1.03
$w_{DLFTO,n}$	.08	1.02
ln(price coefficient), ln(τ_n) ($/10 cups)	.30	1.01
ln(Assortment size) coefficient, λ_n	.11	1.00

A.4 Counterfactual analysis

Table A. 5 shows the result of the counterfactual analysis where all categories are at the same price and with the same assortment size across all observations. Price = 0.30 $/cup and assortment size = 3.

Table A. 5. Own -price elasticities and percentage cross-price effects when all categories are specified to be $0.30/cup and assortment size = 3

		Category *j*			
		Percentage cross-price effect			
Category *i*	Market share	FT	ORG	DLFTO	CONV
FT	18.9 %	-3.474	0.094	2.590	0.791
		(0.084)	(0.003)	(0.073)	(0.027)
ORG	14.8 %	0.121	-1.464	0.971	0.371
		(0.005)	(0.06)	(0.048)	(0.022)
DLFTO	59.0 %	0.836	0.243	-1.405	0.326
		(0.021)	(0.011)	(0.028)	(0.009)
CONV	7.4 %	2.04	0.742	2.608	-5.39
		(0.062)	(0.039)	(0.056)	(0.083)

Standard errors are in parenthesis.

A.5 Robustness analysis

We included observations where the prices of each pair of product categories {Fair Trade, organic} or {DLFTO, organic} were within ± 8% of their average price (within each observation). The observed prices of the categories are not significantly different at the 95% confidence level. Since there are few observations, the utility function specification was simplified to $u_{int} = -\tau p_{int} + \alpha_i + \phi\, ln\, s_{int} + \varepsilon_{int}$ where the constants and coefficients were fixed. In this case, category-specific WTP, w_i were calculated as a ratio of the alternative-specific constants and the price coefficient, α_i/τ. The simplified model was estimated using `mlogit` in R statistical software (Croissant, 2019). The results of the main analysis and the robustness

analysis are summarized in Table A. 6. Case A includes all observations and Case B includes organic enthusiasts.

There were too little datapoints where prices and assortment size of the categories were similar for analysis. Only 346 and 237 where prices and assortment size of the categories are not significantly differently between {Fair Trade, organic}, or {DLFTO, organic} respectively, with as few as 5 or 3 observations selecting some categories.

Table A. 6. Summary of supported hypotheses

	Case A Observations with similar price	Case B Obs. with similar price and excluding organic enthusiasts
Fair Trade vs organic products		
No. of Obs.	1537	1368
Hypothesis 1a: The average WTP for Fair Trade and organic coffees are equal.	Not supported, Organic beats FT	Not supported, Fair Trade beats organic
Hypothesis 1b: Demands for Fair Trade and organic coffees are equally price sensitive.	Not supported, Organic beats FT	Supported
Hypothesis 1c: Fair Trade and organic coffees attract the same level of substituting demand from		
iii) DLFTO coffee	Not supported, Organic beats FT	Supported
iv) conventional coffee	Not supported, Organic beats FT	Supported
Organic vs DLFTO		
No. of Obs.	1104	1167
Hypothesis 3a: The average WTP for the DLFTO category is greater than that for the organic coffee.	Supported	Supported
Hypothesis 3b: The demand for DLFTO coffee is less price sensitive than that for organic coffee.	Not supported, Organic as good as DLFTO	Supported
Hypothesis 3c: DLFTO coffee attracts more substituting demand from _____ than organic coffee**.**		
v) Fair Trade coffee	Not supported, Organic better substitute	Supported
vi) conventional coffee	Not supported, Organic better substitute	Supported

Hypothesis tests were evaluated at the 95% confidence level.

B. Chapter 3 Appendix

B.1 Convergence diagnostics

The Markov chains for estimating the model were tested for convergence using Heidelberg-Welch and Gelman and Rubin's convergence diagnostics. To pass for convergence, the p-value from Heidelberg-Welch diagnostic should be larger than 0.05, and the upper limit of potential scale reduction factors from Gelman and Rubin's diagnostics must be close to 1. Both these criteria were met, as shown in Table B. 1.

Table B. 1 Convergence diagnostics

	Heidelberg-Welch p-value	Gelman and Rubin's upper confidence limit
Premium Conventional WTP$_n$	.09	1.01
Premium FTO, WTP$_n$	.15	1.01
Regular FTO, WTP$_n$	.12	1.03
ln(price coefficient), ln(β_n) ($/10 cups)	.64	1.00
ln(Assortment size) coefficient, λ_n	.20	1.02

B.2 Other estimation results

Other model specifications where the categories had different price coefficients were considered. The model estimations either did not converge or did not fit as well as the model in Equation 1. Goodness-of-fit was assessed in terms of McFadden R^2 and loglikelihood ratio tests. Table B. 2 provides a summary of estimation results.

These models were estimated in the preference space. Consumer *n* obtains utility u_{int} for choosing category *i* at instance *t*, with μ_n assumed to be 1 for estimation purposes (Ben-Akiva & Lerman, 1985). We used likelihood ratio tests when the models were nested. When comparing two non-nested models, the Cox test was applied when the composite model could be estimated. Otherwise, the model with the larger adjusted McFadden $\bar{\rho}^2$ was chosen. Given that the models

were in the preference space, Model E's estimates converged and had the best fit. All models were run twice with different priors. Model E represents Equation 1. The estimation results discussed in the main text represents Equation 2, which is Model E converted to the WTP space specification. This was done for better interpretation and more tightly distributed WTP estimates.

Table B. 2 Description and goodness-of-fit measures of other models fitted.

Model	Interpretation of individual consumer behaviors	Description	Convergence	Number of variables	Loglik	Adjusted McFadden $\bar{\rho}^2$	Relevant statistical tests
A	Simplest model where consumers obtain the same utility for each category.	Includes only constants that are fixed over all consumers. $u_{int} = \alpha_i + \varepsilon_{int}$	Not Applicable (used MLE)	3	-13940	0	
B	All consumers share the same preference for price, assortment size, and the same taste for the categories when all else are held equal.	Includes constants, price, and assortment size. All parameters are fixed over all consumers. $u_{int} = -\tau p_{int} + \alpha_i + \phi\, ln\, s_{int} + \varepsilon_{int}$	Not Applicable (used MLE)	5	-10960	.21	
C	Consumers' taste for the categories is a function of their demographic characteristics.	Adds demographic characteristics, age, years of education, and household income per member to Model B.	Not Applicable (used MLE)	14	-10872	.22	Model C fits significantly better than Model B (p-value <.01).
D	Consumers perceive coffee prices differently. A dollar increase in price has a different marginal effect on each consumer.	Starting with Model B, the price coefficient is changed to individual specific. $u_{int} = -\tau_n p_{int} + \alpha_i + \phi\, ln\, s_{int} + \varepsilon_{int}$	Yes	6	-8357	.40	When compared to Model D, the chances that Model C is more correct is < .01.
E	Consumers value aspects of the categories, besides price and assortment size, differently.	Starting from Model D, the constant is changed to individual specific. $u_{int} = -\tau_n p_{int} + \alpha_{in} + \phi\, ln\, s_{int} + \varepsilon_{int}$	Yes	9	-2872	.79	
F	Consumers perceive prices of the categories differently. A cent increase in price in each category has a different marginal effect on each consumer.	Starting from Model D, price coefficient is changed to be specific to each category too. $u_{int} = -\tau_{in} p_{int} + \alpha_i + \phi\, ln\, s_{int} + \varepsilon_{int}$	No				
G	Consumers perceive prices of both Premium categories similarly and both Regular categories similarly, but more differently between Premium and Regular categories.	To simplify Model E, individual-specific price coefficients are restricted to be equal between both Premium categories and equal between both Regular categories. They remain different between the Premium and the Regular categories.	Yes	8	-5185	.63	
H	Consumers perceive prices of both FTO categories similarly and both Conventional categories similarly, but more differently between FTO and Conventional categories.	To simplify Model E, individual-specific price coefficients are restricted to be equal between both FTO categories and equal between both Conventional categories. They remain different between the FTO and the Conventional categories.	Yes	8	-4726	.66	Fits better than Model G but worse than Model E.

Model	Interpretation of individual consumer behaviors	Description	Convergence	Number of variables	Loglik	Adjusted McFadden $\bar{\rho}^2$	Relevant statistical tests
I	Consumers have different preferences for prices and other aspects of each category.	A composite of Model E and F, with individual-specific preferences for the categories all else equal and for the category prices. $u_{int} = -\tau_{in} p_{int} + \alpha_{in} + \phi \, ln \, s_{int} + \varepsilon_{int}$	No				
J		To simplify Model I, individual-specific price coefficients are restricted to be the same within FTO categories and Conventional categories, as in Model H.	No				
K		To further simplify Model J, the alternative-specific constants of the FTO categories were restricted to be equal.	Yes	9	-3301	.76	Fits worse than Model E.

MLE: Maximum Likelihood Estimation
FTO: Fair Trade and organic

B.3 Weighting

Table B. 3 shows the sample consumer characteristics before and after weighting using the given projection factors. The reweighted K-cup consumer characteristics indicate that single-cup brewers are equally prevalent across all age groups but are more popular with affluent consumers. This trend concurs with market research results (Mintel, 2016).

Table B. 3 Sample consumer characteristics before and after reweighting

	Sample	**Reweighted sample**	**Population**
Number of unique consumers	2938	2938	
Average consumer household income (Thousands)	82.1	9.0	83.1
	(45.3)	(5.9)	
Average consumer household size	2.5	2.7	2.54
	(1.2)	(1.4)	
Average income per household member (Thousands)	37.1	38.9	32.8
	(23.8)	(27.3)	
Average consumer age	56.0	52.8	51.3
	(13.9)	(14.8)	
Average years of education	14.7	14.4	13.8
	(2.1)	(2.2)	

C. Chapter 4 Appendix

C.1 Ways to classify SSPs

Table C. 1. Different ways to classify SSPs based on the nature of the buyer and supplier relationship

Paper	Terms and cut-off
Ponte and Gibbon (2010), De Marchi et al. (2014)	Hands on – mentoring. Close interaction with trust and long-term relationships with standard demand and technical support. Hands off – Internal and external standards (Ponte & Gibbon, 2005)
Formentini and Taticchi (2016)	Non-collaborative: Focal firm relies on contractual power to define governance parameters and impose decision on supply chain counterparts. Collaborative: Socializations to form bonds that facilitate the exchange of information and helps build a culture of mutual commitment
Gold et al., (2010)	Collaboration differs from other forms of interaction, such as monitoring, in the respect that it involves a pro-active stance toward other supply chain actors aiming for substantial engagement in two-way, inter-organizational exchange processes rather than merely reducing risks by safeguarding minimum standards and guarding 'core activities against unforeseen events, hence protecting the competitive positioning of an organization' (Vachon and Klassen, 2006, p.814).
Thorlakson et al. 2018	External or Internal: who defines the practices Standard or intervention: whether social and/or environmental production standards are defined.
Bager & Lambin, 2020	Hands-on: Internal sustainability practices within their company and along their supply chain. Hands-off: External sustainability standards and policies
Jeppesen & Hansen, 2004,	Shallow: Collaborations with little transfer of resources to the local company Deep: Collaborations with significant resource transfer to the local company
Pilbeam et al. (2012)	Formal: Standards which specify quality threshold or criteria for participation Informal: Embedding social structure, development of social norms to influence behaviors

C.2 More information on company characteristics

They are from 30 countries across five continents (Figure C.1). Since this study focused on firms with practices, the manufacturers and retailers were largely from European and North American. Despite the higher representation of manufacturers and retailers from western countries, the average of media attention on palm oil sustainability at the firms' headquarter country did not vary significantly across supply chain stages (p-value = 0.20).

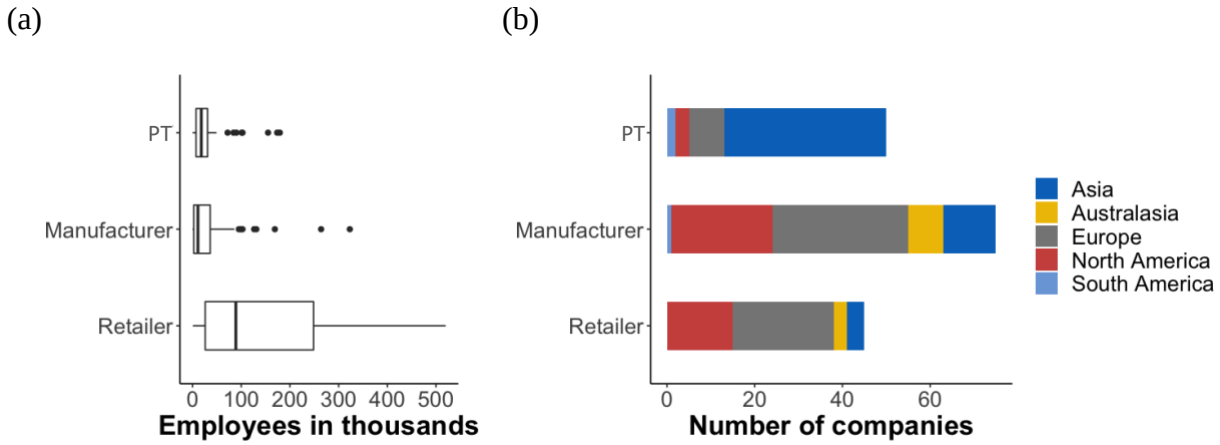

Figure C.1 (a) Boxplot of the number of employees by supply chain stage. The whiskers extend to 1.5 inter-quartile ranges, the left and right hinges are the first and third quartiles, and the thick line is the median. An outlying retailer with 2.3 million employees was excluded from the graph to better visualize the distributions of most companies. (b) Number of companies by continent.

C.3 Model estimation results

The result of Hypothesis 1 based on Model 1 is influenced by firm size. Model 1A, which does not include firm size, shows that the number of hands-off practices did not rely on stage at all (Table C. 2). Besides this, comparison of models 1 and 2 to models 1A and 1B indicate that the firm size variable also affected reduced the significance of Public ownership and high brand value dummy variables. However, the presence of the firm size variable did not influence the result of Hypothesis 2.

The coefficient estimates of Model 3A and 3B are relatively similar to those in Model 3 implying that the estimates in all three models are stable and not strongly influenced by collinearity in the independent variables.

The loglikelihood of models 1, 2, and 3 are -237.76, -227.77, and -95.04.

Table C. 2. Model estimates

	Number of hands-off practices			Number of hands-on practices			Fraction of hands-on practices		
	Model 1A	Model 1B	Model 1C	Model 2A	Model 2B	Model 2C	Model 3A	Model 3B	Model 3C
Constant	-3.37 (0.82)**	-0.84 (0.43)*	-0.74 (0.44).	-5.26 (1.30)**	-3.39 (0.55)**	-3.32 (0.55)**	-2.37 (0.90)**	-2.17 (0.46)**	-2.13 (0.45)**
PT	0.50 (0.30).	0.13 (0.29)	0.05 (0.29)	2.94 (0.44)**	2.66 (0.32)**	2.60 (0.34)**	2.11 (0.31)**	2.08 (0.30)**	2.05 (0.30)**
Manufacturer	0.62 (0.28)*	-0.02 (0.25)	-0.15 (0.25)	1.18 (0.45)**	0.75 (0.30)*	0.68 (0.35)*	0.38 (0.35)	0.34 (0.31)	0.28 (0.34)
Retailer	0	0	0	0	0	0	0	0	0
Log(No. of employees)	0.25 (0.07)**			0.18 (0.09)*			0.02 (0.07)		
Publicly owned	0.30 (0.22)	0.59 (0.20)**	0.58 (0.20)**	0.39 (0.22).	0.57 (0.22)*	0.57 (0.22)*	0.18 (0.21)	0.20 (0.20)	0.19 (0.19)
Media attention	2.69 (1.21)*	2.90 (1.18)*	2.86 (1.21)*	2.75 (1.30)*	2.92 (1.29)*	2.89 (1.30)*	1.19 (1.02)	1.22 (1.04)	1.20 (0.99)
High brand value	0.55 (0.42)	1.02 (0.38)**		1.18 (0.29)**	1.50 (0.27)**		0.98 (0.25)**	1.02 (0.21)**	
High brand value * Manufacturer			1.42 (0.99)			1.58 (0.32)**			1.09 (0.23)**
High brand value * Retailer			0.00 (2.49)			1.21 (2.56)			0.75 (0.52)
Loglikelihood[a]	-238.74	-254.81	-252.63	-227.77	-234.43	-234.25	-95.06	-95.08	-95.05

*Empty cells are omitted variables. Coefficients were not estimated. **: p-value < 0.01, *: p-value < 0.05. [a]The loglikelihood of Model 3 is log pseudolikelihood* (Papke & Woolridge, 1996).