Essays on Retail Efficiency and Cross-channel Integration

田頭，拓己

(Degree)
博士（商学）

(Date of Degree)
2017-03-25

(Date of Publication)
2019-03-25

(Resource Type)
doctoral thesis

(Report Number)
甲第6845号

(URL)
https://hdl.handle.net/20.500.14094/D1006845

博士論文

Essays on Retail Efficiency and Cross-channel Integration

2017 年 1 月 16 日提出

神戸大学大学院経営学研究科

南知惠子　研究室

経営学専攻

学籍番号　124B012B

氏名　田頭拓己

Essays on Retail Efficiency and Cross-channel Integration

氏名　　田頭　拓己

Table of Contents

Chapter 1. Introduction

The retail environment has dramatically changed in the last decade owing to the development of Internet and e-commerce (EC) (Verhoef et al., 2015). This retail environment provides opportunities to retailers to transact with customers through offline channels, such as physical stores, and online channels, such as EC. For retailers, operational scale expansion is important to increase sales and the business growth. Various patterns are available to retailers to expand their operational scale; namely through a traditional way or by using both online and offline channels.

Traditionally, retailers have expanded their scale by increasing the store size and the number of stores by opening new branches (Walters and White, 1987). As retailers increase the number of stores, they need to manage multiple stores efficiently. Chain-store operation by retail headquarters through centralized management and standardized operation has become a popular management method for efficiently expanding the operational scale.

Since the 2000s, due to the development of EC, multichannel (MC) retailing carried out by retailers not only through physical stores but also through EC has become an important business subject in relevant academic fields (Zhang et al., 2010). Therefore, retailers can expand their operational scale not only by opening new store branches but also by operating through EC. Online selling channels allow retailers to transact with customers in broader area through the Internet. Studies on MC retailing and the addition of online channels to existing channels reveal both the positive and negative effects on retailer performance (Biyalogosky and Naik, 2003; Avery et al., 2012). This dissertation includes some key terms to discuss the impacts of cross-channel integration; this chapter introduces the definitions of these key terms. Efficiency can be defined as the ratio of outputs to inputs (Ingene, 1982; Assaf, Barros, and Sellers-Rubio, 2011; Barros, 2006; Mishra and Ansari, 2013). The concept of economies of scale refers to the cost efficiency derived from a decrease in average cost when retailer output or production numbers increase (Hanoch, 1975).

Cross-channel integration can be defined as “the degree of coordination of objectives, retail offerings, distribution and information systems, and organizational structure to create synergetic outcomes for firms and customer benefits” (Cao and Li, 2015). There are narrow and broad approaches to assess cross-channel integration,

which highlight the retailer's use of channels. The narrow approach defines cross-channel integration as a consistent and homogenized offering to customers across channels (Avery et al., 2012). On the other hand, the broad approach emphasizes coordination across channels rather than a homogenized offering and focuses on objectives, retail offerings, distribution and information systems, and the organizational structure of channels (Neslin et al., 2006; Cao and Li, 2015). Because this dissertation aims to comprehensively capture cross-channel integration and identify its impact on retailer performance, the definition of cross-channel integration in this dissertation includes both narrow and broad aspects, that is, it is defined as both, a homogenized offering and coordination of operations. For example, the measurement of cross-channel integration in this dissertation (especially in chapters 4 and 5) includes a homogenized retail brand name, promotions, and coordinated merchandize planning.

This dissertation focuses on how a retailer should manage and coordinate both online and offline channels rather than focusing on the impact of adding online channels on retailer performance. Recent studies conceptually argue and empirically assess the importance of integration of online and offline channels (Neslin et al., 2006; Neslin and Shanker, 2009; Zhang et al., 2010; Van Baal, 2014; Oh, Cao and Li, 2015). The integrated and centralized operations of MC retailers play an important role in providing better value to customers and obtain synergetic sales growth by avoiding the cannibalization of channels (Cao and Li, 2015).

However, an expanded scale leads to increased difficulty and complexity of operation (Srinivasan, Sridhar, Narayan and Sihi, 2013). Retailers produce distribution and other added services as outputs of their business by transacting with customers. Therefore, customer transactions are seen as a basic output of retailers (Mishra and Ansari, 2013). In comparison with manufactures, retailers' value proposition practices to customers such as assortment, advertising, and services impact their cost efficiency (Ingene, 1984). Therefore, an increase in the number of transactions and selling channels (i.e., number of store branches and the addition of EC channel) leads to inefficient operations. More specifically, the operation of online and offline channels results in an inefficient cost structure due to the fundamental differences between online and offline channels (Zhang et al., 2010). Therefore, this dissertation aims to reveal the impacts of integration practices of online and offline channels on performance, including cost-related outcomes rather than merely focusing on customer performance

measures such as customer loyalty and perceived service quality (Van Baal, 2014; Herhausen, Binder, Schoegel and Herrman, 2015).

This dissertation mainly contributes to the stream of studies on MC operation and cross-channel integration by (1) providing conceptual arguments and empirical evidences of the effectiveness of integration patterns on retail performance, and (2) discussing how the integration of online and offline channels impacts cost efficiency. Further, this dissertation contributes to studies on retail efficiency by empirically clarifying the mechanism of how retailers obtain cost advantages from scale expansion.

To achieve the aim of the research and contribute to previous research, this dissertation mainly conducts three empirical studies. The structure of this dissertation is organized as follows. Chapter 2 comprises a literature review to clarify the conceptual foundation of retail efficiency and types of retail formats that represent the types of offline operations (Ingene, 1984).

Chapter 3 focuses on the offline retailing context and empirically analyzes the impact of the number of stores on retailer costs. This chapter conducts plural log-linear regression analysis to reveal how the number of stores impacts on the cost structure of retailers. This chapter clarifies the mechanism of retail efficiency that increased operational scale leads to higher cost efficiency with respect to purchasing, which represents the distribution side, but inefficiency with respect to other administrative costs of the retailer. This tradeoff relationship between purchasing cost and other costs provides a fundamental framework of the relationship between scale expansion and efficiency in the retail context. The content of this chapter is published in proceedings of Academy of Marketing Science (Tagashira and Minami, 2016).

The purpose of chapter 4 is to empirically analyze the effects of integration of online and offline channels on cost efficiency in the retail context. Although the effectiveness of integration has been clarified for demand-related performance, its effects on organizational performance have been questioned in prior studies. This chapter particularly focuses on the chronological development of cross-channel integration. Therefore, the chapter captures the development of integration in the form of ordered levels and analyzes its impact on cost efficiency. Further, this chapter assumes that retailers start the integration process from the simplest functions, such as brand names and marketing messages, and then integrate complex functions, such as assortment, distribution, and organizational structures (Zhang et al., 2010; Cao and Li,

2015). In other words, the definition assumes that retailers start the integration from functions that do not require integration of back-end components, and then integrate functions that require integration of back-end or organizational components. For empirical analysis, this chapter employs a unique panel dataset with 305 firm-year observations to estimate our empirical model. The results show that integration has a positive impact on cost efficiency, whereas retailers' length of EC experience negatively moderates this effect. By revealing the effect of integration on cost efficiency and moderating organizational characteristics, this study provides valuable insights to previous studies related to MC retailing.

Chapter 5 aims to empirically estimate a model to explain the effectiveness of cross-channel integration patterns on retail performance. Although the effectiveness of integration has been clarified in previous studies, the way of development of integration has not been assessed. This chapter focuses on the impacts of integration patterns (i.e., individual and combined effects of components) rather than the chronological development of integration and assuming an ideal way of development. Therefore, although this study collects data from the last several years, the data is analyzed as pooled cross-sectional data rather than panel data, and the dataset is modified from chapter 4 to adapt to this research focus. More specifically, this chapter focuses on each firm-year sample setting. Thus, chapter 5 does not employ the assumption that all integration practices reported in previous years in a specific firm persist for further years for the firm, even if they were not mentioned in the annual report for the further years, which the chapter 4 employed. To clarify the effective integration patterns and test the hypotheses, this study gathers secondary data on 310 Japanese retailers. Empirical models demonstrate that the combination of front-end and back-end systems positively impacts the economies of scale (cost-related performance) and profitability. Overall, the findings indicate empirical evidence of effective integration patterns and further develop prior arguments into how cross-channel integration can be developed.

Chapter 6 summarizes these three empirical works and explains theoretical contributions and managerial implications. Further, this chapter presents limitations that lead to suggestions for future studies.

The three empirical works play an important role in achieving the aim of this research. The empirical results in chapter 3 provide a fundamental framework about the relationship between scale expansion and retail efficiency to discuss how integration

practices lead to cost efficiency. Based on this framework, chapter 4 argues the impact of integration on cost efficiency and empirically analyzes the impact. However, the results in chapter 4 highlight the possibility of future research on the existence of some integration patterns of online and offline channels. Specifically, the individual and combined effects of integrated components are assessed. For example, the front-end component, which represents practices at customer touch points and value proposition for customers, and the back-end component, which represents purchase and administration systems such as logistics and information systems, and organization components, such as organizational structure and employee incentive systems, may have different impacts on retailer performance. Chapter 5 argues and empirically analyzes the individual and combined effects of each component on retailer performance. More specifically, this chapter provides conceptual arguments based on the framework in chapter 3 and the complementarity derived from the empirical results in chapter 4 and empirically analyzes the effectiveness of integration patterns for retailers.

Chapter 2. Retail Efficiency and Type of Retail Format

2.1 Retail Efficiency

Efficiency is defined as the ratio of outputs to inputs (Ingene, 1982; Assaf, Barros, and Sellers-Rubio, 2011; Barros, 2006; Mishra and Ansari, 2013). Further, cost efficiency assesses how well a firm allocates and uses its resources to produce the given outputs (Krasnikov et al., 2009).

Researchers commonly use two inputs required to produce retail outputs—labor and capital. For labor input, the number of laborers is the most common measurement (Arndt and Olsen, 1975; Ingene, 1984; Kamakura, Lenartowicz, and Ratchford, 1996; Reardon, Hasty, and Coe, 1996; Barros, 2006; Yu and Ramanathan, 2008; Mishra and Ansari, 2013; Uyar, Bayyurt, Dilber, and Karaca, 2013). There are several measurements for capital input in retail; however, the most common measurement is the area of sales space (Arndt and Olsen, 1975; Ingene, 1984; Kamakura et al., 1996; Reardon et al., 1996; Barros, 2006; Yu and Ramanathan, 2008; Uyar et al., 2013). Some studies consider the monetary amount of assets as capital input (Betancourt and Gautschi, 1993; Yu and Ramanathan, 2008) and merchandise cost (Mishra and Ansari, 2013) as another input factor. These measurements are employed because sales space is an insufficient measure for capturing the overall retail characteristics such as assortment variety, assurance of product delivery, information delivery, and ambience (Betancourt and Gautschi, 1993). Thus, merchandise cost represents assortment and inventory, and assets represent capital, such as store environment and equipment, which are required to manage the inventory system and information delivery.

In contrast to retail inputs, it is difficult to define retail output factors because of the lack of physical outputs by retailers (Ingene, 1984). In the academic field, most articles employ sales as an output measure (Ingene, 1982; Barros and Alves, 2003; Sellers-Rubio and Mas-Ruiz, 2006; Uyar et al., 2013; Mishra and Ansari, 2013). Sales represent the monetary value of the quantity of products sold and include information on the quantity and price of products sold (Ingene, 1982; 1984). Sales indicate that retail output is related to transactions between retailers and customers because retailers provide distribution and added services to customers (Ingene, 1984). Another output

measurement is the value added, which is calculated as the difference between sales and purchasing cost (Ratchford and Brown, 1985; Reardon Hasty and Coe, 1996).

2.2 Type of Retail Format

Cost efficiency in the retail context refers to the allocation of resources to achieve sales and enable transactions with customers. Thus, the type of retail format impacts retail efficiency (Ingene, 1984). Retail format refers to the commonalities of embodiment of retail business models across retailers, which are composed of two aspects, front-end that represents value proposition to customers and back-end that represents the operational strength of the organization (Goldman, 2001; Reynolds et al., 2007). Therefore, this dissertation especially focuses on the following factors to discuss the impact of retail formats on efficiency with respect to front-end and back-end components: Product assortment that refers to the basic value proposition of retailers (Mishra and Ansari, 2013), added services that provide additional benefits to attract consumers, and the distribution system that represents the resources or ability to manage logistics and inventories.

Assortment width impacts retail efficiency. Retailers increase their basic service level as a distribution service provider by increasing their assortment width (i.e., the variety of products) and cover a wider range of consumer demands (Walters and White, 1987). However, wider assortment leads to higher inventory management cost. German retailer Aldi achieved cost advantages through retail expansion while narrowing its assortment range (Planet Retail, 2006). Further, in terms of chain-store operation, standardization of assortment affects the distribution system. Standardized assortment allows retailers to make centralized buying decisions and have a centralized distribution system for multiple stores. Retailers that operate a centralized distribution system are able to disperse the cost of goods sold toward a larger volume of products, which reduces the average cost. Furthermore, higher service level requires more employees and a better service environment. These additional inputs result in higher operational costs and result in higher prices of products. As a result, the sales amount may decrease and retailers may have a relatively low inventory turnover.

The back-end distribution system is important for retailers to achieve efficiency (see chapter 3 for detailed arguments); further, front-end practices, such as

assortment and services, impact retail efficiency by influencing the retailer's distribution systems. Therefore, retail formats that reflect the typology of retail operations are an important factor to consider in the context of retail efficiency.

In the following chapters, this dissertation empirically analyzes the hypotheses by applying estimation models to Japanese retail data. In the Japanese market, department stores, general merchandise stores (GMS), convenience stores (CVS) and apparel-specific stores are noteworthy formats (Larke and Causton, 2005). Furthermore, multi-format, that is, the operation of multiple formats by retailers, has recently become another important format in the Japanese market.

The traditional departmental store format has survived in the Japanese retail market, whereas this format has limited presence in western markets. Department stores account for approximately 4% of the total retail sales in Japan (METI 2015). Department stores operate a small number of large stores in metropolitan areas. Their main sales are split among grocery, apparel, and household goods while providing a wide assortment of products. Further, they provide less self-service and various high-level personal services (Larke and Causton, 2005). Recently, tourists have been purchasing many products from Japanese department stores. Therefore, these stores have been hiring highly skilled employees to increase sales from tourists (METI, 2015). On the other hand, chain-store management has not been introduced in the department store format in Japan, while the centralized distribution system for multiple stores is well-developed in other modern retail formats (Larke and Causton, 2005). In sum, the characteristics of the department store format, such as wide assortment and high-level personalized services result in relatively low inventory turnover and inefficient operations. However, because department stores achieve a high level of sales from each store and most retailers operate a small number of stores, they possibly achieve quantity advantages while purchasing products and incur relatively low administrative costs required to manage multiple stores from the headquarters. Therefore, department stores are an important format to consider in the Japanese retailing context.

GMS account for approximately 9% of the total retail sales in Japan (METI, 2015). GMS comprise large-scale stores, second in size to department stores, with a wide assortment of products. GMS comprise several, large stores with self-service. Sales are split among grocery, apparel, and household goods; however, grocery is the main product (Larke and Causton, 2005). GMS generally employ a chain-store

operation system and standardize assortment and operations at each store. Further, GMS retailers operate a centralized distribution system to manage standardized stores (Larke and Causton, 2005). In sum, although GMS retailers have a variety of products at many stores, they employ a centralized distribution system to optimize chain-store operations as a company.

CVS is one of the most modernized formats accounting for about 7% of the total retail sales in the Japanese retail market (METI, 2015). The CVS format focuses on inventory turnover with several small stores having long hours of operation (usually 24 hours a day for 365 days in a year). CVS employs chain-store operation, with a wide but standardized assortment and a strongly centralized distribution system and franchise system. Distribution and information systems are important characteristics of CVS operations. For each store, deliveries arrive several times constantly with each product being supplied from the distribution center through local distribution bases (Larke and Causton, 2005). Information on inventories at each store and at the distribution centers is shared by an information technology system, and merchandise planning such as product prices are highly controlled by companies rather than individual stores. In sum, CVS manage a nationwide store network with a developed distribution and information system. However, companies operating major CVS brands also operate in other formats (e.g., Seven & i Holdings Co., Ltd. operates Seven Eleven; Lawson purchased supermarket chain Seijo-Ishii[1]; Aeon operates Ministop; FamilyMart and Uny group holdings were merged[2]).

Retailers specializing in apparel do not have a large share in the overall Japanese retail market because the product line is limited. However, modern apparel retailers focus on efficient and low-cost distribution systems (Larke and Causton, 2005). More specifically, specialty private apparel (SPA) retailers vertically integrate their supply chains from manufacturing to retailing. Further, although apparel stores traditionally operate with a high level of personal services, modern format stores are more self-service oriented. In sum, this format provides limited assortment and have vertically integrated supply chains. Thus, retailers achieve scale advantages through increasing the sales amount with a centralized distribution system and by engaging in

[1] Lawson Value Book 2016
[2] Japan Times, 1st September, 2016

manufacturing.

Based on the above discussion, the type of retail format is an influential factor affecting retail efficiency. The retail format reflects retailers' operational characteristics such as assortment, services, and distribution system; these characteristics impact retail efficiency. Further, department stores, GMS, CVS, multi-format stores, and apparel stores are the noteworthy formats in Japanese retail market (Larke and Causton, 2005). However, the arguments about the type of retail format and offline operational characteristics are not the main focus of this dissertation. This dissertation mainly focuses on retailers' integration of online and offline activities, in general, rather than considering a specific format to discuss and analyze. Therefore, in the following chapters, this dissertation uses the variables that represent type of retail format as control variables for the purpose of analysis and reliable and stable estimation.

Chapter 3. Cost Efficiency of Multiple Store Retailers: A Comparison of Purchasing and Store Operation Costs

3.1 INTRODUCTION

Multi-store chain operations have recently emerged as a significant issue both nationally and globally. According to Dawson (2007), the number of retailers operating business in more than 10 countries increased from only 5 in 1986 to 32 in 2004.

In the context of single store operation, scale refers to the scale per store (Ingene, 1984; Reardon, 1999). However, in the context of multi-store chain operations, the issue of whether operations among multiple stores are efficient enough to keep pace with the firm's growth is an important issue. Therefore, the number of stores is a key factor in considering scale for multi-store chain retailers (Srinivasan et al., 2013).

When retailers increase the scale per store, their prime advantage derives from purchase quantities (Ingene, 1984). However, for retail firms adopting chain operations, they must control multiple stores simultaneously, increasing the difficulty in managing stores and risking a loss of efficiency during their retail expansion (Illueca et al., 2009).

Some recent studies have put forward controversial arguments about the impact of the number of stores on efficiency (Assaf et al., 2011; Barros, 2006; Evans et al., 2008; Ganeshan et al., 2007; Illueca et al., 2009; Srinivasan et al., 2013).

Firms increase the number of stores to expand their sales and market share, not to gain cost efficiency (Srinivasan et al., 2013). Retailers obtain competitive advantages from increasing the number of stores when they achieve sales higher than the cost increase, while closing stores creates cost efficiency (Srinivasan et al., 2013) because managing a large number of store is difficult without increasing general administration costs, thus leading to lost efficiency retail expansion (Illueca et al., 2009).

On the other hand, Barros (2006) shows that the number of stores has a positive impact on retail efficiency using a Data Envelopment Analysis. Assaf et al. (2011) show the positive relationship between the degree of geographical expansion and efficiency by conducting a Bayesian analysis. In addition, studies into the relationship between retail chain strategy and performance claim that retailers increase the number of stores to obtain economies of scale.

Further, studies not only into retail efficiency but also a broader range of retail studies examining standardization, adaptation, and retail chain management (Evans et al., 2008; Ganeshan et al., 2007) have explained the competitive advantages of multi-store operations based on economies of scale.

Economies of scale refer to the cost advantages gained as the average cost decreases as firm output or production numbers increase (Hanoch, 1975).

It is clear from the literature that there is no consensus about the relationship between the number of stores and retail efficiency. Further, both arguments emphasize the cost efficiency.

Moreover, though previous studies analyze the economies of scale of one retailer and estimate extended models including new production factors, such as IT investments (Reardon et al., 1999; Mishra and Ansari, 2013), the results between them are inconsistent. Reardon et al. (1999) show a constant return on scale, while Mishra and Ansari (2013) show diminishing returns on scale. Despite recent technological developments, recent studies indicate that inefficiency may still result from expansion, despite investments in technology.

Therefore, this study investigates the efficiency of multi-store chain retailers by examining the relationship between retail efficiency and the number of stores. Specifically, this study focuses on different types of costs to clarify how retail costs increase when the number of stores increases.

The results show that despite the advantage in distribution in terms of quantities brought through store expansion, there is a constant increase in other costs such as costs for sales and general administration. Thus, this tradeoff relationship between purchasing cost advantages and other costs increases determines whether retailers can achieve total operational cost advantages. The content of this chapter is published in proceedings of Academy of Marketing Science (Tagashira and Minami, 2016)

3.2 Literature Review

Retail efficiency is widely used to measure retail performance with efficiency defined as the ratio of inputs and outputs (Assaf et al., 2011; Barros, 2006; Ingene, 1984; Mishra and Ansari, 2013). Output represents the result of production, which in the retail

context refers to sales and value-added which is calculated as the difference between sales and purchasing cost (Ingene, 1984; Keh and Chu, 2003; Mishra and Ansari, 2013; Yu and Ramanathan, 2008; Uyar et al., 2013). Input represents the factors for production, such as capital and labor (Barros, 2006; Ingene, 1984; Keh and Chu, 2003; Mishra and Ansari, 2013; Reardon et al., 1996; Yu and Ramanathan, 2008). Thus, efficient retailers can produce more with the same inputs as inefficient retailers.

Recently, a few studies examined the impact of number of stores and expansion on efficiency. Barros (2006) conducted a Data Envelopment Analysis (DEA) and tobit regression analysis, and found a positive relationship between efficiency and number of stores.

DEA is a method to calculate a decision-making unit's relative efficiency for multiple input and multiple output situations. Some studies employ this approach to measure retailers' efficiency (Keh and Chu, 2003; Barros and Alves, 2003). Further, Assaf et al. (2011) investigate the degree of geographical expansion and show a positive relationship between geographical expansion and efficiency.

Some studies emphasize economies of scale to explain why multiple store retailers obtain competitive advantages through expansion. For instance, Evans et al. (2008) use a qualitative study to show that standardizing retail operations leads to efficiency through economies of scale. In other words, firms standardize their operations in response to economies of scale through expansion. Further, Ganeshan et al. (2007) use the speed to obtain economies of scale as a parameter in their model wherein retailers decide to localize or centralize their business.

Economies of scale mean that the average cost of production decreases as scale or production increases (Hanoch, 1975). Therefore, some studies propose that the number of stores has a positive impact on efficiency because they can produce with a lower average cost by increasing their scale.

Further, researchers in econometrics have also studied economies of scale in the retail context. Ingene (1984) estimates a Cobb-Douglass production function to test the economies of scale per store based on duality and shows evidence that only drug and variety stores obtain economies of scale.

On the other hand, Reardon et al. (1996) estimate a Cobb-Douglas production function for a retail store in Dallas, Texas, and find that retail stores have constant returns on scale. Mishra and Ansari (2013) estimated a modified Cobb-Douglass

production function for clothing stores in India and observed a diminishing return on scale.

Further, Illueca et al. (2009) focus on geographical expansion and efficiency, and show that expanding operational scale leads to increased difficulty in managing stores and general administration as a firm, which negatively affects efficiency. Srinivasan et al. (2013) show that opening new stores has a negative impact on firm value, because this is a sales expansion-focused initiative, while retailers close stores during a cost-focused initiative. Thus, retailers obtain competitive advantages by increasing the number of stores when the increase in their sales is higher than that in their cost, and expanding operational scale by increasing the number of stores is a cost inefficient activity.

Previous studies contain two controversial arguments. In the first, retailers obtain cost efficiency by increasing the number of stores. In the second, retailers cannot obtain cost efficiency by increasing the number of stores. Therefore, this study proposes a theoretical framework for how retailers' costs are affected by retail expansion, especially by the number of stores, and empirically tests the framework.

However, besides macro issues such as regional, cultural, and economic factors from national and geographical differences, in addition to time variation, factors such as the type of retail format also impact the ability to scale efficiently. Ingene (1984) claims that the format strongly impacts retail efficiency because of the differences related to their retail operations, such as assortment types and selling and promotional strategies. Therefore, other studies have employed a specific retail format as their sample to control the format characteristics, such as differences in assortment and service (Assaf et al., 2011; Barros, 2006; Mishra and Ansari, 2013). Therefore, this study analyzes impact of the number of stores on efficiency while controlling for the impacts of retail formats.

Integrating the above arguments, this study investigates whether retailers' costs have increasing, diminishing, or constant returns as the number of stores increases. Table 1 summarizes the previous studies mentioned in this paper.

Table 1 Summary of main literature

Authors (year)	Focal point	Method	Main variables	Results or Assumption
Assaf et al. (2011)	Retail cost efficiency and firm characteristics (e.g. age, the dgree of vertical integration and geographical expansion) in Spain	Bayesian approach	Total cost; Price of return on capital	Geographical expansion has a positive impact on efficiency
Barros(2006)	Efficiency and strategic factors in Portogal	DEA and tobit regression	Sales; Value added(VA); Labors; Capital	The number of stores has a positive impact on efficiency
Evans et al. (2008)	Drivers of retail internationalization and standardization of retail operation	Qualitative interviews	Internationalization; Standardization and Adaptation	Economies of scale is a driver retailers to standardize their operation
Ganeshan et al. (2007)	An optimization model that allocates buyers between a central buying organization and local retail outlets	Model development and simulation	Full time equivalent; Central/local location	Optimal buying behavior depends on how fast the economies of scale benefits accrue
Illueca et al. (2009)	The effect of geographical expansion on productivity of Spanish banks	DEA and nonparametric regression	Efficiency change; Number of branches; % of number of branches in other market	The way to expand their scale impacts on productivity achievement due to the difficulty to control operation
Ingene(1984)	Economies of scale for retail stores in the USA	Estimation of Cobb-Douglass production function	Sales; Labors; Store size	Economies of scale are observed in specific formats
Mishra and Ansari (2013)	Economies of scale for clothes stores in India	Estimation of Cobb-Douglass production function	VA; SKU; Store size; Location; IT input	Diseconomies of scale are observed
Reardon et al. (1996)	Economies of scale for retail stores in the USA and the impact of IT input	Estimation of Cobb-Douglass production function	VA; Labors; Store size; IT input	Constant return on scale are observed
Srinivasan et al. (2013)	Opening / Closing stores and firm value	Bayesian approach	Firm Value; The number of opening/closing stores; Retailer characteristics	Opening stores have negative impact on firm value

3.3 Theoretical Framework and Hypotheses

While some previous studies claim that retailers obtain cost efficiency by increasing the number of stores, others argue that retailers cannot obtain cost efficiency by increasing stores.

Retailers primarily increase their operational scale in two ways. First, retailers increase the scale per store to increase the amount of product to display and cover a wider range of consumer demands (Walters and White, 1987). Second, retailers increase the number of stores by opening new branches.

When retailers increase their scale, their costs increase as well. Because this study focuses on cost efficiency and scale expansion, it focuses on both whether scale has a positive impact on costs and how cost increases when scale increases. For example, when retailers obtain cost advantages through expansion, scale elasticity of cost is smaller than one.

The most basic cost advantage obtained when retailers increase scale is quantity advantage in purchasing costs which is explained based on economies of scale (Ingene, 1984). Retailers with more stores must make larger purchase amounts of specific products. Hence, retailers can disperse the costs related to one purchase transaction over a larger amount of the product, reducing the average cost for a specific product.

In terms of retail management, a report on Aldi's retail operations claimed that they achieved cost advantages through retail expansion while narrowing their assortment range (Planet Retail, 2006). This implies a possibility that costs associated with purchasing products has a diminishing return on scale.

However, academics have identified this effect only in the context of one store (Ingene, 1984). In multi-store context, retailers have another characteristic whereby any business expansion is accompanied by increased costs.

Srinivasan et al. (2013) emphasize that increasing the number of stores increases costs, and retailers obtain cost advantages by closing stores. Further, retailers must build a store and transact with customers to operate their business. As retailers open new stores and expand their operational scale, the difficulty in controlling operations at each store increases (Illueca et al., 2009). In other words, the costs associated with selling and general administration, and promoting products in each store, has increasing with retail expansion. However, this also has not been empirically tested.

These arguments imply a number of different types of costs, such as purchasing cost, store administration, and general administration costs, which increase differently as the number of stores increases. In other words, the arguments about types of costs represent retailers' two-sided operations, which include purchasing activities in the distribution, and selling activities and store administration as the front end of retail operations. While retailers obtain a scale advantage in purchasing cost by increasing the number of stores, this is accompanied by a constant increase or inefficiency in other types of cost. Thus, this trade-off relationship between purchasing costs and other costs determines whether retailers can achieve total operational cost advantages.

How the cost increase can be analyzed by focusing on elasticity. If the elasticity were one, the cost would increase linearly and it is not an efficient situation, whereas the slope would be small if the elasticity were smaller than one and it shows the efficient situation and if the elasticity were larger than one, the slope would be bigger when the

number of stores increases and it shows the inefficient situation. Based on the following proposition, this study hypothesizes the relationship between cost efficiency and the number of stores.

Proposition 1. When the store elasticity of cost is lower than 1, larger number of stores leads to higher cost efficiency. (For proof, see appendix 1).

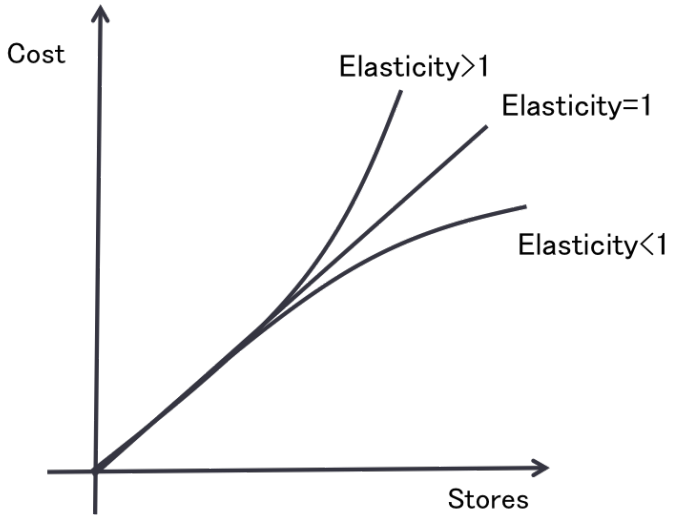
Further, figure 1 visually represents the relationship between elasticity and the way of cost increase. Integrating the above arguments, this study proposes the following hypotheses:

H_1 Elasticity of purchasing cost is smaller than one.

H_{2a} Elasticity of other costs is one.

H_{2b} Elasticity of other costs is larger than one.

Figure 1



3.4 Methods

3.4.1 Data Collection

The hypotheses are tested using a model developed and applied to the retail market in Japan. Japanese retailers expand their business by increasing the number of stores, though compared to those in the U.S., Japanese retailers have traditionally expanded by

opening small store branches rather than expanding the scale per store as a result of Japan's land area and the large scale store law repealed in 2000 (Larke and Causton, 2005). Thus, Japanese market is an appropriate object to analyze the impact of the number of stores.

Further, the Japanese market has been considered one of the most competitive markets since even global retailers such as Wal-Mart and Carrefour encounter difficulties when they enter and operate in Japan (Aoyama, 2007). Therefore, a study of retail efficiency in Japan is relevant.

This study focuses on how costs increase when retailers expand their scale, employing a cross section of data for the Japanese retail market to control for the effect of commodity price and differences in market structure. This dataset is limited to those retailers who have at least one store outlet for the purpose of clarifying and focusing on the impact of the number of stores. Because it is difficult to assess the operational scale for EC or catalogue operators, this study only focuses on retailers that operate physical store outlets (i.e., bricks-and-mortar retailers).

The data is publicly listed and collected from the retailers' 2013 financial reports sourced from EOL, a comprehensive business information database of Asian firms, and from the related corporate websites if necessary. As a result, 213 samples were obtained. EOL contains information from stock exchanges across the country and data for some unlisted firms in Japan, making it an appropriate database to comprehensively collect Japanese retailers' data.

Tables 2 and 3 provide the descriptive statistics and correlation matrix for the study variables, respectively. Because the estimation model uses the logarithm of variables, so the tables provide descriptive information about the raw numbers and the logarithm numbers.

Table 2 Descriptive statistics

Variables	Mean	Std. Dev.	Min	Max
TC	185292.3	485642.6	300	5298872
PC	103871.4	254985.9	187	3163564
OC	81420.84	369022.6	113	4920313
Number of stores	449.21	1384.55	1	11754

Sales-space	3436.63	5927.59	24.060	48813.52
Labor	53.29	112.44	0.317	925.64
log(Sales)	11.07	1.47	5.743	15.52
log(TC)	11.03	1.46	5.704	15.48
log(PC)	10.47	1.53	5.231	14.97
log(OC)	9.88	1.50	4.727	15.41
log(Number of stores)	4.70	1.68	0	9.37
log(Sales-space)	6.95	1.68	3.18	10.80
log(Labor)	3.00	1.33	-1.15	6.83

Table 3 Correlation matrix

	1	2	3	4	5	6	7	8	9	10	11
1 log (Number of stores)	1										
2 log (Sales-space)	-0.41	1									
3 log (Labor)	-0.59	0.64	1								
4 Food specialty	-0.13	0.19	0.24	1							
5 Apparel	0.19	-0.20	-0.28	-0.18	1						
6 Home Center	-0.06	0.25	0.07	-0.13	-0.11	1					
7 GMS	-0.03	0.24	0.15	-0.13	-0.11	-0.08	1				
8 CVS	0.24	-0.14	-0.31	-0.07	-0.06	-0.04	-0.04	1			
9 Drug store	0.19	-0.10	-0.15	-0.14	-0.11	-0.08	-0.08	-0.05	1		
10 Department Store	-0.50	0.27	0.55	-0.12	-0.10	-0.07	-0.07	-0.04	-0.08	1	
11 Multi format	0.21	-0.01	0.02	-0.11	-0.09	-0.07	0.01	-0.04	-0.07	-0.06	1

3.4.2 Measurements and Empirical Specification

This study focuses on the trade-off relationship between different types of costs. To empirically test this framework, this study analyzes how retail costs increase depending on retail expansion, including the number of stores. Thus, this study focuses on the relationship between the main variables including cost and the retail operational scale rather than estimating the cost function. This study analyzes whether each cost has

increasing, decreasing, or constant returns when the number of stores, sales space, and number of employees (labor) increase.

Costs represent the dependent variables in this study, which focuses especially on operational costs since Bianchi (2009) claims that marketing factors for store operation are more important than financial assets to gain competitive advantage in the retail market. This study examines three types of costs. The first is total operational cost (TC), representing costs related to retail operations, calculated in millions of yen with the following:

$$TC = Sales - Operational\ profit$$

The second is purchasing cost (PC), which represents the monetary amount of purchases in millions of yen. The third includes other administration costs (OC), calculated as follows:

$$OC = TC - PC$$

This cost includes those associated with retail operations such as logistics, advertising, store administration, and general administration.

This study uses the number of stores, sales space per store (m^2), and the number of employees as independent variables. Previous studies have adopted sales space as retailers' input (Barros, 2006; Ingene, 1984; Keh and Chu, 2003; Mishra and Ansari, 2013; Reardon et al., 1996; Yu and Ramanathan, 2008). However, previous studies have found inconsistent results in terms of the relationship between sales space and efficiency, so this study analyzes the impact of sales space while controlling the impact of the number of stores and retail format. Labor has also been employed as an input factor (Ingene, 1984; Keh and Chu, 2003; Mishra and Ansari, 2013; Reardon et al., 1996). This study includes part-time employees in the labor variable because part-time employees play an important role in retail store operations. This study uses sales per store and the number of employees per store to avoid multicollinearity between independent variables (Ingene, 1984).

Ingene (1984) claims that format strongly impacts retail efficiency because of the differences related to retail operations, such as assortment type and selling and promotional strategies. Assaf et al. (2011) focuses only on supermarkets to analyze retail efficiency to control for differences in assortment and service between formats. Thus, characteristics inherent to specific formats related to retail operational strategies such as assortment, selling, promotion, and service impacts efficiency. Therefore, this

study controls the impact of format by using dummy variables for some major formats.

As a controlling variable, "specialty retailers" (Ingene, 1984; Keh and Chu, 2003; Mishra and Ansari, 2013; Uyar et al., 2013) are defined as retailers with a specific product type that represents more than 90% of the company's sales to specify assortment specialty. General assortment (Barros, 2006; Ingene, 1984) is defined as a retailer with a multi-product type assortment and no product that accounts for over 80% of sales. This study employs the sub-classification of general assortment as the format. This study follows the classification within the commercial statistics published by the Japanese Ministry of Economy, Trade and Industry.

This study specifically estimates the following log-linear regression models to analyze how costs increase when retail scale increases while controlling for retail format.

(1) $logTC = \alpha_0 + \alpha_1 \log Stores + \alpha_2 \log Size + \alpha_3 \log Labor + Controls + u,$

where TC represents total cost, Stores represents the number of stores, Size represents, Labor represents the number of laborers and Controls represents control variables for type of retail format that includes food specialty stores, apparel, home centers, general merchandise stores, convenience stores, drugstores, department stores and multi-format.

(2) $logPC = \beta_0 + \beta_1 \log Stores + \beta_2 \log Size + \beta_3 \log Labor + Controls + v,$

where PC represents purchasing cost.

(3) $logOC = \gamma_0 + \gamma_1 \log Stores + \gamma_2 \log Size + \gamma_3 \log Labor + Controls + e,$

where OC represents other costs.

Because this model takes the logarithm for both dependent and independent variables, parameters represent elasticity. Therefore, the estimation results show if independent variables have a positive or negative impact on the dependent variables, as well as how the dependent variables increase when the independent variables increase. Figure 1 represents the relationship between estimation result and the way of parameter increase. If the elasticity is one, the cost would increase linearly, whereas the slope would be small if the elasticity is smaller than one and if the elasticity is larger than one, the slope would be bigger when the number of stores increase.

Hypothesis 1 is empirically tested based on following null hypothesis.

$$H_0^1: \beta_1 = 1.$$

Null hypothesis for hypotheses 2a and 2b can be expressed as follows.

$$H_0^2: \gamma_1 = 1.$$

3.5 Results

This study first employs the Ordinary least square (OLS) method, however, heteroskedasticity in the variance was identified in the TC and OC models through a Breusch-Pagan Cook-Weisberg test ($\chi^2(1) = 4.24$, \$p = 0.039 for TC; $\chi^2(1) = 11.57$, p = 0.001 for OC). Therefore, this study employs heteroskedasticity robust standard error (White, 1980) for the TC and OC models. Heteroskedasticity was not identified for the PC model ($\chi^2(1) = 0.05$, p = 0.816\$ for PC).

At the 5% significance level, null hypothesis for PC is rejected (p = 0.005) but null hypotheses for OC (p = 0.858) and TC (p = 0.207) are not rejected. Therefore, H_1 was supported. Also, because a linear increase was observed for other costs, H_2^a was supported.

Because the elasticity of total cost also is one and it increases linearly as the number of stores increases, the hypothetical framework proposing that despite gaining a purchasing cost advantage, the trade-off relationship between purchasing costs and other costs determines if retailers achieve total operational cost advantages was identified.

For TC, PC OC, sales-space elasticity are smaller than one (p = 0.000). On the other hand, TC increases linearly when the number of laborers (p = 0.106), for PC (p = 0.095) and for OC (p = 0.065). Tables 4, 5, and 6 present the results for the TC, PC, and OC analyses.

Table 4 TC results

Variables	Total cost		
	Coefficient	S.E.	p-value
Number of stores	0.941	0.047	0.000
Sales-space	0.099	0.031	0.002
Number of Laborers	0.897	0.063	0.000
Dummy for Grocery stores	-0.057	0.109	0.603
Dummy for Apparel	-0.166	0.126	0.190
Dummy for Home Center	0.114	0.106	0.281
Dummy for GMS	0.023	0.144	0.875
Dummy for CVS	1.038	0.554	0.062
Dummy for Drug Stores	0.331	0.108	0.003
Dummy for Department Store	0.802	0.229	0.001
Dummy for Multi format	0.340	0.407	0.405
Constant	3.140	0.383	0.000
F test	F(11, 201)=109.37 (p=0.000)		
R-sqare adjusted	R-sqare adjusted=0.8693		
Elasticity test of Number of stores	Test α 1=1: F(1, 201)=1.60 (p= 0.207)		
Elasticity test of sales-space	Test α 2=1: F(1, 201)=824.59 (p= 0.000)		
Elasticity test of Number of Labors	Test α 3=1: F(1, 201)=2.63 (p=0.106)		

Table 5 PC Results

Variables	Purchasing cost		
	Coefficient	S.E.	p-value
Number of stores	0.873	0.044	0.000
Sales-space	0.143	0.045	0.002
Number of Laborers	0.878	0.073	0.000
Dummy for grocery stores	0.130	0.172	0.452
Dummy for Apparel	-0.128	0.183	0.485
Dummy for Home Center	0.318	0.232	0.172
Dummy for GMS	-0.023	0.232	0.920
Dummy for CVS	-0.088	0.397	0.824
Dummy for Drug Stores	0.757	0.217	0.001
Dummy for Department Store	0.664	0.319	0.038
Dummy for Multi format	0.101	0.265	0.703
Constant	2.611	0.385	0.000
F test	F(11, 201)=55.29 (p=0.000)		
R-sqare adjusted	R-sqare adjusted=0.738		
Elasticity test of Number of stores	Test β 1=1: F(1, 201)=8.19 (p=0.005)		
Elasticity test of sales-space	Test β 2=1: F(1, 201)=361.76 (p= 0.000)		
Elasticity test of Number of Labors	Test β 3=1: F(1, 201)= 2.82 (p=0.095)		

Table 6 OC results

Variables	Other cost		
	Coefficient	S.E.	p-value
Number of stores	0.992	0.047	0.000
Sales-space	0.053	0.040	0.187
Number of Laborers	0.859	0.076	0.000
Dummy for Grocery stores	-0.286	0.124	0.022
Dummy for Apparel	-0.054	0.108	0.615
Dummy for Home Center	-0.045	0.100	0.652
Dummy for GMS	-0.019	0.160	0.905
Dummy for CVS	0.970	0.937	0.302
Dummy for Drug Stores	-0.211	0.108	0.051
Dummy for Department Store	0.918	0.278	0.001
Dummy for Multi format	0.266	0.411	0.519
Constant	2.268	0.393	0.000
F test	F(11, 201)=94.35 (p=0.000)		
R-sqare adjusted	R-sqare adjusted=0.8289		
Elasticity test of Number of stores	Test γ 1=1: F(1, 201)=0.03 (p=0.858)		
Elasticity test of sales-space	Test γ 2=1: F(1, 201)=560.19 (p= 0.000)		
Elasticity test of Number of Laborers	Test γ 3=1: F(1, 201)=3.42 (p= 0.065)		

3.6 Discussions

The empirical results show that elasticity of purchasing costs for the number of stores is significantly smaller than one, but other costs, including the costs associated with retail operations such as advertising, store administration, and general administration, and thus total operational costs increases linearly when the number of stores increases.

These results are consistent with the hypotheses in this study, and emphasize the tradeoff relationship between purchasing costs and other costs associated with selling and general administration as well as promoting products in each store. Thus, when retailers expand their operational scale by increasing the number of stores, they gain efficiency in the back-end of retail operations related to distribution, but not in the front-end of the retail operation, such as store management and general administration.

The results related to sales space show that all types of costs increase in an efficient way when the sales-space per store increases, indicating that retailers can increase efficiency by increasing the sales space while the number of stores and the number of employees are controlled. In other words, an expansion strategy focusing on

a few large stores is likely to be efficient.

However, increasing the number of employees does not seem to show any efficiency gains. Therefore, it is difficult to improve efficiency by increasing the number of employees so long as the sales space and the number of stores are controlled.

3.6.1 Theoretical Contributions, Managerial Implications and Limitations

Previous studies show controversial results in terms of the relationship between the number of stores and cost efficiency. This study focuses on retailers' cost efficiency, especially regarding increases in costs associated with expansion.

Further, despite technological advancements, recent studies into economies of scale and IT investments show inefficiency as a result (Reardon et al., 1996; Mishra and Ansari, 2013). These results indicate the possibility that it is difficult to gain efficiency through retail expansion, despite investments in technology.

This study highlights the cost structure of multi-store chain retailers. Specifically, the results emphasize that purchasing costs and other costs increase differently as the number of stores increases, indicating as retailers open new stores and expand their operational scale, it becomes more difficult to control operations at each store (Illueca et al., 2009). In other words, the costs associated with selling and general administration and promoting products in each store has increasing returns through retail expansion.

Further, this study also shows that sales space per store and the number of stores have different impacts on cost efficiency. The results also show that an increase in sales space per store leads to efficiency in both purchasing and other costs, such as those associated with selling and general administration. This suggests that retailers' capital input should be considered separately as the number of stores and sales space per store, and not as the total sales space, which is calculated as sales space per store times the number of stores.

The results offer several managerial implications. The results clarify the cost structure of multi-store chain retailers, and can assist managers in determining an investment strategy to grow efficiently. For example, because increasing the number of stores creates cost efficiency in purchasing, it is better retailers that aim to obtain cost efficiency in the channel to reduce investments in operations and to invest more in the

purchasing process. For example, investments in delivery systems, such as through information communication technology is one option.

On the other hand, retailers interested in reducing the rate of increase in store operations and administration, it is better to focus on a practices specifically targeting such costs. For example, advertising and pricing are important. In Japan, many retailers employ high-low pricing and leaflet discount information for each store. A standardized advertising format for the chain and an everyday low price approach could possibly improve retailers' advertising cost efficiency.

Further, an approach to open a few large stores is likely to be efficient. The results show that the number of stores leads to purchasing cost efficiency, but not for other costs, such as those associated with selling and general administration. However, this can be overcome by increasing the sales space per store, as this creates efficiency for both purchasing and other costs.

As this study represents the first analysis of the impact of the number of stores on cost efficiency, it has two limitations. First, the sample for this study is a cross section of data for the Japanese retail market. This method controls for the effect of commodity prices and differences in market structure, though these results cannot be generalized globally due to the characteristics of the data. Extending the sample would help in creating a generalizable result. Further, an analysis of the effect of time and changes in scale on efficiency would aid in understanding the relationship between scale expansion and efficiency.

Second, this study does not assess the impact of online factors on efficiency. Because many retailers operate online stores, studies are required to identify the relationship between online store management and retailer efficiency. This could lead to a better understanding of the relationship between retail expansion and cost structure.

3.6.2 Conclusion

As many retailers expand their business by increasing retail outlets based on chain operations, the number of stores is an important indicator affecting the business' efficiency. However, the previous literature contained conflicting results and arguments about the impact of the number of stores on efficiency. This study contributes the first analysis of how costs increase when the number of stores increases by conducting

log-linear regression analysis.

Overall, when multi-store chain retailers expand their operational scale, they may obtain a quantity advantage in purchasing costs, but this is accompanied by a constant increase in the costs for store operations. Thus, a strategy to create a few large branches is likely to be efficient.

Appendix 1

Proof of proposition 1: First of all, we define a statement "larger number of stores leads to higher cost efficiency" as "larger number of stores (S) leads to lower cost per store (C/S)".

Definition 1. The definition above can be written as follows.

$$\frac{d\left(\frac{C}{S}\right)}{dS} = \frac{\frac{dC}{dS}S - C}{S^2} < 0 \Leftrightarrow \frac{dC}{dS} < \frac{C}{S}.$$

When the store elasticity of cost is lower than 1, the relationship between cost and the number of stores can be written as follows.

$$\frac{\frac{dC}{C}}{\frac{dS}{S}} = \frac{\frac{dC}{dS}}{\frac{C}{S}} < 1 \Leftrightarrow \frac{dC}{dS} < \frac{C}{S}.$$

Example: An example of the proposition above can be shown as follows.
When the cost function is $C = AS^{\alpha}$, marginal and average costs are given by,

$$\frac{dC}{dS} = \alpha A S^{\alpha-1},$$

$$\frac{C}{S} = AS^{\alpha-1}.$$

Thus, when the store elasticity of cost is less than 1 (α <1), $\frac{dC}{dS} < \frac{C}{S}$.

Chapter 4. An Empirical Study on the Impacts of Cross-channel Integration on Retailers' Cost Efficiency

4.1 Introduction

The development of the Internet and e-commerce (EC) changed retailing situation (Verhoef, Kannan, and Inman, 2015). This change, which established multichannel (MC) retailing, drives retailers to sell products and communicate with customers simultaneously through EC and physical stores (Zhang et al., 2010). MC retailing first involves the decision to add new channels to the existing retail channel mix (Geyskens, Gielens, and Dekimpe, 2002). Thus, early studies on MC retailing focus on the effects of both online and offline channel operations on retail performance (Geyskens et al., 2002; Avery, Steenburgh, Deighton and Caravella, 2012; Min and Wolfinbarger, 2005; Homburg et al., 2014). However, previous studies identified both positive and negative influences of MC retailing on retailers' performance (Biyalogosky and Naik, 2003; Avery et al., 2012).

For this controversial argument, recent studies suggest that retailers' cross-channel integration is important to improve retailers' performances (Neslin and Shanker, 2009; Zhang et al., 2010; Cao and Li, 2015). Cross-channel integration can be defined as "the degree to which a firm coordinates the objectives, design, and deployment of its channels to create synergies for the firm and offer particular benefits to its consumers" (Cao and Li, 2015).

Further, previous studies assume that there are some stages retailers to develop cross-channel integration (Zhang et al., 2010; Cao and Li, 2015). First of all, retailers add a new channel to their existing channels, but they manage their channels individually. Second, retailers coordinate value proposition practices such as price, to increase customer value and sales (Zhang et al., 2010). Finally, retailers coordinate information and distribution systems, organizational structure and employees' management to optimize operational practices and increase organizational performances (Zhang et al., 2010; Cao and Li, 2015). Specifically, retailers start the integration process from the simplest functions, such as brand names and marketing messages, and then integrate complex functions, such as assortment, prices, distribution systems and organizational structures (Cao and Li, 2015).

Both conceptual and empirical works provide the consistent understandings of the positive impact of cross-channel integration on demand-related out comes such as customer perceived values (Neslin et al., 2006; Neslin and Shanker, 2009; Zhang et al., 2010; Van Baal, 2014; Herhausen et al., 2015) and sales growth (Cao and Li, 2015). However, there are pros and cons for impacts of cross-channel integration on organizational performances in previous studies on cross-channel integration and synergetic outcome of MC retailing.

Berger, Lee and Weinberg (2006) identify positive impacts on organizational performances. They find that integration of decision-making for online and offline channels leads to higher profit than individual decision-making for each channel. For the conceptual argument, Neslin and Shanker predict that integration leads higher cost efficiency through economies of scale and scope. For an empirical work, Oh, Teo and Sambamurthy (2012) identify that cross-channel integration leads retailers' higher perceived competence.

However, there are some negative arguments for cost-related outcomes. Conceptual works predict that integration of online and offline operations lead to higher operational complexity or difficulties and resultant inefficient operations (Verhoef et al., 2010; Zhang et al., 2010). Campbell and Frei (2010) do not directly assess cross-channel integration, but they reveal that retailers, which obtain sales synergy among online and offline channels have higher average cost because demand for direct human interaction at offline stores increases when customers who use both channels increase. Further, Ofek, Katona and Sarvary (2011) show that increased employees' support for both channels results higher expense and lower profit.

In sum, cross-channel integration has been discussed based on retailers' value proposition to customers and the synergetic impacts on demand-related outcomes have been conceptually discussed and empirically identified (Neslin et al., 2006; Neslin and Shanker, 2009; Zhang et al., 2010; Van Baal, 2014; Cao and Li, 2015; Herhausen et al., 2015). On the other hand, even though retailers obtain positive impacts on sales, their operation can be inefficient. (Campbell and Frei, 2010; Verhoef et al., 2010; Zhang et al., 2010; Ofek et al., 2011).

Nature of retailing makes difficult to understand how cross-channel integration effective for organizational performances. Retailers produce distribution and other added services through transaction with customers. Therefore, the transaction with

customers has been seen as a basic output of retailers (Mishra and Ansari, 2013). In comparison with manufactures, because retailers produce services to customers, their value proposition practices to customers such as assortment, advertising and services impact on their cost efficiency (Ingene, 1984). Hence, the effectiveness of cross-channel integration for cost-related performance is not clear in previous studies.

Furthermore, retailers have more complex cost structure than other service sectors due to product assortment and inventory management (Zhang et al., 2010). Therefore, how cross-channel integration impacts on cost efficiency is a key question to understand its effectiveness on overall organizational performances. Thus the objective of this study is to address following research questions: (1) how does cross-channel integration on retailers' cost efficiency, and (2) how do retailers' characteristics moderate the effect?

The empirical panel data analysis for Japanese retail market reveals that cross-channel integration has a positive impact on cost efficiency. This study contributes to the stream of studies on MC and omni-channel retailing by arguing the mechanism of cost efficiency in cross-channel integration context and testing the hypotheses empirically. Further, given the effectiveness of cross-channel integration is varied from firm-level characteristics (Cao and Li, 2015), it is necessary to address the moderating effect of both online and offline characteristics on the relationship between cross-channel integration and cost efficiency. Providing empirical understandings into the moderating factors, this study proposes further contributions and implications for managers.

For the firm-level characteristics, this study reveals the negative moderating effect of the length of EC experience. This result is empirically and logically consistent with Cao and Li's (2015) results. The result basically reveals that it is difficult to achieve economies of scale with respect to distribution in EC. Further, this result supports our proposed fundamental mechanism that MC retailers achieve cost efficiency from the complementarity of front-end and back-end systems. Therefore, this result contributes to studies on cross-channel integration not only by providing consistent results with Cao and Li's (2015) research but also by proposing a new mechanism for MC retailers to achieve better organizational performance.

To answer research questions, this chapter is organized as follows. First, this study summarizes conceptual foundation and develops hypotheses. Based on knowledge

about retail efficiency and interdependence theory, this study argues the relationship between cross-channel integration and cost efficiency. Following this, the article explains research methodology and current results. Finally, this study discusses the theoretical contributions and managerial implications and outlines limitations and future research directions

4.2 Conceptual Foundation

4.2.1 Cross-channel Integration

In the retailing context, multichannel retailing through catalogs and physical stores has been practiced since the 1920s, and MC retailing has been an important business subject in relevant academic fields since the 2000s because of the development of EC (Zhang et al., 2010). Therefore, retailers' activities that sell products and communicate with customers through multiple channels and, recently, online and offline channels (EC and stores) are the focus of recent research (Neslin et al., 2006).

MC retailing first involves the decision to add new channels to the existing retail channel mix (Geyskens et al., 2002). Thus, early studies on MC retailing focus on the effects of the existence of both online and offline channels on retail performance (Geyskens et al., 2002; Avery et al., 2012; Min and Wolfinbarger, 2005; Homburg et al., 2014). Channel addition can provide synergy between online and offline channels but can also cause cannibalization and complex administration. Therefore, although multichannel retailing first involves the decision to add new channels to the existing retail channel mix (Geyskens et al., 2002), integration across channels has become a primary focus of recent studies that attempt to understand how retailers achieve synergy among MCs (Neslin et al., 2006; Neslin and Shanker, 2009; Zhang et al., 2010; Oh et al., 2012; Cao and Li, 2015). Retailers integrate their MC operation in a range from complete separation to full coordination (Neslin et al., 2006).

Cao and Li (2015) summarized some approaches (narrow and broad) and perspectives (customer and firm-centric) to argue cross-channel integration. Narrow and broad approaches highlight a retailer's use of channels. A narrow approach defines cross-channel integration as consistent and homogenized offering to customers across channels (Avery et al., 2012). On the other hand, a broad approach emphasizes coordination across channels rather than a homogenized offering and focuses on

objectives, retail offerings, distribution and information systems, and the organizational structure of channels (Neslin et al., 2006; Cao and Li, 2015).

Customer-centric perspectives emphasize customer-oriented outcomes such as benefits offered to customers or customer shopping experiences (Gulati and Garino, 2000) while firm-centric perspectives emphasize benefits for firms such as sales synergy and cost efficiency (Neslin and Shanker, 2009; Verhoef et al., 2010). Therefore, cross-channel integration can be defined as "the degree of coordination of objectives, retail offerings, distribution and information systems, and organizational structure to create synergetic outcomes for firms and customer benefits" (Cao and Li, 2015).

Because this study aims to capture cross-channel integration comprehensively and to identify its impact on cost efficiency, the definition of cross-channel integration in this study contains both homogenized offering and coordination of operations. For example, measurement of cross-channel integration in this study includes homogenized retail brand name, promotions and coordinated merchandize planning.

Previous researches assume that there are stages to develop cross-channel integration (Zhang et al., 2010; Cao and Li, 2015). The level of integration can be defined as follows (Cao and Li, 2015). If a retailer operates multiple channels individually, then the integration level becomes one (lowest). If a retailer integrates brands or marketing communication, then the integration level becomes two. If a retailer integrates order fulfillment or consumer information access, then the level become three. If a retailer integrates fundamentals (services, promotion, price, assortment, and loyalty programs), the back-end system (logistics, information systems, databases), or organizational aspects (organization structure, recruiting, and incentive systems) level becomes four (highest).

4.2.2 Retail Efficiency

The definition of efficiency is the ratio of outputs to inputs (Ingene, 1982; Assaf, Barros, and Sellers-Rubio, 2011; Barros, 2006; Mishra and Ansari, 2013). Further, cost efficiency assesses how well a firm allocates and uses its resources to produce given outputs (Krasnikov et al., 2009).

Researchers commonly use two inputs to produce retail outputs, labor and capital. For labor input, number of laborers is the most common measurement (Arndt

and Olsen, 1975; Ingene, 1984; Kamakura, Lenartowicz, and Ratchford, 1996; Reardon, Hasty, and Coe, 1996; Barros, 2006; Yu and Ramanathan, 2008; Mishra and Ansari, 2013; Uyar, Bayyurt, Dilber, and Karaca,, 2013). There are several measurements for retail capital, but the most common measurement is the area of sales space (Arndt and Olsen, 1975; Ingene, 1984; Kamakura et al., 1996; Reardon et al., 1996; Barros, 2006; Yu and Ramanathan, 2008; Uyar et al., 2013). Some studies employ the monetary amount of assets as capital input (Betancourt and Gautschi, 1993; Yu and Ramanathan, 2008) and merchandise cost (Mishra and Ansari, 2013) as another input factor. These measurements are employed because sales space is an insufficient measurement to capture overall retail characteristics such as assortment variety, assurance of product delivery, information delivery, and ambience (Betancourt and Gautschi, 1993). Thus, merchandise cost represents assortment and inventory, and assets represent capital such as store environment and equipment structure to manage the inventory system and information delivery.

On the other hand, it is difficult to define retail output factors because of the lack of physical outputs by retailers (Ingene, 1984). In the academic field, most articles employ sales as an output measurement (Ingene, 1982; Barros and Alves, 2003; Sellers-Rubio and Mas-Ruiz, 2006; Uyar et al., 2013; Mishra and Ansari, 2013). Sales represent the monetary value of the quantity of products sold and include information on the quantity and price of products sold (Ingene, 1982; 1984). It shows that retail output is related to transactions between retailers and their customers because retailers provide distribution and added services to customers (Ingene, 1984).

Therefore, cost efficiency in retail context assesses allocation of resources to achieve sales and transaction with customers. Cost efficiency measures how well a firm well a firm use its resources to meet a given sales volume and market demand.

The primary focal outcome of this study is cost efficiency in the retail context. Some recent studies on offline store operation have suggested controversy concerning the effect of scale expansion on efficiency (Assaf et al., 2011; Barros, 2006; Evans, Bridson, Byrom, and Medway, 2008; Ganeshan, Ring and Strong, 2007; Illueca, Pastor, and Tortosa-Ausina, 2009; Srinivasan, Sridhar, Narayanan, and Sihi, 2013).

Some studies show that retailers expand their selling scale to increase their sales and market share, not to gain cost efficiency (Srinivasan et al., 2013) because general administration costs increases (Illueca et al., 2009).

On the other hand, Barros (2006) shows that the number of stores has a positive impact on retail efficiency using a data envelopment analysis. Assaf et al. (2011) show the positive relationship between the degree of geographical expansion and efficiency by conducting a Bayesian analysis.

These controversial arguments implies that scale expansion surpasses advantage in terms of cost of goods sold through quantity advantage (Ingene, 1984), but the same is not true for other costs including administration (Illueca et al., 2009; Srinivasan et al., 2013). It shows that retailers' scale expansion leads to efficiency in product purchasing but also creates more complex administration.

4.3 Hypotheses Development

This section firstly summarizes some differences about operations between online and offline channel, and then proposes hypotheses based on interdependence of integration components.

Online channel has several unique characteristics in comparison with offline store channel. The differences are basically derived from physical limitation of offline stores. Offline retailers locate physical store outlets to transact with consumers who can physically access to the store. However, online retailers do not face such physical limitation and it enables to transact with consumers in a broader sense. Offline stores also have narrower assortment than EC because the size of shelves is physically limited in offline stores. Further, because the Internet reduces consumer search costs (Bakos, 2001), consumers can compare more products and brands using EC. Thus, EC retailers must provide a wider and deeper range of products to satisfy customers' needs. But retailers can stock a wider assortment of products for online channels (Agatz, Fleischmann, and van Nunen, 2008), whereas it costs more to handle an equally large assortment at a physical store because of the physical capacity of each store. Additionally, store operation requires face-to-face sales assist for their customers, whereas EC only can engage online chatting (Alba et al., 1997).

Distribution systems are also different. This is because the type of cost for online customers to purchase products is different from offline customers. As the above explanation, consumers need to visit stores for purchasing products from offline stores. Therefore, consumers spend trip cost to be stores and go back their houses. On the other

hand, in general, consumers receive products at their houses when they purchase products from EC. In this case, customers need to wait for shipping and its waiting time can be calculated as waiting cost. Therefore, for retailers, product shipping management is different among online and offline selling. Distribution centers supporting an offline channel are organized to handle merchandise cartons and ship to each store as cartons, whereas distribution centers supporting an online channel are organized to receive merchandise in cartons and break the cartons down into individual products to send customers (Zhang et al., 2010). Because online transaction requires individual shipping for each customer, the cost for shipment increases when the sales amount increases. Therefore, cost structure of EC is different from offline stores and it is difficult for EC channel to obtain sales scale advantage in comparison with offline stores (Zhang et al., 2010).

These differences result difficulty for retailers to integrate online and offline operations (Zhang et al., 2010). Specifically, due to the low consumer search cost for online channel, retailers need to provide wide and deep assortment for satisfying online consumer needs whereas it costs more to carry an equally wide and deep assortment at physical stores. Thus appropriate assortment size for each channel is different and thus assortment integration is difficult (Zhang et al., 2010).

Further, it is difficult for retailers to integrate prices. Because the cost structures of EC and offline stores are different, retailers should charge different prices among channels. Pure play EC retailers set low price for selling products because consumer information search cost is low and consumers easily compare prices among many retailers (Bakos, 2001). EC retailers operate only a direct selling channel and develop distribution system to optimize their distribution and achieve low cost operation. However, MC retailers set similar prices to EC players in online market (Xing, Yang and Tang, 2006), unless consumers will compare prices easily and high priced MC retailers are not able to compete against EC retailers. Therefore, MC retailers need to coordinate product prices for each channel based not only on their operations but also on online and offline market conditions. These difficulties lead to higher complexity to manage when retailers integrate front-end practices.

It is important for retailers to achieve high-leveled front-end integration to provide synergetic value to customers to increase their sales growth through customer reliability, loyalty, conversion rate and cross selling (Van Baal, 2014; Cao and Li, 2015).

Further, increased sales amount leads to higher efficiency through distribution. However, difficulty of assortment and price integration obstruct retailers' cross-channel integration. Integration of back-end component plays an important role to solve this problem. Cross-selling environment that enable customers to switch online and offline channels for purchasing products and click-and-collect service require compatible distribution systems and inventory information systems across online and offline channels. If a product was out of stock or did not carried in a channel but another channel sells the item, inventory information should be integrated and customers who want to purchase the product can reach to the inventory information. Also if the distribution system was compatible, customers could choose the most convenient channel to purchase the product and receive the product from the most convenient channel. Click-and-collect service provides benefit for customers based on this compatible distribution. Click-and-collect service users prefer to collect items from their neighbor stores rather than wait the shipment at their houses. Inventory information should be shared to provide this service otherwise the specific item can be out of stock at a store that customer chose to collect. Further, supplementation of lacked items requires compatible distribution system or shared inventory information. Additionally click-and-collect service is effective in efficiency context because retailers do not ship products to each customer and retailers can distribute and stock products as usual offline inventories. Therefore, high-leveled front-end integration requires integrated back-end systems and it results higher sales growth (Cao and Li, 2015).

According to above arguments, this study predicts that integration of front-end and back-end components are complementarity (Ichniowski, Shaw and Prennushi, 1996) on cost efficiency. Complementarity refers to the increase of the use of one practice increases the productivity of another practice on objectives or outcome (Milgrom and Roberts, 1990; 1995). In other words, when complementarity exists, a practice is more effective when other practices are employed simultaneously.

The complementarities of practices are theoretically argued in incentive contract theory (Holmstrom and Milgrom, 1994; Ichniowski et al., 1996). For example, a practice such as using teams for problem solving may be more effective when other practices, such as incentive pay and training, are employed simultaneously (Ichniowski Shaw and Prennushi, 1997). Then complementarities of practices are and applied to the plant productivity (MacDuffie, 1995; Ichniowski et al., 1997), marketing (Nakata, Zhu

and Izberk-Bilgin, 2011) and MC retailing (Avery et al., 2012; Pauwels and Neslin, 2015). Complementarity should be considered as the impact of a group of practices rather than impacts of individual practice (Ichniowski et al., 1997). Therefore, for retailers with high integration level, integration of each component impacts as a group and complementarity among front-end and back-end exists.

Back-end integration is important to provide cross selling or click-and collect services. These services lead to higher sales amount and click-and-collect service. Further, the increased sales amount results scale advantages in distribution when retailers integrate back-end system. The integrated distribution system allows retailers to share purchasing cost into increased sales amount from both online and offline channels. Therefore, increased sales amount by cross-channel synergy increases MC retailers' cost efficiency through scale advantage in distribution (Inegene, 1982). Therefore, this study predicts that higher integration level leads to higher cost efficiency through complementarity of front-end and back-end components. Thus, this study proposes following hypothesis.

H1. Cross-channel integration has a positive impact on cost efficiency.

Firms-level characteristics influence the effectiveness of business strategy (Zeithaml, Varadarajan and Zeithaml, 1988). Within online and offline retail context, both retailers' online and offline characteristic should be considered as influential factors. In previous studies, the degree of online experience and physical store existence are major factors to consider the effects (Srinivasan and Moorman, 2005; Oh et al., 2012; Cao and Li, 2015). Therefore, this study also predicts moderating impacts of online experience and physical store existence.

The degree of firm online experience reflects how many years the retailer operates EC (Oh et al., 2012). Even though experienced retailers seems have higher efficiency, characteristics of EC operations may cause negative effect. Especially, this study identifies following three mechanisms; (1) an impact of EC experience on sales and (2) independence of EC management and (3) early adopter and technology development.

First, Cao and Li (2015) identify the negative moderating effect of online experience on the relationship between cross-channel integration and sales growth.

Customers of online experienced retailers have higher trust for the retailers and thus a lower perceived hesitation for EC usage. Therefore, online customers of greater online experience retailers are reluctant to shift to offline channel and synergy among online and offline channels become lower. Given that, the lower increase of sales amount makes the complementarity of front-end integration and back-end system integration weaker. Therefore, online experience can weaken efficiency by negatively moderating the sales increase by cross-channel integration.

Second, for the independence of EC management, when retailers add online channel to an existing offline channel, retailers tend to manage online channel independently (Zhang et al., 2010). If an independent EC channel has greater experience, it should have high performances such as customer online purchase (Biyalogorsky and Naik, 2003) and unique abilities to achieve high performances such encourage lower consumer search (Bakos, 2001). EC distribution has lower efficiency than offline stores due to the individual shipping for each customer (Zhang et al., 2010). Therefore EC experienced retailers are possibly influenced by EC operation that is less efficient than offline operation. This leads to greater operational differences between EC and offline stores and higher complexity and difficulty to integrate each channel.

Finally, when retailers begin EC, they invest information systems and organize their operation based on the technology at the time. However, technology development is really quick these days. Cost reduction of existing technology and new efficient technology such as Internet, IC chip and cloud systems are introduced. In other words, early EC adopters use the old technologies and design their organization structure based on the technologies that are undeveloped in comparison with technologies that followers (i.e., late EC adopters) employed. Thus, retailers update and reinvest their information system when new efficient technology become poplar and it requires adoption of organization structure. Therefore, early EC adopters need to reshape their organization structure and operational scheme, whereas followers can start their EC business with using the new efficient technologies and designing the organization structure and operational scheme based on the efficient technologies. Therefore, early EC adopters (i.e. EC experienced retailers) lose efficiency. Integrating arguments above, this study proposes following hypothesis.

H2. Retailer's online experience negatively moderates the impact of cross-channel

integration on cost efficiency.

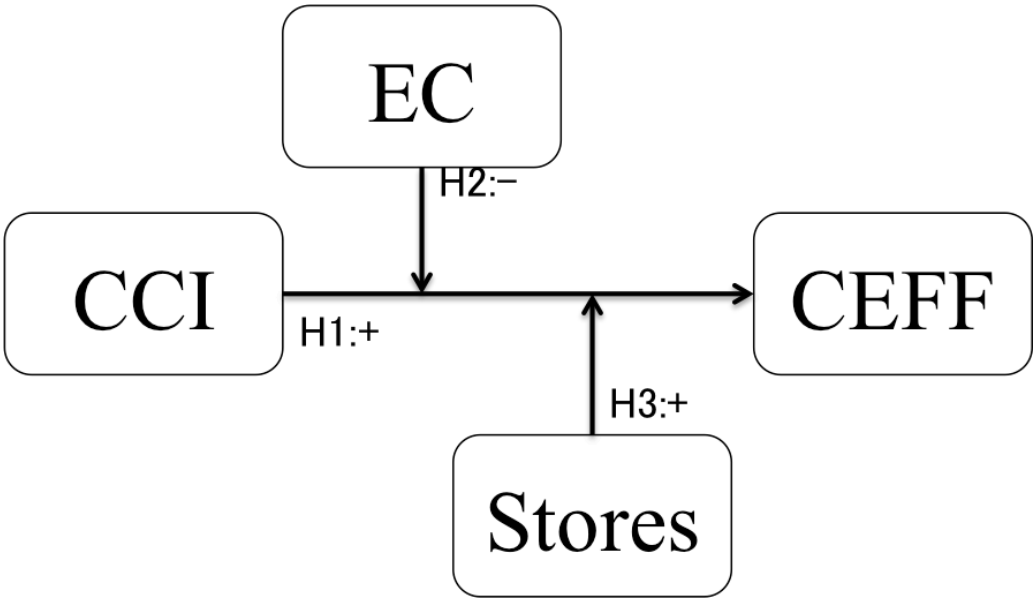
The retailer's physical store presence refers to the number of stores (Oh et al., 2012; Cao and Li, 2015). The number of stores is an important factor to consider, because it represents not only retailers' offline operational scale as a retail chain (Barros, 2006; Oh et al., 2012) but also retailers' operational characteristics. For example, even though two retailers have same total sales space as a firm, operational styles are different among a firm with a few large stores and many small stores. Retailers with larger number of stores need to prepare distribution network for each store to ship products. Therefore, retailers with large number of stores have wider distribution network than retailers with small number of stores. Therefore, retailers with large physical distribution network can use and share their existing distribution resources to develop cross-selling environment such as click-and-collect service.

Further, retailers with large store network have better coverage for multiple offline markets and online customers easily access their neighbor stores (Steinfield, Adelaar and Liu, 2005; Oh et al., 2012). Thus, retailers with more store outlets have larger sales amount for offline market. Therefore, a retailer with larger number of stores spread its purchasing cost into larger amount of product sold than a retailer with smaller number of stores. This study hypothesized that cross-channel integration leads to higher cost efficiency through complementarity of sales increase by front-end component and compatible distribution and information system by back-end system. If a retailer integrates its distribution system and has a large number of stores, the amount of product sold is larger and the cost can be spread into more products than a retailer with smaller number of stores. Integrating these arguments above, this study proposes following hypothesis.

H3. Retailer's physical store presence positively moderates the impact of cross-channel integration on cost efficiency.

Figure 2 represents a hypothetical framework of this study.

Figure 2 A hypothetical framework (Chapter 4)



4.4 Methods

4.4.1 Data Collection and Samples

The hypotheses are tested using a model developed and applied to the Japanese retail market. The data are publicly listed corporate level data collected from the retailer for four periods (2012-2015) and from financial reports sourced from EOL, a comprehensive business information database of Asian retailers, and corporate websites if necessary. 123 firms that operate both online and offline channels during the period listed in EOL as retailers were comprised. This study drops retailers that do not publish when they started EC and with missing values for the variables used in this study. As a result, 83 retailers, for a total of 305 firm-year observations were obtained. Thus, the dataset is an unbalanced panel dataset

4.4.2 Measurements

Cost efficiency and level of cross-channel integration, main variables of this study, are not directly observable from firm's IR information. Therefore, this study conducts stochastic frontier analysis (SFA) to derive cost efficiency variable (Krasnikov et al., 2009) and conducts content analysis for the level of cross-channel integration based on

empirical codes developed by Cao and Li (2015).

Cost Efficiency Estimation

To calculate cost efficiency value, this study estimate cost function by using SFA (Krasnikov, 2009). Cost efficiency is measured based on how a firm's inputs or costs are from the efficiency frontier (i.e. the most efficient firm) for a given firm set (Greene, 1993).

To calculate cost efficiency, this study follows two steps. Firstly, cost function for retailers is estimated.

$$(1)\ \ln C_i = f(w_i, y_i, e_i),$$

where C represents total cost of inputs, w represents input factor prices, y represents output and e represents residual. For the cost function estimation, this study employs number of laborers (Arndt and Olsen, 1975; Ingene, 1984; Kamakura et al., 1996; Reardon et al., 1996; Barros, 2006; Yu and Ramanathan, 2008; Mishra and Ansari, 2013; Uyar et al., 2013), fixed asset as a capital input (Betancourt and Gautschi, 1993; Yu and Ramanathan, 2008) and cost of goods sold as a merchandise cost (Mishra and Ansari, 2013) for input factors. This study also employs sales as an output measurement (Ingene, 1982; Barros and Alves, 2003; Sellers-Rubio and Mas-Ruiz, 2006; Uyar et al., 2013; Mishra and Ansari, 2013). Sales represent the monetary value of the quantity of products sold and include information on the quantity and price of products sold (Ingene, 1982; 1984).

SFA approach assumes that as a sample gets closer to the efficiency frontier, the error term becomes smaller (Krasnikov et al., 2009). Therefore, a sample that has the smallest error can be defined as the cost efficiency frontier within the sample set.

For the second step, this study calculate efficiency term "*CEFF"* for each sample as the difference between the residual for a given sample and the smallest residual within the sample set.

$$(2)\ \ CEFF_i \equiv \exp(\ln e_i - \ln \min e),$$

where *CEFF* represents value of cost efficiency, e represents residual for firm i and min e represents minimum residual value.

Because *CEFF* represents the difference between a retailer's cost efficiency and the cost efficiency of the most efficient retailer, higher (lower) value of *CEFF*

means to lower (higher) cost efficiency.

Level of Cross-channel integration

This study follows Cao and Li (2015)'s work and conduct content analysis to develop the level of cross-channel integration variable for each final sample. IR information such as annual report, financial report, financial results briefing materials and news release for each sample was collected as coding sample data. This study analyzes the data to identify cross-channel integration practices and firms' level of integration in each year based on the coding definition of Cao and Li (2015). As Cao and Li (2015), this study assumes that all integration practices reported in previous years in a specific firm persist for further years for the firm, even if they were not mentioned in the annual report for the further years.

Cao and Li (2015) manipulate the level of cross-channel integration as follows. If a retailer operates multiple channels individually, then the integration level becomes one. If a retailer integrates marketing communication, then the integration level becomes two. If a retailer integrates order fulfillment or consumer information access, then the level become three. If a retailer integrates fundamentals (services, promotion, price, assortment, and loyalty programs), the back-end system (logistics, information systems, databases, or HR management such as organization structure, recruiting, and incentive systems) level becomes four. The integration of fundamentals is regarded as a high-level practice because these factors usually require an integrated back-end system. For example, the coordination of assortment requires an integrated back-end system to efficiently manage inventory for both online and offline channels. Therefore, this study assumes that retailers start the integration process from the simplest functions, such as brand names and marketing messages, and then integrate functions that require integration of back-end or organizational components, such as assortment, distribution, and organizational structures (Zhang et al., 2010; Cao and Li, 2015). Thus, this definition of cross-channel integration is appropriate to capture the development process of integration within a firm.

Level of integration for each firm-year sample is measured as the "highest level of strategic activity for the given year" (Cao and Li, 2015). Therefore, if a retailer conducts two activities such as the use and presence of different channels (level one) and click

and pick up in-store (level three), the integration level would be three. This study employs single back-translation procedure for the codes into Japanese and applied codes into Japanese market. Table 7 shows the codes that this study employed and sample excerpts.

Further, figure 3 presents the chronological changes in the integration level within the samples that this study employs. For samples in 2012, most retailers operate MCs individually (i.e., for 38% of the retailers in the samples, the integration level is 1) and only for 4% of the retailers in the samples, the integration level is 4. Similar distribution has been observed for samples in 2013. However, in 2013, most retailers integrate brand names or marketing messages (i.e., for 32% of retailers in the samples, the integration level is 2), and for 18% of retailers in the samples, the integration level is 4. Further, in 2015, 24% of the retailers in the samples exhibit integration level 4. Therefore, from a chronological point of view, among the samples, retailers first operate MCs individually, then use consistent brand names or marketing messages, and finally, integrate more complex factors, such as fundamentals, back-end systems, and organizational components.

Figure 3 Integration level (2012-2015)

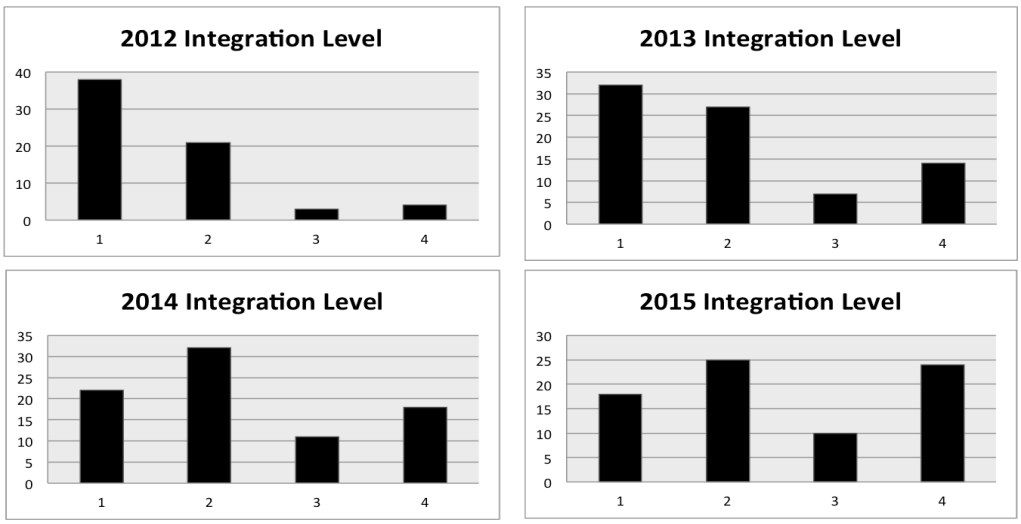


Table 7 Empirical Codes

Aspects	CCI level	Distinguishing subcategories	Codes	Sample excerpts
Front-end	Level2	Integrated marketing communication	Constant use of the same brand in all channels	"MUJI net shop" (Ryohin Keikaku Co., Ltd. Annual report 2013; "Opened "Aoyama tailor official online store" in September 2010" (Aoyama trading website http://www.aoyama-syouji.co.jp/about/outline/history_2006.html); "We assort home appliance, information and communication equipment, and entertainment products and propose pleasant life style to customers through a variety of specialized retail formats and online shop ." (Joshin Denki Co. Ltd. Financial statement 2013)
			Consistent marketing message across channels	
	Level 3	Integration of consumer order fulfillment	Click and pick up in store	As the first example of a department store format, we began an online product service through which customers can order online, fit, and receive services at stores. (MATSUYA Co., Ltd. Annual report 2014).
			Click-to-call	
			Buy online and return in-store	
		Integration of consumer information access	Access to online inventory and online order fulfilled by staff in store	"At the online store, we provide a function whereby customers can check in-store inventory and provide a service to allow products to be collected at a specified shop." (United Arrows Ltd. Annual Report 2014; "We distribute applications for smartphones called "MUJI Passports," which offer a new shopping experience for customers in 15th May." (Ryohin Keikaku Co., Ltd. Interim report 2013)
			Allowing online consumers to browse in-store inventories	
			Linkage between store and mobile apps (Wi-Fi in store; locating store by apps)	
	Level 4	Alignment of fundamentals	Aligned services	"We conducted a sale at both stores and the EC site called 'Apo select,' simultaneously." (Nihon Chozai Co., Ltd. Newsletter 2014 September)
			Aligned promotion	
			Aligned price	
			Aligned loyalty program	
			Aligned assortment	
Back-end		Centralized of back system	Integrated merchandize plannning system	We reduced lost sales opportunities from stock shortages by increasing the number of EC sites that connect to the distribution warehouse inventory information. Each website shows product pictures even if the website does not have the inventory, and when a customer orders the product, we send the product from the distribution warehouse (United Arrows Ltd. Annual report 2014) ; "We held a pre-season order service through the EC website to predict product demand. Because we could expect more sales volume for products with larger order volume, we could increase production beforehand" (United Arrows Ltd. Annual report 2013)
			Integrated logistics	
			Integrated of information system	
			Centralized call center service	
			Client database integration	
HR		Organization transformation	Knowledge sharing	"We established an omnichannel strategy department. (UNY Group Holdings Co., Ltd. 2015 annual report) ; we established a system to accurately evaluate when an employee recommended a product to a customer, but the customer bought the product by EC. Employees pass a formatted note showing the part number of the product to customers who are considering a purchase and do not have to buy immediately" (United Arrows Annual Report 2012)
			Recruiting talent with dual competencies in retail and EC	
			Changing organizational structure to adapt to the integration of different channels	
			Incentive system linked to both online and offline sales	

Online experience, Physical store Presence and Control variables

Retailer online experience ("*EC*") is approximated by logarithm of the number of years

in which firm has operated EC that calculated as the difference between the sample year and the year when the retailer started EC (Oh et al., 2012; Cao and Li, 2015).

Retailer physical store presence ("*Stores*") was measured by the logarithm of the number of physical outlets reported by retailers for each year (Oh et al., 2012; Cao and Li, 2015).

Moreover, as with testing the hypotheses, this study controls some sample characteristics that may have an impact on cost efficiency such as *retail formats,* which represent common characteristics among some retailers such as product assortment, services, distribution and the competitive environment (Ingene, 1984), *franchise system* (Donthu and Yoo, 1998) and the number of laborer that represents *firm size*.

4.4.3 Empirical Specification

This study focuses on whether cross-channel integration impacts on retailer's cost efficiency and the retailer's characteristics to moderate the impact. The data have panel structure and this study estimate fixed effect model because the result of Hausman test. The result rejected the null hypothesis that the random effect model is more appropriate than fixed effect model for the data ($p<0.05$). Thus the fixed model was more appropriate for this study.

This study estimates following lagged regression model.

(3) $$CEFF_{it+1} = \beta_0 + \beta_1 CCI_{it} + \beta_2 (CCI_{it} \times EC_{it}) + \beta_3 (CCI_{it} \times Stores_{it}) + \beta_4 EC_{it} + \beta_5 Stores_{it} + Controls_{it} + u,$$

where $CEFF_{it+1}$ is the cost efficiency value of the retailer i at time (t+1), CCI_{it} represents the level of cross-channel integration of the firm i at time t, EC_{it} represents the online experience of the firm i at time t, $Stores_{it}$ represents the physical store presence of the firm i at time t and $Controls_{it}$ represents the control variables such as *retail format*, *franchise system* and *firm size* for the firm i at time t. This study employed one year lagged model because it is possible to predict that highly efficient retailers have enough resources to invest and integrate the online and offline channels. Therefore, to clarify the causal effect, this study employed one year lagged data for explained variable.

4.5 Results

4.5.1 Descriptive Statistics and Correlation Results

Table 8 summarizes descriptive statistics and the correlation coefficients of the variables.

Table 8

	Mean	S.D.	1	2	3	4	5	6	7	8	9
1. Level	2.1278	1.1151	1								
2. EC	1.9069	0.73301	0.1929	1							
3. Stores	5.3238	1.884	0.2532	−0.0026	1						
4. Apparel	0.21967	0.41470	−0.0681	−0.011	0.1951	1					
5. GMS	0.04918	0.21659	−0.1759	−0.1735	−0.1057	−0.1207	1				
6. Depart	0.09836	0.29829	0.0313	0.1271	−0.5654	−0.1752	−0.0751	1			
7. Multi	0.1049	0.30695	0.1048	0.1428	0.1888	−0.1558	−0.0779	−0.1131	1		
8. Franchise	0.36393	0.48192	0.1029	−0.0028	0.4508	−0.0392	−0.1405	−0.227	0.1858	1	
9. Labor	11850.4	33402.6	0.1764	0.164	0.3786	−0.1007	−0.0205	−0.0445	0.4799	0.2266	1

4.5.3 Regression Results

Table 9 presents the results of the regression analysis for the model 3.

Table 9

	Hypotheses	Coefficient	S.E. (Robust)
CCI	H1: −	−0.010**	0.005
CCI × EC	H2: +	0.004**	0.002
CCI × BR	H3: −	−1.E−04	5.00E−04
EC		4.00E−03	3.E−03
BR		0.001	0.002
Apparel		−0.008	0.006
GMS		−0.002	0.008
Department		0.007	0.007
Multi−format		−0.006	0.005
Franchise		0.004	0.005
Labor		1.84E−07*	0.000
Constant		1.002***	0.013
R^2			
Within		0.121	
Between		0.001	
Overall		0.001	
Hausman		22.48**	

Hausman test reveals that random effect estimation does not provides consistent estimator ($p<0.05$). Therefore, this study employs fixed effect model to

estimate the empirical model. First, the table presents the main effect of cross-channel integration. Because of the definition of *CEFF* value, effects that increase (or decrease) retailers' efficiency are expressed as negative (positive) signals. The negative significant coefficient ($p<0.05$) shows that integration leads to higher cost efficiency, in support of H1.

Regarding to the moderating effect, online experience has a positive significant coefficient ($p<0.05$). Thus the result supports the H2 that online experience has a negative moderating effect on the relationship between cross-channel integration and cost efficiency. However, H3 was not statistically significant ($p>0.10$). Thus H3 was not supported.

4.6 Discussions and Conclusion

As retailers engaging in cross-channel integration, its impact on organizational performances has become an important issue. However, little is known about the relationship between cross-channel integration and organizational performances (Zhang et al., 2010; Cao and Li, 2015). Because retailers have complex cost structure than other service sectors due to product distribution and inventory management (Zhang et al., 2010), impacts of cross-channel integration on cost efficiency were the primary focus of this study. The analysis of 83 Japanese retail firms from 2012 to 2015 (305 firm-year observation) reveals that cross-channel integration has a positive impact on cost efficiency. As the hypothetical arguments, this study claims that integrated front-end component and its synergy in sales and integrated distribution system are complements. As a result, higher level of cross-channel integration leads to higher cost efficiency.

Furthermore, the results show that retailer online experience has a negative moderating effect on the relationship between cross-channel integration and cost efficiency. It implies that a firm with more experience and special ability on online channel obtains less efficiency from cross-channel integration. EC characteristics such as an impact of EC experience on sales, independence of EC management and early adopter and technology development lead to the empirical result.

However, physical store presence does not have a significant moderating effect. Hypothetical argument predicts that physical store presence provides positive moderating effect through quantity advantages. A plausible explanation of this result is

based on consumer behavior toward retailers. Physical store presence leads to consumers to categorize the retailer more as a traditional retailer than an EC retailer, and customers expect ability as a traditional retailer such as physical contact and communication with shop staffs (Benedicktus et al., 2010; Cao and Li, 2015). Thus consumers expect more human interactions with the retailers and it requires larger number of employees and offline support to customers. As a result, offline operation become less efficient and offset the quantity advantage on purchasing cost, and thus the coefficient of interaction term was positive but insignificant.

4.6.1 Theoretical Contributions

This study contributes to the stream of studies on retailers' online and offline operations by explaining why the cross-channel integration leads to higher cost efficiency and proposing the empirical evidences. Retailers need to integrate both front-end and back-end components to provide synergetic value for customers in MC environment. Because retailers produce services to customers, their value proposition practices to customers such as assortment, advertising and services impact on their cost efficiency. Further, inventory management of retailers leads to more complex cost structure than other service sectors and operations for EC and offline stores are different (Zhang et al., 2010). These facts lead to difficulties for retailers to integrate online and offline channel operations. Especially, it is difficult to integrate product assortment and prices and to provide cross-selling environment for customers. Cross-selling environment that enable customers to switch online and offline channels for purchasing products and click-and-collect service require compatible distribution and inventory information systems across online and offline channels. Therefore, retailers need to integrate both front-end and back-end components to achieve high-leveled cross-selling services. In the MC retailing context, this study argues a mechanism of the impact on cross-channel integration on cost efficiency based on complementarity of front-end and back-end integration and empirically reveals the significant evidence.

The empirical evidences also contribute to the previous studies because this directly analyzed the impact on organizational performance rather than demand-related performance. Although previous studies provides empirical evidences for the impact of cross-channel integration on customer performances (VanBaal 2014; Cao and Li, 2015)

and conceptually discuss effectiveness on organizational performance (Neslin et al., 2006; Neslin and Shanker, 2009; Zhang et al., 2010), it has not empirically clarified how cross-channel integration impacts on organizational performances (Zhang et al., 2010; Cao and Li, 2015). Especially, unless the importance, cost-related performance has not been empirically analyzed. This study provides clear relationship between cross-channel integration and cost-efficiency.

This study also addresses how firm-level factors moderate the relationship between cross-channel integration and cost efficiency. This study shows that greater EC experience causes inefficiency when retailers integrate online and offline channels. The negative moderating effect of EC experience shows that EC operation leads to inefficiency; this finding is consistent with the prediction of this study. Because the distribution process for EC transactions leads to lower scale advantages with respect to distribution (Zhang et al., 2010). EC diminishes the efficiency in distribution that is derived from integration.

Further, degree of EC experience impacts on sales (Cao and Li, 2015). EC experience negatively moderates the impact of cross-channel integration on sales growth. Online customers of retailers with greater EC experience place higher trust in the retailers and perceive convenience benefit; as a result, there is less probability for these customers to move to offline channels. Hence, retailers with greater EC experience have lower opportunity to achieve cross-selling synergy among online and offline channels. The resultant decreased sales make the complementarity of front-end and back-end systems weak. This result is logically consistent with a previous study (Cao and Li, 2015) and supports our proposed fundamental mechanism that MC retailers achieve cost efficiency from the complementarity of front-end and back-end systems. Therefore, this result contributes to studies on cross-channel integration not only by providing a consistent result with a previous study (Cao and Li, 2015) but also by proposing a new mechanism for MC retailers to achieve organizational performances.

4.6.2 Managerial Implications

According to the result, MC retailers should integrate their multiple channels to increase their cost efficiency, though the positive impact depends on a firm-level factor. The

results indicate some managerial implications. First, this study indicates the important practice for MC retailers. Specifically, this study emphasized the importance of compatible distribution systems for online and offline channels. Therefore, it is necessary for retailers to organize compatible distribution systems rather than focusing only on value proposition practices such as mobile application development and website design. Distribution centers for offline store channel is designed to ship merchandise cartons from distribution centers to each store whereas distribution centers for online channel are designed to break the carton down into individual items for individual customers (Zhang et al., 2010). Therefore, it is necessary for retailers to integrate distribution systems and information by creating compatible distribution systems that allow retailers to share product inventories for online and offline. For example, the systems that retailers ship products for online customers from stocks in offline stores and/or ship products to stores from online inventories are important goals for retailers. Further, a system to share and analyze sales trend at offline stores and ship appropriate amount of additional products for each store from online distribution centers is another example to establish compatible distribution.

Second, retailers should consider their individuality of EC department or operation. An EC experienced retailer seems to have advantages as a MC retailer. However, EC experienced retailers have higher individuality for their operation, and EC retailers have higher marginal cost for their distribution than physical store retailers (Zhang et al., 2010). Therefore, EC experienced retailers possibly have inefficient MC distribution systems than inexperienced retailers, because EC systems is more influential when retailers integrate their multiple channels. Further, as EC operation or department becoming more independent, it is more difficult to coordinate between EC and physical store department. The increased coordination cost results inefficiency. Thus, EC experienced retailers need to consider its independence and to conduct organizational coordination practices such as communication.

4.6.3 Limitations and Future Research Directions

The findings provide an important step to understanding the effectiveness of cross-channel integration for retailers. Further research is needed to expand the knowledge and to surpass the following limitations.

First, combined effect of integration components is a potential research. Even

though this study hypothetically argued the complementarity of front-end and back-end components, the analysis does not directly analyze the combined impact itself. Because retailers need to integrate back-end systems to achieve high-leveled front-end integration, the definition of the level of cross-channel integration (Cao and Li, 2015) is appropriate and thus the hypothetical arguments and the results of this study is reliable. However, the analysis of combined effect between front-end, back-end and organizational components provides better understanding about cross-channel integration.

Second, identifying antecedents of cross-channel integration is another potential future research. The level of integration is different from retailers. Therefore, what makes retailers to integrate their online and offline operations is another important research question. Retailers' characteristics, managers' traits and market conditions can impact on the decision.

Third, the specific impact of each factor of the front-end component is another research opportunity. The purpose of this study is to provide comprehensive arguments and empirical evidences about the relationship between cross-channel integration and cost efficiency. Therefore, the definition of cross-channel integration (Cao and Li, 2015) is appropriate for this study. However, within the front-end component, both homogeneity and coordination are included. Thus, whether homogeneity and coordination of operation have different impacts on retailer performance is another important topic for further studies.

Chapter 5. An Empirical Study on the Impacts of Cross-channel Integration patterns on Retailers' Performances

5.1. Introduction

Recently, retailers operate online selling channels such as e-commerce (EC) while operating physical stores simultaneously. This practice is called multichannel (MC) retailing. MC retailing incorporates retailers' multiple selling and communication channels (Zhang et al., 2010). Although MC retailing is not a new phenomenon, academics have particularly focused on MC retailing since the early 2000s because of the development of the Internet and EC (Zhang et al., 2010). MC retailing through online (EC) and offline (physical stores) channels has been studied as bricks and clicks (Min and Wolfinbarger, 2005), channel addition (Geyskens, Gielens, and Dekimpe, 2002), channel expansion (Homburg, Vollmayr, and Hahn, 2014), and the focal point has been whether MC retailing affects retailers' performance. However, MC retailing itself has both positive and negative impact on performances (Biyalogosky and Naik, 2003; Avery, Steenburg, Deighton and Caravella, 2012).

Therefore, recent studies focus on cross-channel integration (i.e., the integration between online and offline channels) as an important practice for retailers to obtain competitive advantages rather than simply focusing on whether a retailer engages in MC retailing (Neslin et al., 2006; Neslin and Shanker, 2009; Zhang et al., 2010; Herhausen, Binder, Schoegel, and Herrmann, 2015). The integration concept includes not only the value proposition for customers such as cross-selling that enables customers to switch online and offline channels easily but also systems and organization structures behind the value proposition. For cross-channel integration, there are three components such as front-end integration such as marketing communication, order fulfillment, consumer information access, services, promotion, price, loyalty programs, and assortment, back-end integration such as logistics and information systems and organization integration such as organizational structure, human resource management and employee incentive systems (Cao and Li, 2015).

This study advances arguments into the patterns of integration rather than arguing the vertical level of integration. Previous studies conceptually predict and

empirically reveal the effectiveness of cross-channel integration (Neslin and Shanker, 2009; Zhang et al., 2010; Oh, Teo and Sambamurthy, 2012; Cao and Li, 2015). However, it is not appropriate to assume that there is an ideal integration approach for all retailers because the effectiveness of integration is varied among firms' characteristics (Cao and Li, 2015). Therefore, appropriate approaches to integrate are different based on firm characteristics. For example, retailers with high-leveled personal services have their own ways to integrate the online and offline operations (Zhang et al., 2010). These retailers can apply the existing service skills and create service-oriented cross-selling environment by focusing on employee management and organization structure to provide high-leveled personal service among online and offline channels. On the other hand, retailers with wide physical distribution network can integrate their back-end systems and increase customer benefit and provide services that enable customers to purchase and receive products from the most convenient channel for them. Therefore, there are some patterns of cross-channel integration in managerial context.

Further, components of integration such as front-end, back-end and organization have different characteristics. Integration of front-end component and value proposition for customers positively impacts customer loyalty (VanBaal, 2014) and sales growth (Cao and Li, 2015). Retailers' efficiency is derived from scale advantages in back-end distribution (Tagashira and Minami, 2016). Further, Organization component leads to lower expense (Neslin and Shanker, 2009) and enhances the effectiveness of integration for retailers' perceived competence (Oh et al., 2012). Therefore this study focuses on the individual and combined effects of each component to identify effective patterns of cross-channel integration for organizational performances.

The argued performances are divided into those that are demand-related, such as sales growth and customer loyalty, and cost-related performances such as efficiency (Neslin and Shanker, 2009; Verhoef et al., 2010; Zhang et al., 2010). The summary of prior studies on the relationship between cross-channel integration and retailers' performances is presented in table 10. More specifically, table 10 shows that prior empirical studies provide insights into the effectiveness of cross-channel integration on retailers' competences (Oh et al., 2012), customer retention, loyalty, cannibalization (van Baal, 2014), and sales growth (Cao and Li, 2015). However, because cross-channel integration possibly causes additional operational difficulties and costs (Zhang et al.,

2010), studies that empirically demonstrate the effectiveness of cross-channel integration on profitability including cost-related performance such as efficiency are required (Cao and Li, 2015).

Moreover, identifying whether multichannel integration creates economies of scale is a key challenge (Neslin and Shanker, 2009). Retail efficiency is basically derived from scale advantage (Ingene, 1984). Retail growth is derived from increased scale. Increased sales scale leads to increased amount of a specific product to purchase and thus retailers can disperse the cost per one transaction for larger amount of product. Therefore, how can a retailer manage increased scale efficiently is a fundamental and important issue to concern in retailing context. Therefore, this study focuses on the scale advantages as the efficiency measure of MC retailers. Specifically, this study assesses economies of scale as a performance measure that represents the cost efficiency from a decrease in average cost when retailer output or production numbers increase (Hanoch, 1975).

Further, this study also employs profitability of retailers as another performance variables to identify not only the efficiency of the retailers but also abilities to reach consumer demand in a same time. Integrating arguments above, the objective of this study is to answer following research question: which integration pattern (i.e. combination of integration components) is effective to obtain economies of scale and higher profitability.

For answering the question, this study empirically tests hypotheses by using data that collected from the Japanese retail market. This study contributes to the stream of studies on MC retailing by arguing and empirically identifying the effective integration patterns. Further, this study expressively reveals that economies of scale are the fundamental efficiency mechanism for MC retailers.

The structure of this paper is organized as follows: the next section clarifies the conceptual foundation of components of cross-channel integration and economies of scale, and proposes hypotheses. Later, this study describes the empirical methods such as data collection, the measurements of variables, and empirical specification. Then, this study presents the estimation and test results. Finally, a discussion of the empirical results, contributions to previous research stream, and limitations that lead to suggestions for future studies are presented.

Table 10 Studies on the impact of cross-channel integration on performance

Author	Research Approach	Data	Outcome(s)
Berger et al. (2006)	Mathmatical model (Coorporative Advertising model)	n.a	Profit (+)
Neslin et al. (2006)	Literature review and conceptual arguments	n.a.	Consumer preference, perception, Customer life time value, loyalty and Sales
Neslin and Shanker (2009)	Literature review and conceptual arguments	n.a.	Consumer preference, perception, customer loyalty, sales,customer life time value, economies of scale, economies of scope and profit
Verhoef et al. (2010)	Literature review and conceptual arguments	n.a.	Competitive advantage, a rallying point for the organization, economies of scale, economies of scope, channel efficiency and financial return
Yan et al. (2010)	Game theory (Direct- and indirect-dual channelintegration model)	n.a.	Profit (+)
Zhang et al. (2010)	Literature review and conceptual arguments	n.a.	Cost, customer satisfaction, loyalty and strategic resources, profitablity
Avery et al. (2012)	Quasi-experimental design	Monthly panel data for multi-channel retailers in one U. S. state	Short-term (S) catalog sales (−), S online sales (+), Long-term (L) catalog sales (+) and L online sales (+)
Oh et al. (2012)	Survey data and PLS	Multichannel retailers in Singapore	Exploitative and Explorative capability (+)
van Baal (2014)	Survey data and PLS	Consumers in Germany	Customer retention (+), Cannibalization (−) and Customer loyalty (+)
Cao and Li (2015)	Interview and panel regression	Multichannel retailers in U.S. from 2008 to 2011	Sales growth(+)
Herhausen et al. (2015)	Technology adoption research and diffusion theory	Experimental data of German and Swiss consumers	Percieved service quality of EC (+), Intentional outcome for EC (+) and Intentional outcome for BR (n.s.)

5.2. Conceptual Foundation

5.2.1 Cross-channel integration

In retail context, MC retailing through catalogs and physical stores has been practiced since the 1920s, and MC retailing has been an important business subject in relevant academic fields since the 2000s because of the development of EC (Zhang et al., 2010). Therefore, retailers' activities that sell products and communicate with customers through multiple channels and, recently, online and offline channels are the focus of recent research (Neslin et al., 2006).

MC retailing first involves the decision to add new channels to the existing retail channel mix (Geyskens et al., 2002). Thus, early studies on MC retailing focus on the effects of the existence of both online and offline channels on retail performance (Geyskens et al., 2002; Avery et al., 2012; Min and Wolfinbarger, 2005; Homburg et al.,

2014). However, existence of online channel and offline channel itself has both synergetic benefit and cannibalization (Biyalogosky and Naik, 2003; Avery et al., 2012). Thus recent literatures focus on how to manage these MCs as a firm (Neslin et al., 2006; Neslin and Shanker, 2009). Especially, cross-channel integration has been emphasized as an important practice to achieve synergetic outcome for retailers (Zhang et al., 2010; Oh et al., 2012; Cao and Li, 2015).

Cross-channel integration is defined as "the degree of coordination of objectives, retail offerings, distribution and information systems, and organizational structure to create synergetic outcomes for firms and customer benefits" (Cao and Li, 2015). Further, previous studies assume retailers develop and maturate cross-channel integration based on following stages (Zhang et al., 2010; Cao and Li, 2015). First, retailers add new online (offline) channel to existing offline (online) channel. Second, they integrate fundamental value proposition practices such as brand, advertisement and assortment to coordinate basic value proposition to customers. At the end of the development process, they integrate distribution or information systems to optimize MC operation or organization structure to exploit channel capabilities of organization (Zhang et al., 2010; Cao and Li, 2015). However, even though the integration development is theoretically predictable, the ideal integration way for every retailer is not an appropriate assumption. Therefore, this study focuses on integration patterns that assess how to develop their integrated channels rather than a level.

Regarding to the assessment of cross-channel integration patterns, Cao and Li (2015) identify that cross-channel integration practices are divided into three components. First, they identified front-end integration, which represents practices at customer touch points and value proposition for customers such as marketing communication, order fulfillment, consumer information access, services, promotion, price, loyalty programs, and assortment. Second, the authors identify back-end integration, which represents purchasing and administration systems such as logistics and information systems. Finally, the authors identify organization integration, which represents the optimization of organizational structure and employee incentive systems.

5.2.2 Retail efficiency and economies of scale

This study employs economies of scale, cost-related efficiency as a performance

variable. Economies of scale refer to the cost efficiency from a decrease in average cost when retailer output or production numbers increase (Hanoch, 1975). The definition of efficiency is the ratio of outputs to inputs (Ingene, 1982; Assaf, Barros, and Sellers-Rubio, 2011; Barros, 2006; Mishra and Ansari, 2013). Because this is the most common interpretation of productivity in the retailing context, this study adopts this definition.

Retail efficiency is derived from the quantity advantage in the purchasing amount by increasing the sales scale (Ingene, 1984). In other words, retailers obtain economies of scale by spreading purchasing and fixed costs among a larger number of products. Further, retailers achieve ES for purchasing cost but not for other cost when they expand the sales scale (Tagashira and Minami, 2016)

In summary, retailers' outputs are different from manufacturer plant outputs and depend on transactions with customers such as sales. Retailers' scale expansion leads to productivity in product purchasing but also creates more complex administration.

5.2.3 Interdependence among Managerial Practices

This study applies interdependence as a theoretical framework to argue the combined effect of each component. In previous studies, combined effect of management practice has been analyzed as interdependence (MacDuffie, 1995; Ichniowski, Shaw, and Prennushi, 1997). Interdependence is composed of two forms—complementarity and substitution. If the practices are complements (or substitutes), the increase of the use of one practice increases (decreases) the productivity of another practice on objectives or outcome (Milgrom and Roberts, 1990; 1995).

The complementarities of practices are theoretically argued in incentive contract theory (Holmstrom and Milgrom, 1994; Milgrom and Roberts, 1995) and applied to the plant productivity (MacDuffie, 1995; Ichniowski et al., 1997), marketing (Nakata, Zhu and Izberk-Bilgin, 2011) and MC retailing (Avery et al., 2012; Pauwels and Neslin, 2015). For example, a practice such as using teams for problem solving may be more effective when other practices, such as incentive pay and training, are employed simultaneously (Ichniowski Shaw and Prennushi, 1997). The interdependence of management practices on productivity has been identified in the manufacturer context (MacDuffie, 1995; Ichniowski et al., 1997). Plant productivity was thought to

be determined by technological features. However, productivity differs among seemingly similar plants. Thus, the aforementioned studies focus on the source of performance differences among similar firms. Previous studies identify the impact of human resource (HR) management practices on plant productivity while controlling for the effect of the considerable technological features of equipment (Ichniowski et al., 1997; Ichniowski and Shaw, 1999). Additionally, previous studies examine the individual effect of each practice and the interdependence of the practices (Ichniowski et al., 1997).

Empirical studies identify the interdependence of management practices and other factors. For example, MacDuffie (1995) identifies the complementarity of HR management practices and buffers in a plant. Further, HR management practices enhance the positive impact of IT usage on productivity (Nevo and Wade, 2010). Therefore, previous empirical studies identify the combined impact on management practices and the combined impact on management practices and physical and technological features.

Furthermore, some marketing studies applied interdependences as their conceptual framework to argue the combined effect of any two practices or channels (Nakata, Zhu and Izberk-Bilgin, 2011; Avery et al., 2012; Pauwels and Neslin, 2015). For instance, interdependence framework will provide clear understanding of synergetic outcome of retailers' online and offline channels (Avery et al., 2012; Pauwels and Neslin, 2015).

These interdependences (complementarity or substitution) have been empirically analyzed by testing if the coefficient of the interaction term is positive or negative in a regression model (MacDuffie, 1995; Lumineau and Malhotra, 2011). Thus, this study adopts this approach to analyze the interdependence of cross-channel integration components.

5.3 Hypotheses Development

This section firstly argues the individual effect of each component and then proposes hypotheses about effectiveness of integration patterns based on interdependence of integration components. Referred to the previous studies, front-end is the first step to develop cross-channel integration (Zhang et al., 2010; Cao and Li, 2015) because value

proposition toward customer is the primary concern of MC retailers (Neslin et al., 2006; Neslin and Shanker, 2009). Hence this study argues three integration patterns as follows; (1) front-end oriented, (2) back-end oriented and (3) service oriented. For the front-end oriented, this study argues the individual effect of front-end component integration on performances. For the back-end oriented, retailers more focus on integrated distribution and information systems to manage integrated front-end services (i.e. back-end systems are simultaneously integrated). Therefore, interaction effect of front-end and back-end will be argued. Service oriented pattern focuses more on human interaction toward customer or organizational factors to operate MC retailing. Therefore, interaction effect of front-end and organization is argued.

Front-end component represents customer touch-point activities such as marketing communication, order fulfillment, consumer information access, services, promotion, price, loyalty programs, and assortment (Cao and Li, 2015). Fundamental differences such as assortment and price between online and offline channels lead to difficulty and complexity to integrate front-end components (Zhang et al., 2010). The differences are basically derived from physical limitation of offline stores. For offline stores, available assortment width and depth are physically limited. On the other hand, retailers can stock a wider and deeper assortment for online channels (Agatz, Fleischmann, and van Nunen, 2008), whereas it costs more to handle an equally large assortment in stores because of the physical capacity of each store. Therefore, for integrating assortment, retailers need to provide a greater variety of products at EC than store and encourage customers to easily switch from offline channel to online channel when a product is out of stock in an offline store (Zhang et al., 2010). This activity requires integrated distribution and information systems to share products and inventory information for both channels.

Additionally, different cost structures between EC and physical stores (Grewal et al., 2010) and lower consumer searching costs for EC result different optimal prices between EC and physical stores (Ratchford, 2009). Product shipping management is different among online and offline. Distribution centers supporting an offline channel are organized to handle merchandise cartons and ship to each store as cartons. However, distribution centers supporting an online channel are organized to receive merchandise in cartons and break the cartons down into individual products to send each customer (Zhang et al., 2010). Thus, it is difficult to obtain scale advantages

in cost for EC operation because increased sales amount leads to additional shipping cost. Therefore, distribution cost structures are different between online and offline channels that offline channel can obtain economies of scale in distribution whereas it is difficult in EC context.

Further, pure play EC retailers set low price for selling products because consumer information search cost is low and they easily compare prices among many retailers (Bakos, 2001). EC retailers operate only a direct selling channel and develop a distribution system to optimize their distribution and achieve low cost operation. However, MC retailers need to set similar prices to EC retailers in online market (Xing, Yang and Tang, 2006), unless consumers will compare prices easily and high priced MC retailers are not able to compete against EC retailers. Therefore, MC retailers need to develop a compatible distribution system such allow to ship products for online customers from stocks in offline stores, and/or to ship products to stores from online inventories to coordinate product prices. As a result, price coordination becomes difficult for MC retailers without integrating back-end system simultaneously (Zhang et al., 2010). Integrating arguments above, front-end oriented pattern diminish scale advantage in cost. Therefore, this study proposes following hypotheses.

H_{1a} Front-end integration has a negative effect on ES.

On the other hand, front-end integration leads to increased demand quantity. Consumers tend to categorize MC retailers as physical store players rather than pure EC players and physical store presence enhances the reliability (Benedicktus, Brady, Darke and Voorhees, 2010). Therefore, consistent use of retail brand name and marketing massages leads to higher reliability as a retailer. Further, customer information access to online and offline channels leads to higher perceived service quality (Herhausen et al., 2015), and front-end integration leads to higher customer loyalty toward retailers (VanBaal, 2014). As a result, front-end integration leads to higher customer perceived value and higher sales growth if a retailer provides cross-selling environment that enables customers to seamlessly and compatibly use online offline channels (Cao and LI, 2015). Thus, front-end integration results synergetic sales increase.

However, as we argued above, some front-end integration practices such as price, assortment and click-and-collect services requires integrated back-end systems.

Thus the positive effect of front-end integration on sales is weaker and not enough to surpass the negative effect in cost side when back-end is not simultaneously integrated. Further, even though front-end integration has positive effect on demand quantity, it is important for retailers to integrate back-end systems to develop cross-sell environment. Integrating arguments above, this study proposes following hypothesis about the relationship between front-end integration and profitability.

H_{1a} Front-end integration has a negative effect on profitability.

Second, back-end component represents distribution and administration systems (Cao and Li, 2015). Inventory management is different across online and offline channels. Specifically, retailers ship and manage inventory for offline stores as a carton whereas they break down the carton into individual items for online sales (Zhang et al., 2010). Therefore, retailers need to integrate inventory distribution and information by creating compatible distribution systems that allow retailers to ship products for online customers from inventories in offline stores and/or to ship products to stores from online inventories. Compatible and centralized distribution systems require integrated merchandise system. Distribution can be compatible when products are shared across online and offline channels, otherwise a retailer needs to build optimal distribution systems such as inventories and information management for each channel and they will loose shared benefit of centralized distribution systems and efficiency. Thus centralized distribution system can be effective for efficiency through the economies of scale and scope (Neslin and Shanker, 2009).

This study argues that the individual impact of front-end on economies of scale is negative. This is because front-end integration leads to operational difficulty for assortment and prices without integrated and compatible distribution and information systems to share inventory information between channels. Specifically, cross-selling environment that enable customers to switch online and offline channels seamlessly require compatible distribution and inventory information across online and offline channels. If a specific item was out of stock or did not carried in a channel but it was available in another channel, inventory information should be integrated and customers who want to purchase the product can reach to the available inventory information. Also if the retailer provides compatible distribution system, customers could order and

receive the product from the most useful channel for them. Click-and-collect service provides similar benefit for customers. Click-and-collect service users prefer to collect items from their neighbor stores rather than wait the shipment at their houses. For this service, inventory information should be shared and distribution should be compatible to specify which store has inventory of the ordered product and to supplement the lacked items at the store. Therefore, high-leveled front-end integration requires integrated back-end systems and it results higher sales growth (Cao and Li, 2015).

Integrating arguments above, for back-end oriented pattern, this study predicts that integration of front-end and back-end components are complements on cost efficiency. When retailers integrate front-end and back-end components simultaneously, the sales amount increases by providing cross-selling environment and the increased sales amount. Integrated and compatible distribution systems allow retailers to obtain scale advantages in distribution. Hence, integration of both front-end and back-end components results synergetic increase of sales among online and offline channels and the increased sales amount leads to scale advantage in integrated distribution. Therefore, retailers obtain higher efficiency in cost by economies of scale.

Furthermore, this study also predicts that this integration pattern (combination of front and back-end components) provides synergetic sales increase through cross selling. In other words, this study predicts that the combination of front-end and back-end is effective for both cost and sales performances. Therefore, subsequently, retailers achieve higher profitability through back-end oriented integration. Therefore, this study proposes the following hypotheses.

H_{2a} Back-end integration positively enhances the effect of front-end integration on ES.
H_{2b} Back-end integration positively enhances the effect of front-end integration on profitability.

Third, organization component represents the optimization of HR management systems, organizational structure, incentive systems, and the recruitment of employees with the ability to manage both physical stores and EC (Cao and Li, 2015). Some mathematical calculations show that centralized organization structure leads to lower expenditure and higher profit than individual decision-making unit (Berger, Lee and Weinberg, 2006; Neslin and Shanker, 2009). When a headquarter operates two

channels, separate (independent) decision making leads to higher cost and lower profit than integrated organization structure.

However, conceptual works predict that there are operational complexity or difficulties to integrate organization structure and additional cost to integrate (Verhoef et al., 2010; Zhang et al., 2010). Consumers tend to categorize a MC retailer as a traditional retailer than EC retailer, and expect personal services such as physical contact and communication with shop staffs (Benedicktus et al., 2010). Campbell and Frei (2010) do not directly assess cross-channel integration, but they reveal that even though retailers obtain sales synergy among online and offline channels, average cost increases because demand for direct human interaction at offline stores also increase. Therefore, synergetic demand increase requires more number of laborers at physical stores. Further, incentive payment and recruitment of high skilled people leads to higher cost. Ofek, Katona and Sarvary (2011) show that increased employees' support for MCs results higher expense. Therefore, even though organizational integration theoretically leads to higher cost efficiency, it requires additional cost and inefficiency from managerial point of view. Therefore, this study proposes following hypothesis.

H_{3a} Organization integration negatively enhances the effect of front-end integration on ES.

On the other hand, organizational integration has a positive impact on sales. Incentive system and high skilled employees lead to better services and value proposition at customer touch points. Normally, employees who work for a specific channel concern the performance of their own channel. Therefore, high skilled people to manage both channels to avoid cannibalization (VanBaal, 2014) are an important resource to provide synergetic benefit for customers. Further, store employees need to encourage customers to use online channel if a product was out of stock at the store and try not to miss the selling opportunity as a firm. Therefore, the incentive for employees to introduce online channel to offline customers and the knowledge about the online procedure are required. As a result, retailers with integrated organization component have higher ability to provide new services and to increase sales (Oh et al., 2012). According to above arguments, service oriented integration pattern leads higher ability to increase sales but the increase sales result higher average cost. Therefore, this study

proposes following hypothesis.

H_{3b} Organization integration positively enhances the effect of front-end integration on profitability.

Figure 4 represents the hypothetical framework for the impacts on economies of scale whereas figure 5 represents impacts on profitability (π).

Figure 4 A hypothetical framework 1 (chapter 5)

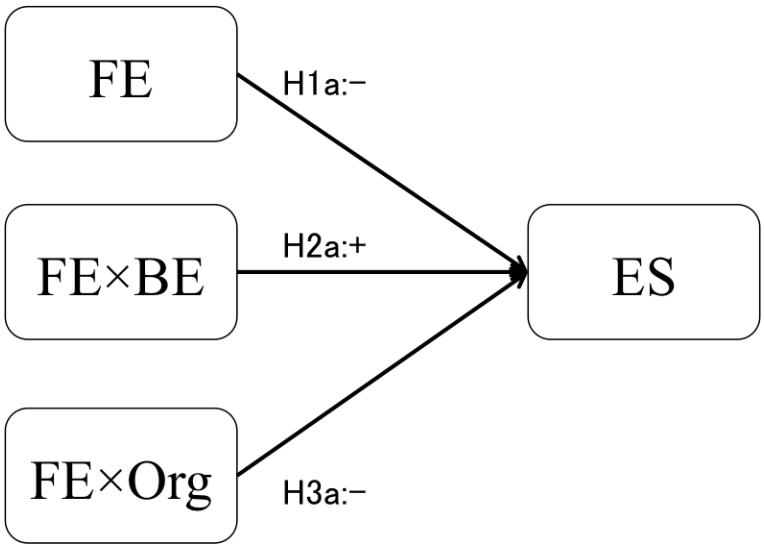
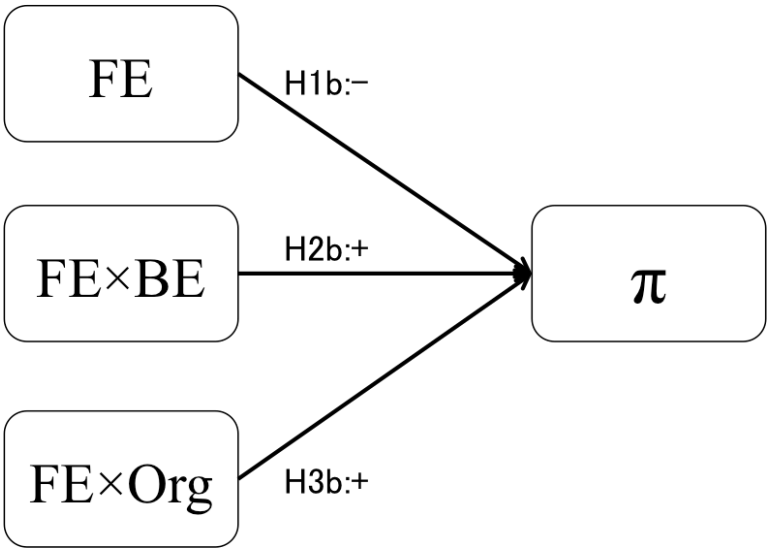


Figure 5 A hypothetical framework 2 (chapter 5)



5.4. Methods

5.4.1 Data collection

The hypotheses are tested using empirical models that developed and applied to the Japanese retail market. This study collects both quantitative data and qualitative data for analysis.

The quantitative data are publicly listed corporate level data collected from the retailer for three periods (2013, 2014, and 2015) and from financial reports sourced from EOL, a comprehensive business information database of Asian retailers, and corporate websites if necessary. All companies that operate both online and offline channels listed in EOL as retailers were selected, and samples with missing values were dropped. As a result, 310 samples were obtained. EOL contains information from stock exchanges across the country and data for some unlisted retailers. Therefore, it is considered an appropriate database to comprehensively collect Japanese retailers' data.

Qualitative data for the samples was collected to generate variables of integration patterns. Specifically, this study identified each retailer's practices related to MC retailing and cross-channel integration using their investor relations (IR) information such as annual reports, financial statements, news releases, and explanatory briefing materials and corporate websites.

This study focuses on the impacts of integration patterns (i.e. individual and combined effect of components) rather than chronological development of integration. Therefore, even though this study collects data from several years period, this study analyzes the data as pooled cross-section data rather than panel data. Thus this study especially focuses on the impacts of integration patterns on performances for each firm-year sample.

5.4.2 Measurements

Economies of scale

To analyze the effects of cross-channel integration on economies of scale, this study employs the predicted value of economies of scale for each sample by using the

estimation results for cost function because economies of scale is not a directly observable variable. Previous studies on retail productivity employ an indirect cost function based on a duality theory approach (Kamakura Lenartowicz and Ratchford, 1996). For specification of the functional form, Kamakura et al. (1996) adopt a trans-log functional form to assess retail productivity (Christensen and Greene, 1976).

To achieve cost function, total cost C is defined as

$$C \equiv min \sum_{i}^{m} w_i x_i \;\; s.t. \; y = g(x), \quad i = 1,2, \dots, m.$$

where *y* represents the output quantity, *w* represents input prices and *x* represents input factors. As a result, the following cost function shows the minimized cost subject to produce the output quantity *y*.

$$C = f(w_i, y).$$

The trans-log cost function can be written as

$$\ln C = \alpha_0 + \sum_i \alpha_i \ln w_i + \frac{1}{2}\sum_i \sum_j \alpha_{ij} \ln w_i \ln w_j + \alpha_y \ln y + \frac{1}{2}\alpha_{yy}(\ln y)^2 + \sum_i \alpha_{iy} \ln w_i \ln y,$$

where *C* represents total cost, which is calculated as a summation of all of the input factors and $\alpha_{ij} = \alpha_{ji}$. Additionally, this model implies the following restriction among parameters (Christensen and Greene, 1976).

$$\sum_i \alpha_i = 1,$$

$$\sum_i \alpha_{ij} = \sum_j \alpha_{ij} = \sum_i \sum_j \alpha_{ij} = 0\,.$$

Given Shepard's lemma, the cost share equation is derived, and this study estimates the cost share and trans-log cost function, simultaneously, using SUR (seemingly unrelated regression).

$$S_i = \frac{w_i x_i}{C} = \frac{\partial \ln C}{\partial \ln w_i} = \alpha_i + \sum_j \alpha_{ij} \ln w_j + \alpha_{iy} \ln y,$$

The cost share equation implies the following assumption

$$\sum_i S_i = 1,$$

where the assumption shows that the sum of cost share becomes one. Thus, this study,

simultaneously, estimates the trans-log cost function and two cost share equations using SUR.

The economies of scale for total outputs are defined as

$$ES = \sum_{k}\left(1 - \frac{\partial \ln C}{\partial \ln y}\right) = 1 - (\alpha_y + \alpha_{yy} \ln y + \sum_{i} \alpha_{iy} \ln w_i),$$

where ES represents economies of scale, α represents the estimated parameters by SUR, and y represents output. The results with a positive value represent scale economies, whereas negative values represent scale diseconomies (Christensen and Greene, 1976). For example, the positive value of ES implies following inequality.

$$\frac{\partial \ln C}{\partial \ln y} < 1.$$

Therefore, the positive value of ES indicates that costs increase efficiently.

This study defines the predicted economies of scale value for retailer n, n = 1, 2, …, 310, as follows.

$$ES_n = 1 - (\alpha_y + \alpha_{yy} \ln y_n + \sum_{i} \alpha_{iy} \ln w_{in}),$$

where y_n represents output for retailer n, and w_{in} represents the input factor price i for retailer n.

The variables representing retail output is sales. Sales are the monetary value of physical products in millions of Japanese yen purchased by customers (Ingene, 1982; Barros and Alves, 2003; Sellers-Rubio and Mas-Ruiz, 2006; Uyar, Bayyurt, Dilber and Karaca, 2013; Mishra and Ansari, 2013).

Variables representing inputs are labor, capital, and assortment. In the cost function estimation, this study uses the unit price of each input factor. The unit price of labor is defined as the ratio between total labor costs to the number of laborers including part-time workers. Some studies employ assets as retail capital (Betancourt and Gautschi, 1993; Yu and Ramanathan, 2008). However, in general, retailers operate their businesses using their own assets and lease. Therefore, this study employs summation of fixed assets and rental charge as the monetary value of capital because although sales space is a fundamental capital input in the retail context (Arndt and Olsen, 1975; Ingene, 1984; Kamakura et al., 1996; Reardon, Hasty, and Coe 1996; Barros, 2006; Yu and Ramanathan, 2008; Uyer et al., 2013), retailers' equipment and structure also represent considerable capital store environments and ambience (Betancourt and Gautschi, 1993;

Yu and Ramanathan, 2008). The unit price of assortment is defined as the cost of goods sold divided by the number of stores. This study defines the unit price of assortment as cost per store because stock and merchandise represent the sales at each store (Mishra and Ansari, 2013).

This study controls for several factors to identify the impact of cross-channel integration. For example, because sales value can be improved by higher price setting, market share that represents market power may affect the estimation. Thus, this study employs market share as a control variable.

Ingene (1984) shows that the type of retail format strongly affects retail productivity because of the differences in retail operations, such as assortment type and selling and promotional strategies. Assaf et al. (2011) focus only on supermarkets in their analysis of retail efficiency and control for differences in assortment and service between formats. Thus, the characteristics inherent to specific formats related to retail operational strategies such as assortment, selling, promotion, and service affect efficiency. Therefore, this study controls for the effect of format using dummy variables for some major formats. Because *franchise system* is another potential factor affecting retail productivity (Donthu and Yoo, 1998), this study also controls for the franchise system. Appendix 2 specifies variables for cost function estimation.

Profitability

Economies of scale describe how a retailer's cost is efficient when the operational scale increases (Hanoch, 1975). On the other hand, profitability assesses not only the cost efficiency but also how well a firm reaches market demands and satisfies customer needs (Krasnikov et al., 2009).

However, profit amount itself is influenced by not only the ability of firms but also the product price. Even if two retailers had same ratio between profit and sales, profit amount of a retailer with expensive products would be higher than a retailer with cheap products. Therefore, this study employs ratio of the operating profit to the sales rather than amount of profit to assess retailers' ability to increase their profit. Profit here represents the operating profit from retailers' financial statement and thus the profit focuses on retailers' operational ability of each firm.

Cross-channel Integration Patterns

This study generates variables of cross-channel integration components from quantitative data by using retailers' IR information. For the variable development, this study conducts content analysis based on empirical codes that defined by Cao and Li (2015). Because this study aims to clarify the impacts of integration patterns (combinations of each component), dichotomous variables are generated for each component rather than generating an ordinal measurement of the integration level. Integration is carried out by retailers and is difficult to measure as a numeric measure. Therefore, this study employs dichotomous measurements for integration practices because dichotomous variables expressly define qualitative differences among samples. First, if a retailer mentions practices that refer to front-end integration, which represents practices at customer touch points and value proposition for customers such as marketing communication, order fulfillment, consumer information access, services, promotion, price, loyalty programs, and assortment, the front-end dummy variable become one. Second, if a retailer mentions practices that refer to back-end integration, which represents purchasing and administration systems such as logistics and information systems, the back-end dummy variable becomes one. Finally, if a retailer mentions practices that refer to organization, which represents the optimization of organizational structure and incentive systems, organization dummy variable become one. Appendix 3shows the empirical codes and sample excerpts.

As with testing the hypotheses, this study controls some sample characteristics such as *retail formats,* which represent common characteristics among some retailers such as product assortment and a competitive environment (Ingene, 1984), *franchise system* (Donthu and Yoo, 1998), the *number of stores* that represents retailers' offline operational scale (Barros, 2006) and *year* dummy variables that may have an impact on performances. Table 2 represents the measurement for empirical models.

Table 11 Measurements of Model 1 and 2

Notation	Variable	Definition	Related literature
ES	Economies of Scale	Predicted value based on cost function estimation result	Christensen and Greene, 1976
π	Profitability	Operating profit/Sales	
FE, BE, Org	Integration components	Dummy variables: takes a value of 1 if the sample is relevant, otherwise 0	Cao and Li, 2015
Stores	The number of stores	Number of physical outlet that is reported by retailers in each year	Barros, 2006
Controls	Formats (apparel, GMS, department store, multi-format), Franchise and Year (2012,2013)	Dummy variables: takes a value of 1 if the sample is relevant, otherwise 0	Ingene, 1984; Donthu and Yoo, 1998; Zhuang et al., 2002; Assaf et al., 2011;

5.4.3. Empirical specification

To identify the impact of integration patterns on performances, this study employs the following regression models. Model 1 represents the impacts of integration on economies of scale and model 2 represents the impacts on profitability.

(1) $ES_n = \beta_o + \beta_1 FE_n + \beta_2 BE_n + \beta_3 Org_n + \beta_4 (FE_n \times BE_n) + \beta_5 (FE_n \times Org_n) + X_n\lambda + u,$

where ES represents the predicted value of economies of scale *FE, BE*, and *Org* represent dummy variables of front-end, back-end and organization integration component based on content analysis and *X* represents a vector of control variables including the number of stores.

(2) $\pi_n = \gamma_o + \gamma_1 FE_n + \gamma_2 BE_n + \gamma_3 Org_n + \gamma_4 (FE_n \times BE_n) + \gamma_5 (FE_n \times Org_n) + + X_n\theta + v,$

where π represents retailers' profitability and rest of variables are consistent with model 1.

Because economies of scale have a "natural interpretation in percentage terms" (Christensen and Greene, 1976), Economies of scale represents the percentile change of total cost when output changes. Moreover, firms need to increase their input level to produce more output in general. Thus, the assumption that higher output requires higher

cost implies that the value of economies of scale is censored data and cannot assume a value above one. Ordinary least-square (OLS) estimation will not provide consistent estimators for the use of censored data (Cameron and Trivedi, 2009). Tobit model estimation is relevant to estimate linear regression models with censored explained variables. Further, profitability also is the censored data and cannot assume a value above one. Therefore, this study applies the tobit estimation method to the regression models above and tests the hypotheses.

With in the models, the impact of front-end integration can be shown as follows.

$$\frac{\partial ES_n}{\partial FE_n} = \beta_1 + \beta_4 BE_n + \beta_5 Org_n,$$

where β_1 represents the individual impacts of front-end integration practices (BE = Org = 0), whereas β_4 represents the interdependent impacts of front-end and back-end integration (i.e., the impact when retailers integrate front-end and back-end but not Org), β_5 represents the interdependent impact of front-end and organization integration (i.e., the impact when retailers integrate front-end and Org but not back-end). Therefore, the test results of $\beta_1 = 0$, $\beta_4 = 0$ and $\beta_5 = 0$ represent $H_{1a,}$ H_{2a} and H_{3a}, respectively. In model 2, $\gamma_1 = 0$, $\gamma_4 = 0$ and $\gamma_5 = 0$ represent $H_{1b,}$ H_{2b} and H_{3b}, respectively

5.5. Results

Table 12 represents descriptive statistics and the correlation coefficients of the explaining variables.

Table 12 Descriptive Statistics and Correlation Coefficients

	Mean	S.D.	1	2	3	4	5	6	7	8	9	10	11
1. Front	0.448	0.498	1										
2. Back	0.071	0.257	0.155	1									
3. Org	0.035	0.185	0.037	0.354	1								
4. Apparel	0.184	0.388	−0.076	−0.002	0.044	1							
5. GMS	0.026	0.159	−0.106	−0.045	−0.031	−0.077	1						
6. Department	0.106	0.309	−0.122	−0.055	−0.066	−0.164	−0.056	1					
7. Multi	0.087	0.282	0.090	0.093	0.249	−0.147	−0.050	−0.107	1				
8. Franchise	0.297	0.458	0.082	0.096	0.142	−0.035	−0.017	−0.201	0.175	1			
9. 2012	0.361	0.481	−0.152	−0.077	−0.072	−0.045	−0.038	0.024	0.054	0.026	1		
10. 2013	0.397	0.490	0.064	−0.070	−0.013	0.007	0.034	−0.023	−0.087	−0.022	−0.610	1	
11. Stores	1269.987	9122.167	0.108	0.302	0.097	−0.039	−0.020	−0.047	0.074	0.174	0.062	−0.057	1

Table 13 and 14 presents the estimation and test results of the model 1 and 2 respectively. The significant, negative effects of front-end ($p<0.01$) indicate that the

front-end individually reduces economies of scale, in support of H_{1a}. Further, the significant, positive effect of interaction term of front-end and back-end ($p<0.05$) indicates that the front-end and back-end are complements, thus, back-end oriented has positive effect on economies of scale and profitability, and H_{2a} and H_{2b} are statistically supported. On the other hand, results reveal that interaction term of front-end and organization components have a significant, negative effect ($p<0.05$), on economies of scale, as this study predicts as H_{3a}. However, significant impacts of front-end, and interaction term of front-end and organization on profitability were not identified ($p>0.10$), contrary to H_{1b} and H_{3b}.

Table 13 Results of regression model (1)

	Hypotheses	Coefficient	S.E.
FE	H_{1a}: —	−0.011***	0.003
BE		−0.042***	0.011
Org		0.039**	0.007
FE × BE	H_{2a}: ＋	0.034**	0.017
FE × Org	H_{3a}: —	−0.055***	0.012
Apparel		0.020***	0.004
GMS		−0.034***	0.005
Department		−0.051***	0.006
Multi-format		−0.023***	0.006
Franchise		0.010***	0.004
2012		−2.E−04	0.004
2013		0.011***	0.004
Stores		5.30E−07***	1.E−07
Constant		0.378***	0.004
Log likelihood		686.72	
F (296)		47.18***	

Table 14 Results of regression model (2)

	Hypotheses	Coefficient	S.E.
FE	H_{1a}: —	0.008	0.005
BE		0.001	0.005
Org		−0.007	0.007
FE × BE	H_{2a}: ＋	0.034**	0.017
FE × Org	H_{3a}: ＋	0.011	0.015
Apparel		0.033***	0.007
GMS		−0.005	0.007
Department		−0.012**	0.005
Multi-format		−0.011**	0.005
Franchise		0.008	0.006
2012		0.013**	0.006
2013		0.006	0.006
Stores		1.01E−06***	1.650E−07
Constant		0.022***	0.006
Log likelihood		532.8	
F (296)		15.47***	

5.6 Discussions

This study attempts to provide empirical evidence of the relationship between patterns of cross-channel integration and performances. Based on the analysis of Japanese MC retailers, this study confirms that different components and different combinations have different impacts on economies of scale and profitability. Specifically, front-end oriented integration (i.e. front-end component is integrated) has a negative impact on economies of scale whereas insignificant impact on profitability was identified. Substantial differences in operations across EC and physical stores, such as assortment width and depth (Agatz et al., 2008) and prices (Ratchford, 2009) cause increased operational difficulty and additional costs for integration. Further, even though the insignificance, the signal of coefficient of front-end on profitability is positive. Therefore, front-end oriented integration may increase demand quantity, but it is not enough to surpass the cost disadvantages in current situation.

On the other hand, back-end oriented integration (i.e. a combination of front-end and back-end integration) leads to complementarity of front-end and back-end components. This creates cost advantages by increasing the purchasing amount of products sold through the synergetic sales increase. As a result, this study clarifies that back-end oriented integration has positive effect on both economies of scale and

profitability. Table 15 shows the marginal effect of moderators and clarifies that the effect of front-end has a significant, negative effect on economies of scale when retailers do not integrate back-end, but this turns into an insignificant effect when retailers integrate back-end simultaneously. Further, table 16 represents the marginal effects on profitability. This identifies that the impact of front-end integration is not significant whereas it is significantly positive when back-end component is simultaneously integrated. These results imply that back-end modifies inefficient operations from front-end integration.

On the other hand, when retailers conduct service-oriented integration (combination of front-end and organization integration), HQ must coordinate merchandise practices that have substantial differences across channels such as price and assortment. This fact creates additional difficulty and complexity in the management of relevant merchandise practices for both channels. Higher personal support at stores requires more store staffs and thus leads to higher average cost. As subsection 6.4.2 demonstrates, this result represents the moderating effect of organization component on the effect of front-end on economies of scale while back-end system is not integrated. Therefore, this result reveals that integrated front-end and organization without back-end integration creates greater difficulty and costs for HQ and employees and a negative impacts on efficiency. This study predicts that service-oriented integration pattern results increased demand quantity and surpasses cost disadvantages. However, the combined effect does not have a significant, positive impact on profitability though the signal is positive. Therefore, service-oriented integration may increase demand quantity, but it is not enough to surpass the cost disadvantages in current situation.

Table 15 Marginal effects of moderators in model (1)

	Coefficient	S.E.
FE(BE=0)	−0.013***	0.003
FE(BE=1)	0.022	0.016
FE(HR=0)	−0.008**	0.003
FE(HR=1)	−0.063***	0.011

Table 16 Marginal effects of moderators in model (2)

	Coefficient	S.E.
FE(BE=0)	0.009	0.0052
FE(BE=1)	0.043***	0.0165

5.6.1 Theoretical Contributions

This study extends the research on the effects of cross-channel integration on retail performances by providing empirical evidence of the effects of cross-channel integration patterns on economies of scale and profitability. Because the relationship between cross-channel integration and cost-related productivity such as economies of scale has not been clarified (Neslin and Shanker, 2009), the results of this study address the knowledge gap.

The main theoretical contribution of this study is that the results advance the understanding of the relationship between cross-channel integration and retail performances. Prior studies on MC retailing note and classify the stages of integration development (Chaffey, 2010; Zhang et al., 2010; Cao and Li, 2015). The results of this study extend the argument into how retailers should develop their integration practices. This study focuses on three integration patterns such as front-end, back-end and service oriented integration and empirically analyzes the effectiveness of these patterns. For example, this study indicates that back-end component should be integrated with front-end operations, and retailers can reduce the difficulty of front-end integration by integrating back-end systems.

Another theoretical contribution is that this study provides empirical evidence of the effects of cross-channel integration on economies of scale and profitability. Although conceptual arguments emphasize economies of scale as a cost advantage of cross-channel integration (Neslin and Shanker, 2009; Zhang et al., 2010), there is a lack of evidence for this argument. Therefore, the empirical evidence provides knowledge of the impacts of various integration patterns on economies of scale and the profitability.

5.6.2 Managerial Implications

This study also provides some managerial implications. First, this study demonstrates the effective pattern for retailers to integrate MC practices. The results indicate that when retailers integrate online and offline channels, they should integrate back-end systems to reduce the increased difficulty and cost by integrating the front-end component. Therefore, the effective integration pattern that this study identified is an important suggestion for managerial field.

Second, this study identifies that retailers' offline operational characteristics impact on economies of scale and profitability. This study only employs MC retailers as samples. In MC retailing context, apparel specialty retailers have better economies of scale and profitability whereas department stores and multi-format retailers have lower economies of scale and profitability. These results imply that general assortment retailers face higher difficulty and complexity to manage for both online and offline channels. Therefore, in current situation, specialty retailers are suitable for MC operation. Further, recently, apparel retailers tend to vertically integrate their supply chain. Those retailers can achieve scale advantages in manufacturing processes. Therefore, limited assortment and vertical integration of supply chain are important characteristics to operate MC retailing efficiently.

5.6.3 Limitations and suggestions for future studies

This study has some limitations, which also suggest directions for future study. First, although this study demonstrates recommended integration patterns for retailers, why managers or HQs choose a specific integration pattern is not revealed. Therefore, studies that identify the antecedents of integration decisions such as HQ or market's characteristics may help to propose a comprehensive framework for cross-channel integration including antecedents, retailers' behavior, and performance.

Second, this study focuses on operating profit rather than ordinary profit as a performance of retailers because this study focuses on operational excellence of MC retailers. Therefore, this study does not assess financial instruments and real estate management. This point may results the fact that multi-format retailers have negative impact on profitability because most multi-format retailers are big holdings such as Seven & i holdings and Aeon and they exploit financial instruments and real estate management to increase profit. Because this study focuses on retailers' ability to operate

online and offline channelseffectively, operating profit is the appropriate measure for this study. However, retailers' ability to increase ordinary profit in MC retailing environment is another opportunity for future research.

Third, the dataset represents only Japanese retailers that tend to maintain smaller stores and a larger number of stores in comparison with retailers in western market. For example, although retailers with a large sales space per store, such as department stores and supermarkets, decrease their sales, convenience stores increase their sales (METI, 2012). Additionally, Japanese retailers have the same level of gross margin as western retailers, but Japanese retailers cost higher for administration than western retailers (METI, 2012). This implies that Japanese retailers' administration systems are not optimized and this characteristic may affect the results. In other words, efficient administration (e.g., effective standardization) may affect the relationship between cross-channel integration and economies of scale. Thus, although this study provides insights from a developed Asian retail market, replication of the analysis in a different market is required.

Appendix 2 Variables for cost function estimation

Notation	Variable	Definition	Related literature
C	Total cost	Summation of monetary value of input factors	
y	Sales	Sales (millions of JP yen)	Ingene, 1982; Barros and Alves, 2003; Rubio and Ruiz, 2006; Uyar et al., 2013; Mishra and Ansari, 2013
wl	Unit price of labor	Total labor cost/ amount of labor	Arndt and Olsen, 1975; Kamakura et al., 1996; Uyer et al., 2013
wc	Unit price of fixed assets	Capital/size (square meters) of sales space	Betancourt and Gautschi, 1993; Yu and Ramanathan, 2008
wg	Assortment cost per store	Cost of goods sold/number of stores	Mishra and Ansari, 2013
Capital cost	Fixed assets+rental Charge	Monetary value of fixed assets (millions of JP yen)	Betancourt and Gautschi, 1993; Yu and Ramanathan, 2008
Labor cost	Total labor cost	Total spent on salary and wages in a year	Arndt and Olsen, 1975; Ingene, 1984; Kamakura et al., 1996; Reardon et al., 1996; Barros, 2006; Yu and Ramanathan, 2008; Mishra and Ansari, 2013; Uyer et al., 2013
CGS	Cost of goods sold	Monetary value of cost of goods sold	Arndt and Olsen, 1975; Ingene, 1984; Kamakura et al., 1996; Reardon et al., 1996; Barros, 2006; Yu and Ramanathan, 2008; Uyer et al., 2013)
Controls	Marketi share, Formats (apparel, GMS, department store, multi-format), Franchise and Year (2012, 2013)	Dummy variables: takes a value of 1 if the sample is relevant, otherwise 0	Ingene, 1984; Donthu and Yoo, 1998; Zhuang et al., 2002; Assaf et al., 2011;

Appendix 3 Empirical codes

Components	Distinguishing subcategories	Codes	Sample excerpts
FE	Integrated marketing communication	Constant use of the same brand in all channels	"MUJI net shop" (Ryohin Keikaku Co., Ltd. Annual report 2013 ; "Opened "Aoyama tailor official online store" in September 2010" (Aoyama trading website http://www.aoyama-syouji.co.jp/about/outline/history_2006.html) ; "We assort home appliance, information and communication equipment, and entertainment products and propose pleasant life style to customers through a variety of specialized retail formats and online shop ." (Joshin Denki Co. Ltd. Financial statement 2013)
		Consistent marketing message across channels	
	Integration of consumer order fulfillment	Click and pick up in store	As the first example of a department store format, we began an online product service through which customers can order online, fit, and receive services at stores. (MATSUYA Co., Ltd. Annual report 2014).
		Click-to-call	
		Buy online and return in-store	
	Integration of consumer information access	Access to online inventory and online order fulfilled by staff in store	"At the online store, we provide a function whereby customers can check in-store inventory and provide a service to allow products to be collected at a specified shop." (United Arrows Ltd. Annual Report 2014 ; "We distribute applications for smartphones called "MUJI Passports," which offer a new shopping experience for customers in 15th May." (Ryohin Keikaku Co., Ltd. Interim report 2013)
		Allowing online consumers to browse in-store inventories	
		Linkage between store and mobile apps (Wi-Fi in store; locating store by apps)	
	Alignment of fundamentals	Aligned services	"We conducted a sale at both stores and the EC site called 'Apo select,' simultaneously." (Nihon Chozai Co., Ltd. Newsletter 2014 September)
		Aligned promotion	
		Aligned price	
		Aligned loyalty program	
		Aligned assortment	
BE	Centralized of back system	Integrated merchandize plannning system	We reduced lost sales opportunities from stock shortages by increasing the number of EC sites that connect to the distribution warehouse inventory information. Each website shows product pictures even if the website does not have the inventory, and when a customer orders the product, we send the product from the distribution warehouse (United Arrows Ltd. Annual report 2014) ; "We held a pre-season order service through the EC website to predict product demand. Because we could expect more sales volume for products with larger order volume, we could increase production beforehand" (United Arrows Ltd. Annual report 2013)
		Integrated logistics	
		Integrated of information system	
		Centralized call center service	
		Client database integration	
HR	Organization transformation	Knowledge sharing	"We established an omnichannel strategy department. (UNY Group Holdings Co., Ltd. 2015 annual report) ; we established a system to accurately evaluate when an employee recommended a product to a customer, but the customer bought the product by EC. Employees pass a formatted note showing the part number of the product to customers who are considering a purchase and do not have to buy immediately" (United Arrows Annual Report 2012)
		Recruiting talent with dual competencies in retail and EC	
		Changing organizational structure to adapt to the integration of different channels	
		Incentive system linked to both online and offline sales	

Chapter 6. Conclusion

6.1 Summary

The purpose of this dissertation is to reveal the impacts of integration of online and offline channels on the retailer performance, including cost-related outcomes. To achieve this research purpose, this dissertation conducts three empirical studies. The purpose of chapter 3 is to reveal how the number of stores impacts the cost structure of retailers. This chapter collects Japanese retail data and analyzes it using log-linear regression models to clarify the mechanism of retail efficiency that results in increased operational scale and lower purchasing cost, which represents the distribution side, but leads to inefficiency with respect to other administrative costs. This tradeoff relationship between purchasing cost and other costs establishes a fundamental framework about the relationship between scale expansion and efficiency in the retail context.

The purpose of chapter 4 is to reveal the impact of cross-channel integration on cost efficiency and the moderating effect of firm-level characteristics. Although the effectiveness of integration has been clarified for demand-related performance, its effect on organizational performance has been questioned in previous studies. This study employs a unique panel dataset with 305 firm-year observations to estimate our empirical model. The results of the panel data regression model indicate that integration has a positive impact on cost efficiency; however, length of retailers' EC experience negatively moderates this effect. By showing the effect of integration on cost efficiency and the moderating effect of firm-level characteristics, this study provides valuable insights to previous studies related to MC retailing.

Chapter 5 aims to discuss and empirically clarify the effectiveness of cross-channel integration patterns on retail performances. Chapter 4 captures cross-channel integration in a comprehensive way and implicitly treats the integration level as a bundle of each component. For example, in chapter 4, if a retailer mentions that he used an integrated distribution system in 2013 and that he used only an aligned assortment without mentioning the distribution system in 2014, this study would score his response at level 4 for both the years and interpret that the retailer integrates both front-end and back-end components in

2014. On the other hand, chapter 5 expressly argues the effectiveness of specific combinations of integration. Therefore, chapter 5 advances the findings of chapter 4 by focusing on how integration is achieved in each year rather than focusing on the comprehensive impact of integration. To clarify the effective integration patterns and test the hypotheses, this study gathers secondary data on 310 Japanese retailers. The empirical models demonstrate that the when the front-end and back-end systems are simultaneously integrated, integration positively impacts the economies of scale (cost-related performance) and profitability. Overall, the findings provide empirical evidence of effective integration patterns and progress prior arguments into integration patterns rather than assuming an ideal way of integration.

The findings in chapter 4 show that cross-channel integration has a positive impact on cost efficiency. On the other hand, Chapter 5 shows that front-end itself has a negative impact on economies of scale, which is a cost advantage to the retailer; however, the combination of integrated front-end and back-end systems has a positive impact on economies of scale. These results imply that front-end integration (i.e., retailers' integration practices at customer touch points) itself has a negative impact on cost-related performance; however, the complementarity of front-end and back-end integration positively impacts cost-related performance and profitability. The results in chapter 4 reflect this complementarity because the level of integration captures the bundle of integration practices.

Retailers grow their business by expanding scale and increasing sales. Traditionally, retailers operating formats such as department stores established large stores and widened the variety of products to reach a broader consumer demand. Further, retailers increased the number of stores in the form of chain stores to expand their operational scale that they could not achieve through single-store operation (Walters and White, 1987). Scale expansion helps retailers increase sales. However, scale expansion increases operational costs. Therefore, although scale expansion is necessary for retail growth, it also leads to lower efficiency due to increased management difficulty and complexity. Hence, scale expansion and efficient operations are both important aspects that retailers must consider to enhance their performance.

Furthermore, recently, retailers have been expanding their operational

scale not only by establishing new store branches but also through EC. Because EC operation does not require additional physical store establishment, retailers can easily transact with customers in a much broader sense through EC. However, fundamental differences between online and offline operations causes difficulty in managing both online and offline channels (Zhang et al., 2010). Therefore, the approach by which a retailer manages online and offline channels is an important factor affecting retail growth in the MC retailing context.

6.2 Theoretical Contributions and Managerial Implications

Empirical studies of this dissertation mainly contribute to the stream of studies on MC operation and cross-channel integration in the following three ways. First, this dissertation provides conceptual arguments and empirical evidences of the effectiveness of integration patterns on retail performance. Although previous studies clarify the importance of integration of online and offline channels, they do not discuss how a retailer can integrate channels. Chapter 5 theoretically discusses the effectiveness of integration patterns based on interdependences of integration components and empirically analyzes the individual and combined effects of each component. Therefore, the major contribution of this dissertation is that it advances arguments as to how integration can be achieved rather than assuming an ideal integration approach.

Second, this dissertation discusses how the integration of online and offline channels impacts cost efficiency and empirically tests the hypotheses. This dissertation mainly focuses on the cost-related performance of retailers. The impacts of retail growth and operational practices on cost efficiency are important issues to understand the effectiveness of the practices. In chapter 3, this dissertation reveals that increased scale leads to efficiency with respect to purchasing cost; however, it does not result in efficiency with respect to other costs. This result provides a framework to discuss how cross-channel integration impacts cost efficiency. Based on this framework, this dissertation empirically shows the positive impact of cross-channel integration on cost efficiency. The addition of an online channel may result in increased inefficiency (Zhang et al., 2010). However, this dissertation shows that the integration helps retailers achieve synergetic benefits for cost efficiency. Further, this dissertation shows that

back-end oriented integration has a positive impact on economies of scale and that the combination of back-end and front-end systems results in efficient operation. This implies that back-end oriented integration pattern leads to effective growth for MC retailers.

Additionally, this dissertation shows that retailers with greater EC experience achieve a relatively low cost efficiency when integrating online and offline channels. This finding shows that firm-level contingent factors affect the relationship between cross-channel integration and cost-efficiency. A prior study (Cao and Li, 2015) shows that EC experience negatively moderates the relationship between cross-channel integration and sales growth. Therefore, the result in chapter 5 is consistent with the prior study (Cao and Li, 2015) and implies that increased sales positively impact efficient back-end operations.

This dissertation has some managerial implications. First empirical evidences of the impacts of integration on retailer performance provide a direction to retailers for managing online and offline channels. The results and arguments in chapter 4 show the effectiveness of cross-channel integration for organizational performances. More specifically, this dissertation emphasizes the importance of the back-end component rather than simply focusing on the front-end component. Further, chapter 5 shows the complementarity between front-end and back-end components. The integration of front-end and back-end components leads to a cross-selling environment such that customers can order and collect the product from the channel that is most convenient to them.

Furthermore, the results imply possible integration steps for retailers. The results in chapter 5 imply that front-end oriented integration may increase the demand quantity; however, the increased quantity is not enough to surpass the cost disadvantages. Retailers can integrate the front-end component as a first step to increase sales and then invest to integrate it with the back-end component and thus improve their efficiency and profitability. This step is one of the options for retailers to develop cross-channel integration.

6.3 Limitations and Suggestions for Future Studies

Although this dissertation contributes to previous studies and provides some managerial implications, there are some limitations. First, the dissertation does not

cover why retailers choose a specific integration pattern and what drives retailers to integrate their operations. Therefore, studies that identify the antecedents of integration decisions, such as headquarters or market characteristics, may help propose a comprehensive framework for cross-channel integration, which includes antecedents, retailers' behavior, and performance.

Second, this dissertation focuses on operating profit rather than ordinary profit as a performance measure of retailers. Therefore, this dissertation does not assess financial instruments and real estate management. Because this dissertation focuses on retailers' ability to efficiently operate online and offline channels and meet consumer demand, operating profit is an appropriate measurement for this dissertation. However, the retailers' ability to increase ordinary profit in a MC retailing environment is a topic of potential research that may help assess the strength of giant retail corporations such as Seven & i Holdings and Aeon.

Third, the dataset used in this dissertation represents only Japanese retailers. Japanese retailers have specific characteristics such as they tend to grow their business by establishing a relatively large number of small stores in comparison with the western market (Larke and Causton, 2005). The typical example of this characteristic is CVS format. These retailers have strong distribution systems for frequent shipment to ensure a wide coverage. Thus, although this dissertation provides insights from a leading retail market in Asia, replication of the analysis in a different market must be considered

Fourth, the measurement of integration is another opportunity for further research. The purpose of this dissertation is to provide comprehensive arguments and empirical evidences about the relationship between cross-channel integration and retailer performance. Therefore, the definition of cross-channel integration includes both homogeneity and coordination of operation, which is appropriate given the purpose of this research. However, assorting the same range of products among MCs and coordinating the assortment for each channel based on gathered information are different practices. Thus, whether homogeneity and coordination of operations have different impacts on retailer performance is another important topic for future studies. To assess this research topic, arguments based on the differences between the narrow and broad approaches are required.

Finally, this dissertation does not assess the integration of offline formats. Some retailers operate multiple retail formats in the offline market. For

example, Seven & i Holdings operates CVS, super markets, shopping malls, department stores, and other specialty stores. Because this dissertation focuses on the integration of online and offline channels, this dissertation provides arguments based on the fundamental differences between EC and physical store operations. Thus, the arguments in this dissertation are internally consistent. However, integration practices are also required for multiple offline format operations. Thus, the integration of multiple formats including EC and offline formats is another opportunity for future studies.

References

Agatz, N. A. H., Fleischmann, M., & Van Nunen, J. A. E. E. (2008). E-fulfillment and Multi-channel Distribution - A review. *European Journal of Operational Research*, *187*(2), 339–356.

Alba, J., Lynch, J., Weitz, B., Janiszewski, C., Lutz, R., Sawyer, A., & Wood, S. (1997). Interactive Home Shopping: Consumer, Retailer, and Manufacturer Incentives to Participate in Electronic Marketplaces. *Journal of Marketing*, *61*(3), 38.

Aoyama, Y. (2007). Oligopoly and the structural paradox of retail TNCs: an assessment of Carrefour and Wal-Mart in Japan. *Journal of Economic Geography*, *7*(4), 471–490.

Arndt, J., & Olsen, L. (1975). A Research Note on Economies of Scale in Retailing. *The Swedish Journal of Economics*, *77*(2), 207–221.

Assaf, G., Barros, C., & Sellers-Rubio, R. (2011). Efficiency Determinants in Retail Stores: A Bayesian Framework. *Omega*, *39*(3), 283–292.

Avery, J., Steenburgh, T. J., Deighton, J., & Caravella, M. (2012). Adding Bricks to Clicks: Predicting the Patterns of Cross-Channel Elasticities Over Time. *Journal of Marketing*, *76*(3), 96–111.

Bakos, Y. (2001). The Emerging Landscape for Retail E-Commerce. *Journal of Economic Perspectives*, *15*(1), 69-80.

Barros, C. P. (2006). Efficiency Measurement Among Hypermarkets and Supermarkets and the Identification of the Efficiency Drivers: A Case Study. *International Journal of Retail and Distribution Management*, *34*(2), 135–154.

Barros, C. P., & Alves, C. A. (2003). Hypermarket retail store efficiency in Portugal. *International Journal of Retail & Distribution Management*, *31*(11), 549–560.

Betancourt, R., & Gautschi, D. (1993). The Outputs of Retail Activities: Concepts, Measurement and Evidence from US Census Data. *The Review of Economics and Statistics*, *75*(2), 294–301.

Benedicktus, R. L., Brady, M. K., Darke, P. R., & Voorhees, C. M. (2010). Conveying Trustworthiness to Online Consumers: Reactions to Consensus,

Physical Store Presence, Brand Familiarity, and Generalized Suspicion. *Journal of Retailing*, *86*(4), 310–323.

Berger, P. D., Lee, J., & Weinberg, B. D. (2006). Optimal Cooperative Advertising Integration Strategy for Organizations Adding a Direct Online Channel. *Journal of the Operational Research Society*, *57*(8), 920–927.

Bianchi, C. (2009). Retail internationalisation from emerging markets: case study evidence from Chile. *International Marketing Review*, *26*(2), 221–243.

Biyalogorsky, E., & Naik, P. (2003). Clicks and mortar: The effect of on-line activities on off-line sales. *Marketing Letters*, *14*(1), 21–32.

Cameron, Colin, A., & Trivedi, Pravin, K. (2009). *Microeconometrics Using Stata*. *Stata Press*. Texas: Stata Press.

Campbell, D., & Frei, F. (2010). Cost Structure, Customer Profitability, and Retention Implications of Self-Service Distribution Channels: Evidence from Customer Behavior in an Online Banking Channel. *Management Science*, *56*(1), 4–24.

Cao, L., & Li, L. (2015). The Impact of Cross-Channel Integration on Retailers' Sales Growth. *Journal of Retailing*, *91*(2), 198–216.

Chaffey, D. (2010). Applying Organisational Capability Models to Assess the Maturity of Digital-marketing Governance. *Journal of Marketing Management*, *26*(3-4), 187–196.

Christensen, L. R., & Greene, W. H. (1976). Economies of Scale in US Electric Power Generation. *Journal of Political Economy*, *84*(4), 655–676.

Dawson, J. A. (2007). Scoping and conceptualising retailer internationalisation. *Journal of Economic Geography*, *7*(4), 373–397.

Donthu, N., & Yoo, B. (1998). Retail Productivity Assessment Using Data Envelopment Analysis. *Journal of Retailing*, *74*(1), 89–105.

Evans, J., Bridson, K., Byrom, J., & Medway, D. (2008). Revisiting retail internationalisation: Drivers, impediments and business strategy. *International Journal of Retail & Distribution Management*, *36*(4), 260–280.

Ganeshan, R., Ring, L. J., & Strong, J. S. (2007). A mathematical approach to designing central vs. local ordering in retail. *International Journal of Production Economics*, *108*(1-2), 341–348.

Goldman, A. (2001). The transfer of retailing formats into developing economies:

The example of China. *Journal of Retailing*, 77, 221-242.

Greene, W. (1993). "The Econometric Approach to Efficiency Analysis," in The Measurement of Productivity Efficiency, H. Fried, C. A. Knox Lovell, and S. Schmidt, eds. New York: Oxford University Press, 68-119.

Grewal, D., Janakiraman, R., Kalyanam, K., Kannan, P. K., Ratchford, B., Song, R., & Tolerico, S. (2010). Strategic Online and Offline Retail Pricing: A Review and Research Agenda. *Journal of Interactive Marketing*, *24*(2), 138–154.

Gulati, R., & Garino, J. (2000). Get the Right Mix of Bricks & Clicks. *Harvard Business Review*, *78*(3), 107–114, 214.

Hanoch, G. (1975). The Elasticity of Scale and the Shape of Average Costs. *The American Economic Review*, *65*(3), 492–497.

Herhausen, D., Binder, J., Schoegel, M., & Herrmann, A. (2015). Integrating Bricks with Clicks: Retailer-Level and Channel-Level Outcomes of Online–Offline Channel Integration. *Journal of Retailing*, *91*(2), 309–325.

Holmstrom, B., & Milgrom, P. (1994). The Firm as an Incentive System. *The American Economic Review*, *84*(4), 972–991.

Homburg, C., Vollmayr, J., & Hahn, A. (2014). Retailer Value Creation Through Major Channel Expansions: Evidence from an Event Study in the United States. *Journal of Marketing*, *78*(May), 38–61.

Ichniowski, C., Kochan, T. A., Levine, D., Olson, C., & Strauss, G. (1996). What Works at Work: Overview and Assessment. *Industrial Relations*, *35*(3), 299–333.

Ichniowski, C., Shaw, K., & Prennushi, G. (1997). The Effects of Human Resource Management Practices on Productivity: A Study of Steel Finishing Lines. *American Economic Review*, *87*(3), 291–313.

Ichniowski, C., & Shaw, K. (1999). The Effects of Human Resource Management Systems on Economic Performance: An International Comparison of U.S. and Japanese Plants. *Management Science*, *45*(5), 704–721.

Illueca, M., Pastor, J. M., & Tortosa-Ausina, E. (2009). The effects of geographic expansion on the productivity of Spanish savings banks. *Journal of Productivity Analysis*, *32*(2), 119–143.

Ingene, C. (1982). Labor Productivity in Retailing. *The Journal of Marketing*, *46*(4), 75–90.

Ingene, C. (1984). Scale Economies in American Retailing: A Cross-industry Comparison. *Journal of Macromarketing*, *4*(2), 49–63.

Kamakura, W. A., Lenartowicz, T., & Ratchford, B. T. (1996). Productivity Assessment of Multiple Retail Outlets. *Journal of Retailing*, *72*(4), 333–356.

Keh, H. T., & Chu, S. (2003). Retail productivity and scale economies at the firm level: a DEA approach. *Omega*, *31*(2), 75–82.

Krasnikov, A., Jayachandran, S., & Kumar, V. (2009). The Impact of Customer Implementation on Cost and Profit Efficiencies : Evidence from the U. S. Commercial Banking Industry. *Journal of Marketing*, *73*(November), 61–76.

Larke, R., & Causton, M. (2005). *Japan: A Modern Retail Superpower*. New York: Palgrave Macmillan.

Lumineau, F., & Malhotra, D. (2011). Shadow of the Contract: How Contract Structure Shapes Interfirm Dispute Resolution. *Strategic Management Journal*, *32*, 532–555.

MacDuffie, J. P. (1995). Human Resource Bundles and Manufacturing Performance: Organizational Logic and Flexible Production Systems in the World Auto Industry. *Industrial and Labor Relations Review*, *48*(2), 197–221.

Milgrom, P., & Roberts, J. (1990). The Economics of Modern Manufacturing: Technology, Strategy, and Organization. *The American Economic Review*, *80*(3), 511–528.

Milgrom, P., & Roberts, J. (1995). Complementaries and fit Strategy, structure, and organizational change in manufacturing. *Journal of Accounting and Economics*, *19*(2–3), 179–208.

Min, S., & Wolfinbarger, M. (2005). Market Share, Profit Margin, and Marketing Efficiency of Early Movers, Bricks and Clicks, and Specialists in e-Commerce. *Journal of Business Research*, *58*(8), 1030–1039.

Ministry of Economy, Trade and Industry (2012) *Sangyou Kouzou Shingi Kai Ryutsu Bukai Shingiyou Sankou Shiryou [Materials for deliberation at Industrial Structure Council Distribution Department]*. Retrieved 15th March, 2016 from http://www.meti.go.jp/committee/sankoushin/ryutsu/pdf/001_05_00.pdf

Ministry of Economy, Trade and Industry (2015). Syougou Doutai Toukei [Yearbook of the Current Survey of Commerce]. Retrieved 20th November, 2016 from http://www.meti.go.jp/statistics/tyo/syoudou/

Mishra, A., & Ansari, J. (2013). A Conceptual Model for Retail Productivity. *International Journal of Retail & Distribution Management*, *41*(5), 348–379.

Nakata, C., Zhu, Z., & Izberk-Bilgin, E. (2011). Integrating marketing and information services functions: a complementarity and competence perspective. *Journal of the Academy of Marketing Science*, *39*(5), 700–716.

Neslin, S. A., Grewal, D., Leghorn, R., Shankar, V., Teerling, M. L., Thomas, J. S., & Verhoef, P. C. (2006). Challenges and Opportunities in Multichannel Customer Management. *Journal of Service Research*, *9*(2), 95–112.

Neslin, S. A., & Shankar, V. (2009). Key Issues in Multichannel Customer Management: Current Knowledge and Future Directions. *Journal of Interactive Marketing*, *23*(1), 70–81.

Nevo, S., & Wade, M. R. (2010). The Formation and Value of It-Enabled Resources: Antecedents and Consequences of Synergistic Relationships. *MIS Quarterly*, *34*(1), 163–183.

Ofek, E., Katona, Z., & Sarvary, M. (2011). "Bricks and Clicks": The Impact of Product Returns on the Strategies of Multichannel Retailers. *Marketing Science,* 30(1), 42-60.

Oh, L. B., Teo, H. H., & Sambamurthy, V. (2012). The Effects of Retail Channel Integration Through the Use of Information Technologies on Retailer Performance. *Journal of Operations Management*, *30*(5), 368–381.

Planet Retail (2006). *How Aldi works*. Report, Planet Retail.

Pauwels, K., & Neslin, S. a. (2015). Building with Bricks and Mortar: The Revenue Impact of Opening Physical Stores in a Multichannel Environment. *Journal of Retailing*, *91*(2), 182–197.

Ratchford, B. T. (2009). Online Pricing: Review and Directions for Research. *Journal of Interactive Marketing*, *23*(1), 82–90.

Ratchford, B. T., & Brown, J. R. (1985). A Study of Productivity Changes in Food Retailing. *Marketing Science*, *4*(4), 292–311.

Reardon, J., Hasty, R., & Coe, B. (1996). The Effect of Information Technology on Productivity in Retailing. *Journal of Retailing*, *72*(4), 445–461.

Sellers-Rubio, R., & Mas-Ruiz, F. (2006). Economic Efficiency in Supermarkets: Evidences in Spain. *International Journal of Retail and Distribution Management*, *34*(2), 155–171.

Steinfield, C., Adelaar, T., & Liu, F. (2005). Click and Mortar Strategies Viewed from the Web: A Content Analysis of Features Illustrating Integration Between Retailers' Online and Offline Presence. *Electronic Markets*, *15*(3), 199–212.

Srinivasan, R., & Moorman, C. (2005). Strategic Firm Commitments and Rewards for Customer Relationship Management in Online Retailing. *Journal of Marketing*, *69*(4), 193–200.

Srinivasan, R., Sridhar, S., Narayanan, S., & Sihi, D. (2013). Effects of Opening and Closing Stores on Chain Retailer Performance. *Journal of Retailing*, *89*(2), 126–139.

Tagashira, T., & Minami, C. (2016). Cost Efficiency of Multiple Store Retailers: A Comparison of Purchasing and Store Operation Costs. In K. Kim (Ed.), *Celebrating America's Pastimes : Baseball , Hot Dogs , Apple Pie and Marketing? Proceedings of the 2015 Academy of Marketing Science (AMS) Annual Conference* (pp. 507–523). New York: Springer.

Uyar, A., Bayyurt, N., Dilber, M., & Karaca, V. (2013). Evaluating Operational Efficiency of a Bookshop Chain in Turkey and Identifying Efficiency Drivers. *International Journal of Retail and Distribution Management*, *41*(5), 331–347.

Van Baal, S. (2014). Should Retailers Harmonize Marketing Variables Across their Distribution Channels? An Investigation of Cross-channel Effects in Multi-channel Retailing. *Journal of Retailing and Consumer Services*, *21*(6), 1038–1046.

Verhoef, P. C., Kannan, P. K., & Inman, J. J. (2015). From Multi-Channel Retailing to Omni-Channel Retailing. *Journal of Retailing*, *91*(2), 174–181.

Verhoef, P. C., Venkatesan, R., McAlister, L., Malthouse, E. C., Krafft, M., & Ganesan, S. (2010). CRM in data-rich multichannel retailing environments: A review and future research directions. *Journal of Interactive Marketing*, *24*(2), 121–137.

Walters, D., and White, D. (1987). *Retail Marketing Management*. Basingstoke: Macmillan.

White, H. (1980). A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity. *Econometrica*, *48*(4), 817–838.

Xing, X., Yang, Z., & Tang, F.-F. (2006). A Comparison of Time-Varying Online Price and Price Dispersion Between Multichannel and Dotcom DVD Retailers. *Journal of Interactive Marketing*, *20*(2), 3–20.

Yan, R., Wang, J., & Zhou, B. (2010). Channel Integration and Profit Sharing in the Dynamics of Multi-channel Firms. *Journal of Retailing and Consumer Services*, *17*(5), 430–440.

Yu, W., & Ramanathan, R. (2008). An Assessment of Operational Efficiencies in the UK Retail Sector. *International Journal of Retail and Distribution Management*, *36*(11), 861–882.

Zeithaml, V. a., Varadarajan, P., & Zeithaml, C. P. (1988). The Contingency Approach: Its Foundations and Relevance to Theory Building and Research in Marketing. *European Journal of Marketing*, *22*(7), 37–64.

Zhang, J., Farris, P. W., Irvin, J. W., Kushwaha, T., Steenburgh, T. J., & Weitz, B. A. (2010). Crafting Integrated Multichannel Retailing Strategies. *Journal of Interactive Marketing*, *24*(2), 168–180.

Zhuang, G., Zhou, N., & Herndon, N. C. (2002). Scale Economies of Department Stores in the People's Republic of China. *The International Review of Retail, Distribution and Consumer Research*, *12*(1), 3–12.