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The impact of e-retail characteristics on initiating mobile retail services: A modular innovation perspective

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ABSTRACT

The rise and challenges of m-commerce have led to an urgent need to examine how firms adopt the emerging sales channel. Early studies mainly discussed the differences between e-commerce and m-commerce. Our study shows the modular innovation from e-retailing to m-retailing, which changes the core component of service delivery but keeps the operations intact, provides more opportunities for well-entrenched firms. Using a dataset of e-retailers, we find e-retail characteristics have an impact on firm's migration to the mobile domain. Firms with online service competencies, economies of scale, and physical outlets are more inclined to exploit opportunities provided by mobile technologies.

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1. Introduction

1.1. Motivation and research question

With the advent of smartphones, especially the introduction of iPhone in 2007 as well as improvements in mobile broadband networks, comScore [18] recently reported that two-thirds of all smartphone owners perform some sort of shopping activities on their phones. While some argue that m-commerce only accounted for 2% of the overall e-commerce sales in 2010 [24] and view m-commerce only as a fad/experiment on small-scale mobile services, Forrester Research [21] reports that m-commerce generated $6 billion in revenues in 2011 and the sales would continue to rise, on average by 39% every year, to $31 billion by 2016. Similarly, a recent forecast projects that the global m-commerce market is expected to grow at a compound annual growth rate of 32.23% over the period 2014–2019 [49]. Despite forecasts of increased mobile spending, firms have been slow to commit to m-commerce. The mobile conversion rates of early adopting firms are deemed anemic at best [3]. The nontrivial challenge of developing effective business strategies and generating revenues by exploiting mobile technologies has prevented many firms from initiating m-commerce [34].

The extant related literature has mainly focused on the distinct features of m-commerce and developing generic conceptual frameworks to exploit the advantages of m-commerce or to elaborate the limitations of mobile data devices. For instance, Clarke [17] summarizes value propositions for m-commerce in the following four dimensions: ubiquity, localization, personalization, and convenience. Each dimension is associated with a group of mobile applications that manifest the specified value proposition, such as mobile payments for convenience and mobile advertising for personalization. Similarly, Anckar and D'Incau [2] identify five distinct value contexts of mobile data services in terms of time sensitivity, location-based services (LBS), spontaneity, entertainment needs, and efficiency. Shankar and Balasubramanian [51] discuss key marketing implications based on the location specificity, portability, and wireless feature of mobile devices. In spite of these opportunities, mobility comes at the price of hardware limitations such as small screen and relatively low connection speed [37,54,57]. These hardware constraints of mobile devices not only raise the need for efficient and effective service delivery but also require firms to develop services that are tailored to mobile shopping activities.

In mobile retailing, customers can simply use their smartphones or smart pads to access the existing e-commerce websites of e-retailers. However, in an attempt to provide high-quality service delivery, many e-retailers make further significant efforts to initiate mobile retail services. *Mobile retail services* involve the development of mobile-oriented websites or applications that are

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specifically designed and optimized for mobile devices. Despite the need for extra effort and resources, such developmental initiatives are deemed necessary by e-retailers who aim to improve services in online retailing [22]. To reflect the growing importance of mobile functionality, Google recently made changes to its search algorithm to favor mobile-friendly sites suitable for small screens with bigger text and separate links that make them easier to select [67].

According to a recent survey by Retail Systems Research [5], one major business objective and ensuing challenge for retailers presently is to incorporate mobile technologies and services into their existing online and off-line operations. Examining the reactions and strategies of firms in this emerging and fast-growing market is of great interest to managers and researchers alike. In the early m-commerce era, consumers might perceive the transition from personal computer (PC)-based Internet to mobile network as different; similarly, firms tend to place emphasis on unique features of mobile devices while planning for their m-retail initiatives. However, merely articulating distinct attributes of m-retailing is necessary but not sufficient. More in-depth analysis and comparison are required. In this respect, we posit that e-retailing and m-retailing still share many common business operations, and they may be more closely associated than assumed. Our study aims to broaden the somewhat-constrained research focus on differences between e-retailing and m-retailing by empirically assessing the dependencies between existing e-retail operations and new m-retail initiatives.

Our analysis of the impact of *e-retail characteristics* on initializing *mobile retail services* is stimulated by the earlier transition from store-based retailing to Internet retailing at the early stages of the Internet. As e-retailing can extend sales to previously unreachable areas beyond physical distribution channels, store-based retailing and e-retailing are widely perceived as two distinct platforms. In addition, the emergence of web-only retailers and potential channel conflicts between distribution channels and direct virtual channels of manufacturers have led to extensive debates on how e-retailing differs from, competes with, or even cannibalizes physical retailing. Porter [47], however, points out that these virtual activities are in fact complementary to physical operations, as back-end processes such as warehousing and logistics are still critical to successful e-retail operations. An important implication from this earlier transition is that both online and physical retail stores demand some common and complementary capabilities/resources to sustain and grow their businesses.

Based on the implication of the first transition, we argue that the transition from e-retailing to m-retailing is a modular innovation. Instead of dichotomous categorization of incremental and radical innovations, Henderson and Clark [29] classify innovations into two dimensions: the innovation's impact on core components of a product and its impact on the interaction between components. In their classification, modular innovation refers to an innovation that changes one or more core design concepts, but the relationship between the core components remains intact. In this study, we view e-retailing as a service product. The use of mobile devices and wireless networks of m-retail services changes the core design concept of the user-interfacing component, which provides the mobility and ubiquity that wired PCs lack. Nevertheless, both e-retailing and m-retailing operate via the Internet and share some common business functions. The underlying architecture of e-retailing that links all other core components – inventory, logistics, and order fulfillment – remains unchanged. While m-retailing replaces the core design of the user interface based on wired connection with one based on wireless mobility, other resources and capabilities of e-retailing can be reapplied to the new context without much change. Although mobility relaxes some of the constraints of e-commerce, researchers should not overlook how firms can leverage their e-retail resources and capabilities to facilitate decisions and enhance performance in the mobile market. To date, few empirical studies on m-commerce have explored the impact of structures in the e-commerce landscape on the initiatives of m-commerce.

Due to the paucity of and hence the need for studies on the dependency between e-commerce and m-commerce, our study attempts to answer the following research question: *What is the impact of firms' e-retail characteristics on their initiation of mobile retail services?* In particular, we address this research question by conducting an analysis based on the concept of modular innovation, which changes a core design concept of a product but reinforces the remaining core components and the existing linkage of components. As m-retailing is a modular innovation that heavily leverages inherent resources of e-retailing, we examine its dependency on e-retail characteristics from both operation and customer perspectives. Analyzing a cross-sectional dataset of e-retailers in North America, we find that e-retail characteristics have an impact on the migration of firms to the mobile domain in terms of initiating mobile retail services. Our econometric analysis suggests that firms with advantages of operating resources in e-service competencies, economies of scale, and physical outlets are more inclined to grasp at market opportunities provided by m-commerce and hence are more likely to initiate mobile retail services.

1.2. Contribution to the literature

Table 1 summarizes the related literature with a majority of studies on m-commerce focusing primarily on the distinct features of mobile devices and value propositions enabled by the new context (e.g., [17,51]). Despite unique value contexts enabled by mobile devices, both e-retailing and m-retailing involve extensive online transactions facilitated by many capabilities in common. Our paper contributes to the literature of m-commerce and m-services both theoretically and empirically. On the theoretical front, we contribute to the literature by applying the concept of modular innovation and explore the dependency between e-retail characteristics and m-retail services to elucidate the fundamental aspects of these associated constructs. We further assess the link between e-commerce and m-commerce along two distinct dimensions: resources related to business operations and those related to customer preferences. As firm-level analyses tend to focus on operation-related resources/capabilities, the dimension of customer demand/preferences has been understudied [68]. We incorporate customer-related factors into our research model and test their effects on the initiatives of firms toward m-commerce.

Our second contribution to the literature is empirical, as the majority of studies supported by empirical data tend to focus on customers' perceptions on and reactions to mobile data services (e.g.[36,71]). Empirical evidence for the assertions at the firm level is lacking, as shown in Table 1. To help firms develop mobile services, conceptual frameworks of the strategic implications ofvarious m-commerce initiatives have been proposed (e.g., [6,73]). Few studies, however, have gone beyond conceptual frameworks to empirically assess m-commerce initiation at the organizational level. Dahlberg et al. [19] conduct an in-depth review of the literature on mobile payment research and comment, "Surprisingly, we identified only four papers focusing exclusively on merchant... Merchant adoption had not been studied with quantitative data and surveys." In the broader context of m-commerce, only a few studies such as those of Mallat and Tuunainen [39] and Guo et al. [27] examine the merchant initiation of mobile services. Bang et al. [7] and Picoto et al. [46] discuss the characteristics of mobile devices (e.g., anytime access) and assess business value derived from mobile services in the organizational context.

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Table 1
Related literature on m-commerce.

		Focus: distinction of mobile data services	Focus: link between e-commerce and m-commerce
Qualitative	General framework	Clarke [17]; Anckar and D'Incau [2]; Balasubramanian et al. [6]; Zhang et al. [73]; Siau and Shen [54]; Lee and Benbasat [37]; Dahlberg et al. [19]; Shankar and Balasubramanian [52]	NA (to our knowledge)
Quantitative	Customer's perspective	Wu and Wang [69]; Hong and Tam [31]; Kim et al. [33]; Sheng et al. [53]; Lee et al. [36]; Xu et al. [71]	Lin [38]
	Firm's perspective	Mallat and Tuunainen [39]; Guo et al. [27]; Bang et al. [7]; Picoto et al. [46]	Wei and Ozok [66]; Swilley et al. [56]

As seen in Table 1, the aforementioned studies, although at the organizational level, tend to focus on distinct features of mobile data services. Our research complements these studies by empirically examining the dependency between a firm's e-retail structure and its m-retail initiation. To the best of our knowledge, Lin [38], Wei and Ozok [66], and Swilley et al. [56] are three exceptions that also empirically investigate the link between e-commerce and m-commerce. Among the three, Lin [38] explores whether customers carry over their impressions on firms from e-commerce to m-commerce, whereas the other two examine the dependency at the organizational level. Wei and Ozok [66] specifically examine the dependency between website functions of e-ticketing sites and those of m-ticketing sites. Our firm-level analysis of the dependency between e-retailing and m-retailing differs from the study by Wei and Ozok [66] by explicitly considering web functionality as well as other factors. In contrast to the function-centric view of Wei and Ozok [66], Swilley et al. [56] examine the dependency using a broad concept of e-business capabilities. Our paper differs from the study by Swilley et al. [56] in that we identify more specific e-retail factors and formally test the impact of each factor on m-retail initiatives.

Furthermore, Chen and Holsapple [14] conduct a review of 618 related articles and report that most quantitative studies on e-commerce use psychometric models (i.e., survey-based instruments) to articulate the behavioral intentions of consumers. Similarly, in the context of m-commerce, numerous studies are focused on assessing customers' perceptions about distinct features of mobile data services and mobile web browsing (e.g., [31,33,36,53,69]). Empirical studies that make novel use of archival data to assess m-commerce initiatives are scarce, with the exception of the study by Wei and Ozok [66]. Our study differs from prior studies and extends the existing literature in that we shift the focus from customers' acceptance of m-commerce to firms' responses to the prospect of m-commerce. Instead of using customer-level survey data, we collect organization-level secondary data to conduct an econometric analysis of firms' initiatives toward m-commerce.

The remainder of this paper is organized as follows. Section 2 describes the concept of modular innovation and proposes five hypotheses on m-retailing initiation. Section 3 describes the collected data and operationalization of variables. Section 4 presents the estimation methodology and results of our empirical analysis. Section 5 discusses the practical and research implications, limitations, and potential directions for future research. Section 6 concludes the paper.

2. Theoretical foundation and hypothesis development

2.1. Modular innovation

In the literature of technological innovations, researchers (e.g., [61]) have classified technological innovations as competence-enhancing innovations versus competence-destroying innovations. The former are also called incremental innovations, which introduce relatively minor changes to the existing product and often reinforce the dominance of established firms. Companies typically use incremental innovations to issue different versions of products such as car models and software upgrades. The latter are referred to as radical innovations, which introduce a new dominant design and hence overturn the current product market, illustrated by the example of music format from cassette tapes to compact disk (CD) and then from CD to MP3. Henderson and Clark [29] argue that this dichotomous distinction, while providing important insight, is incomplete. They state that some innovations involve modest changes but have dramatic competitive consequences, while others can still exploit the established foundation. The distinction lies in the two types of knowledge of product development: component knowledge and architecture knowledge. Component knowledge refers to the knowledge of core design concepts and their implementation in each core component. Conversely, architecture knowledge indicates the ways in which each component is integrated or linked together coherently to build the final product. They then classify technological innovations along these two dimensions, as shown in Fig. 1. The horizontal dimension captures the impact of an innovation on components and the vertical dimension captures its impact on the linkages between components.

Radical and incremental innovations are extreme points along both dimensions. The other two types with modest changes include architectural and modular innovations. Architectural innovation is based on the reconfiguration of an established system to link together existing components in a new way, such as the difference between ceiling-mounted room fans and portable fans. While primary components are largely the same, the architecture of the product is different. *Modular innovation* refers to the innovation that changes only one or more core design concepts of a technology, but the other components and the link between these components remain intact. Because architecture knowledge (e.g., information-processing procedures) is difficult for firms to adjust, Henderson and Clark [29] argue that this type of innovation poses subtle challenges for well-entrenched firms. By contrast, *modular innovation*, such as the replacement of analog telephones with digital telephones, leads to few changes for the organization [1]. To some extent, firms can simply replace an analog dialing device with a digital device and maintain the same operation of the product of telephone services (i.e., architecture knowledge is still applicable).

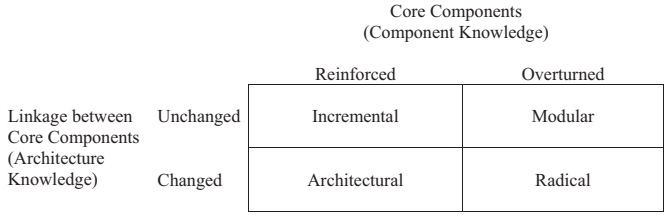

Fig. 1. The classification of innovations by Henderson and Clark [29].

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In this study, we view the transition from e-retailing to m-retailing as a modular innovation. Mobile retail services with the use of mobile devices and wireless networks differ from e-retailing primarily in terms of service delivery. For example, instead of using regular Transmission Control Protocol/Internet Protocol (TCP/IP) to deliver services among various computers, m-retailing transmits messages among mobile devices using multifarious mobile network technologies (e.g., CDMA2000, Long Term Evolution (LTE), TCP/IP) supported by various network operators. Moreover, while e-retail services are nearly identical among different brands of PCs, m-retail services are dependent on various mobile devices that differ in sizes, displays, platforms, and performances. Accordingly, these established e-retail services would have to be readjusted to fit various configurations of mobile devices (e.g., Android and iOS) and limited network transmissions. In addition to networks and application platforms, the content of m-retailing services can be further refined for location-based transactions (i.e., more time-critical but less information-intensive content), while e-retailing services are adept at carrying out information-intensive transactions [7].

Although e-retailing and m-retailing differ in the mode of service delivery, the back-end operations and some front-end functionalities of e-retailing are still effective in the m-retail domain. Previously, the e-retail channel required customers to use computers with wired networks, but the present m-retail channel allows customers to shop for groceries even when waiting in line. Because of mobile devices and wireless networks, the delivery of m-retail service is no longer limited by time and location constraints. However, while the purchase is made via a mobile device, the order still requires common value chain activities to check inventory, assign the order to the warehouse, prepare order picking, and dispatch to outbound logistics. In addition, although m-retail customers browse products using mobile devices instead of PC-based browsers, the design of website functions and the back-end IT infrastructure as well as the navigation of product selection and order checkout are still derived from the experience and knowledge accumulated from e-retailing operations. In their study examining major US airlines, Wei and Ozok [66] present a salient example of a significant similarity between e-ticketing and m-ticketing websites.

In the case of m-commerce, we typically tend to focus on the proliferation of its wireless capability and the emerging opportunities beyond those of the fixed-line PC. Nevertheless, the fundamental link between these core retail activities (i.e., the architecture knowledge) that ensures smooth operations in the cyber-shopping experience remains unchanged. Based on the concept of modular innovation, we expect firms to rely on accumulated e-retail resources and capabilities to develop their strategies for initiating m-retail services. In particular, well-entrenched e-retailers are expected to leverage their advantages and perform actively in the m-retail domain.

2.2. Hypothesis development

2.2.1. Research framework

From a theoretical perspective, modular innovation enables us to frame the dependency, but it does not elaborate on how or in what dimensions the existing e-retail operations can be applied to the new mobile context. In order to further explore the effect of e-retailer characteristics on m-retail initiatives, we examine the dependency from two dimensions – *operational* and *customer* – that are closely linked to the adoption decisions of firms. Witt [68] argues that economists seem to overemphasize on the operations of producers but overlook changes in consumer preferences of products and services. Guided by this unbalanced emphasis, numerous firm-level analyses focus on operational resources and capabilities. A notable exception is the study by Thirumalai and Sinha [59], who empirically explore the online personalization strategies of retailers from both operational (supply-side) and market (demand-side) perspectives. They assess the influences of a firm's size and type for operational characteristics, whereas they examine customers' preferences of product price, collection, and variety for market characteristics. It is noted that the two dimensions of operation and market proposed by Thirumalai and Sinha [59] is a classifying research framework for relevant empirical factors, rather than a normative theory. In the present study, we follow the strategy proposed by Thirumalai and Sinha [59] to categorize factors of our research model.

Motivated by Witt's [68] critique and Thirumalai and Sinha's [59] categorization of factors, we extend the modular innovation perspective and investigate the dependency between e-retailing and m-retailing from both *operational* and *customer* dimensions. From the *operational dimension*, we investigate three e-retailer characteristics: e-retail functions, e-retail type, and e-retail market share. The three e-retail characteristics are mapped to three key operational factors in the e-commerce literature, as shown in Table 2. We include these relevant variables and develop three associated hypotheses (H1–H3) to predict whether operational attributes would cause e-retailers to extend to m-retailing. From the *customer dimension*, we analyze two e-retailer characteristics – e-retail shopper age and average basket value – and map the two characteristics to short duration usage, security concerns, and target customers of mobile services. Specifically, we develop two hypotheses (H4 and H5) to identify the fit of accumulated e-retail market resources with new customer preferences of the m-retail market. Table 2 summarizes the representative literature for operational and customer-oriented characteristics. The influences of these e-retail characteristics and the respective research hypotheses are discussed in the next subsection.

2.2.2. Research hypotheses

Front-end and back-end functions are technology enablers of a firm's digitalized services. Zhu and Kraemer [75] classify e-commerce functions into four digitalized services dimensions: information, transaction, customization, and supplier support. Alternatively, Voss [64] defines a three-layer model that categorizes digitalized services into foundational, customer-centered, and value-added functions. These website functions are among the critical determinants of a firm's online competence, service quality, and sales performance [16]. Zhu [74] and Zhu and Kraemer [76] find a significant correlation between website functions and e-business value in financial and retail industries.

As m-retailing represents a modular innovation involving digitalized services via wireless networks, firms who effectively developed e-retail functions are expected to utilize their e-retailing experiences and associated architecture knowledge to facilitate the development of the new core component of mobile

Table 2
Related literature on e-retail characteristics examined in our study.

Characteristics	Representative studies
Operational	
e-retail functions	Voss [64]; Zhu and Kraemer [76]; Chuang et al. [16]
e-retail type	Vishwanath and Mulvin [63]; Xia and Zhang [70]
e-retail market share	Hong and Tam [31]; Thirumalai and Sinha [59]
Customer	
e-retail shopper age	Anckar and D'Incau [2]
e-retail basket value	Shankar and Balasubramanian [51]

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retail services. Wei and Ozok [66] compile a list of functions that support online ticketing processes from leading e-commerce websites to evaluate the mobile ticketing websites of 27 major airlines. They find a significant level of similarity in functions between the e-ticketing and m-ticketing websites of these airlines. According to Cam Fortin, the director of business development at Wine.com, one of the factors critical to successful mobile site implementation is the established website functions that the firm has been able to accumulate from its e-commerce website [41]. Moreover, firms with comprehensive e-retail functions are generally considered more technologically innovative. According to the e-service model by Voss [64], firms build upon their online foundational functions and further expand to value-added ones. Hence, a technologically competent/innovative firm with established e-retail functions is more likely to extend retail services to the mobile domain, which creates a new channel to serve customers.

Customers also derive their perception about e-service quality based on e-retailer website functions [28]. As perceived service quality can be transferred from one channel to another, customers may use a firm's m-retail website or application because they have formed favorable perceptions about the firm's e-service quality [38]. Therefore, firms with well-established e-retail functions may benefit from their accumulated reputation of e-service quality to achieve superior m-retail performance. Overall, we hypothesize the following:

Hypothesis H1 (e-Retail function hypothesis:).
Ceteris paribus, firms with more e-retail functions are more likely to initiate mobile retail services.

Some may presume that e-retailers only refer to web-only retailers without physical store presence. Yet, in e-commerce-related reports and studies, retailers with both physical and online stores (i.e., retail chains) are viewed as key players of e-retailing. Thus, we refer to retail chains as store-based e-retailers with potential cross-channel synergies between virtual and physical channels [32,40,70]. For example, JCPenney, Walgreens, and Office Depot have increased customer visits to their physical outlets through increased cooperation between their websites and physical stores through such convenient features as online inventory data lookup for each store location and online prescription pickup at the chosen physical store [9,26,47]. In addition, with physical outlets, retail chains can provide online customers with a free option of "shipping to store." Some retailers further upgrade this option by allowing customers to buy products online, schedule a pickup time, and have employees meet them curbside with their purchased goods [62]. Product return is another concern in e-retailing, because returns occur more frequently in online retailing than in traditional retailing [70]. The store presence also enables retail chains to provide the "return-to-store" service, which is beneficial for the e-retail operations of retail chains [63].

Although m-retailing changes the mode of service delivery, it is a modular innovation that is still dependent on other components of e-retailing. Retail chains can extend these store-based e-retailing synergies and the accumulated architecture knowledge to m-retailing. Both options of in-store pickups and return/exchange are also applicable and critical to mobile retail services, which may be all the more significant due to the mobility and physical proximity enabled by mobile devices. The new mobile channel also brings extra traffic to physical outlets. Customers can browse and check out products through mobile devices at any time and place, especially when they receive LBS such as real-time promotions and advertisements. Later, they can visit the nearest physical outlet to check out products and make sure the products are to their taste. Customers can also visit physical outlets and purchase products immediately without waiting for deliveries [58]. This combination of location and mobility fulfills the so-called "instant gratification" characteristic of the millennial and younger generations. Brynjolfsson et al. [12] argue that mobile computing is diminishing the gap between physical and online retailing by providing consumers with multiple touch points and a seamless "omnichannel retailing" experience, thus transforming the world into a "showroom without walls."

Overall, when compared with other non-store e-retailers (e.g., web-only retailers, catalog retailers, and consumer brand manufacturers), retail chains with physical store presence can create cross-channel synergies more effectively when they adopt the mobile platform [12]. This leads to our second hypothesis.

Hypothesis H2 (e-Retail type hypothesis:).
Ceteris paribus, retail chain firms are more likely to initiate mobile retail services than the other firm types.

The e-retail market share reflects a firm's relative size/scale in the product category. To achieve a significant size/scale in a product market, a firm must acquire and deploy the corresponding resources and capabilities. For example, Grewal et al. [25] argue that economic reward alone is not sufficient incentive to maintain a stable online customer base, given that competition is only a click of a mouse or a touch of a screen away. Instead, reliable order fulfillment and customer trust are two equally important drivers of successful online business. The former increases online customer satisfaction and the latter reduces perceived risks associated with online transactions. Zhu [74] and Zhu and Kraemer [76] survey firms in the retail industry and find that firms with close integration of back-end infrastructures in such supply chain activities as inventory and order fulfillment have better e-retail and overall financial performances. Hulland et al. [32] find that the brand management and customer service capabilities of e-retailers are positively associated with their e-retail performances. As m-retailing is a modular innovation that changes mainly one core component (i.e., wireless delivery of digitalized services) but maintains the others and the interactions among components, firms with higher e-retail market share and more accumulated resources should be able to leverage their existing e-commerce competencies and extend their e-retail advantages to the m-retail arena. This results in our third hypothesis.

Hypothesis H3 (e-Retail market share hypothesis:).
Ceteris paribus, firms with higher e-retail market shares are more likely to initiate mobile retail services.

Classified as a modular innovation, m-retailing changes the core component of service delivery through wireless networks and adds to the benefits of retail services anytime and anywhere. Apart from these operational benefits, the change of service delivery may also introduce new business rules such as security concerns and the profile of frequent users of mobile networks for consideration. The next two hypotheses H4 and H5 are related to customers and assess how the existing e-retail resources of firms match the new business rules of m-retailing.

Brynjolfsson et al. [12] note that retailers need to consider the types of products sold through each channel when drafting and implementing business strategies to cope with cross-channel competition. According to a survey of 117 firms with mobile retail services, 56% report that their average dollar amount of orders received through the mobile channel is <$75 [11]. One possible explanation for the small order value is customers' security concerns about m-commerce. Customers' perception of underdeveloped security has been found to affect their trust in and usage of

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mobile data services [54,72]. In addition, due to hardware constraints of mobile devices and the typically short duration of usage, to a great extent, m-commerce is spontaneous and instant [2]. As a result, when using mobile retail services, customers tend to make purchases that involve instant decisions without extensive information search and price comparison [51]. Transactions with small order values are perceived to be less risky and to satisfy these spontaneous buying criteria.

According to the previous discussion on security concerns, hardware constraints, and spontaneous purchasing, a firm with relatively small order value in e-retailing is likely to sell products better suited for m-retailing. It is reasonable to expect customers' purchase patterns, such as order quantities for specific products and firms' product/service offerings, to carry over from e-retailing to m-retailing. This leads to our fourth hypothesis.

Hypothesis H4 (e-Retail order value hypothesis:).
Ceteris paribus, firms with smaller e-retail order values are more likely to initiate mobile retail services.

Demographic characteristics such as age and gender have been identified as key factors driving technology adoption and usage [42,43]. In the context of m-commerce, Anckar and D'Incau [2] conduct a consumer survey in Finland and find that customer willingness to use mobile data services is greater among the younger generation. In a more recent survey conducted by the National Retail Federation [45], 26.8% of American adults with a smartphone report using these devices for research or holiday purchases, while 45% of young adults aged 18-24 years would do so. Based on these statistics, the young generation is apparently more likely to opt for mobile retail services. Moreover, this generation tends to influence their peers' purchase decisions and hence bring additional customers to a retailer through word of mouth and referrals. From the firm's perspective, offering mobile retail services is a sensible and viable strategy to enhance shopping convenience and entice its young customer base.

As young adults have been found to make up a significant proportion of potential m-retail patrons, a firm with a relatively young e-retail consumer base should be more willing to initiate mobile retail services to persuade its existing young shoppers to try the m-retailing channel. This carryover effect is more likely to take hold in online retailing, as customer loyalty is found to be higher online than off-line [52]. This leads to our final hypothesis.

Hypothesis H5 (e-Retail shopper age hypothesis:).
Ceteris paribus, firms with a younger e-retail customer base are more likely to initiate mobile retail services.

3. Data and measures

As the major focus of the study is to explore the dependency between e-retailer characteristics and mobile retail services, we collect data on online sales, website functions, and other metrics pertaining to leading e-retailers from the Top 500 Guide published by Internet Retailer, a data services company. The Top 500 Guide provides an annual ranking of the largest e-retailers in the United States and Canada based on annual online sales. Several studies in the past have used the same data source to investigate online retail services (e.g., [15,16,60]). We analyze the cross-sectional dataset of the top 500 e-retailers in 2010. Yet, as the data on some variables are missing, the dataset for our analysis consists of 456 firms.

We define *mobile retail services* as a binary dependent variable where 1 indicates a firm that has initiated a mobile-oriented website or a mobile application, and 0 otherwise. Independent variables reflect the e-retailer characteristics. The variable *e-retail function* represents the ability of a firm to provide digitalized services through system functions relative to its peers. We apply the construction method proposed by Tsai et al. [60] and adopted by recent studies on e-retail services (e.g., [15,16]). Our website functions include 60 service features that cover multiple dimensions, and Appendix A provides the complete list of these e-retail functions. Each feature takes on one of two possible values (0 = not implemented and 1 = implemented) and represents a specific function that facilitates online retail operations. First, we take the ratio of 1 (if the firm has implemented one particular feature) over the total number of firms with the same function, and we sum up such ratios for the 60 binary features. This ratio sum number is then normalized to show a firm's relative functional strength compared with peers. In other words, a firm's e-retail function is represented by a Z score considering the average and variations of peers. *Retail chain* is a dummy variable, which takes the value of 1 for retail chains and 0 for other firm types including catalog retailers, consumer brand manufacturers, and web-only retailers. The variable *e-retail market share* captures the percentage of a firm's e-retail sales to the total sales of its own product market. Each firm in our sample belongs to one of the following 14 product markets: apparel/accessories, books/music/video, computers/electronics, flowers/gifts, food/drug, hardware/home improvement, health/beauty, home furnishings, jewelry, mass merchant, office supplies, specialty/non-apparel, sporting goods, and toys/hobbies. Finally, *e-retail order value* and *e-retail shopper age* are included to reflect the extent to which a firm is susceptible to the customer preferences toward online retailing. The former is operationalized by the average dollar amount of customer orders placed through the e-retail channel. The latter is approximated by the average age of customers who make purchases through the e-retail channel.

Table 3
Variable description and summary statistics (N = 456).

Variable	Description	Mean	Stdev.	Min	Max
Dependent variable					
Mobile retail services	Dummy variable 1 for initiating firms 0 for non-initiating firms	0.33	0.47	0.00	1.00
Independent variables (H1–H5)					
e-Retail Function	Normalizing a weighted sum of binary features, which reflect a firm's ability to provide e-retail services through system functions	−0.02	0.95	−2.05	4.01
Retail Chain	Dummy variable 1 for retail chain and 0 for other firm types	0.31	0.46	0.00	1.00
e-Retail Market Share	Percentage of a firm's e-retail sales to total sales of the product market	0.03	0.07	0.00	0.61
e-Retail Order Value	Average dollar value of purchases made through the e-retail channel	192.71	217.58	8.00	1800.00
e-Retail Shopper Age	Average age of e-retail shoppers	40.15	2.52	34.00	47.10

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Table 4
Frequency table of categorical control variables.

Variable	Count
Public firm	456
Public	133
Nonpublic	323
Merchandize category	456
Apparel/Accessories	115
Books/Music/Video	22
Computers/Electronics	49
Flowers/Gifts	7
Food/Drug	21
Hardware/Home Improvement	24
Health/Beauty	25
Home Furnishings	46
Jewelry	13
Mass Merchant	30
Office Supplies	15
Specialty/Non-Apparel	49
Sporting Goods	25
Toys/Hobbies	15

Table 5
Pair-wise Pearson correlation coefficients ($N = 456$).

	1.	2.	3.	4.	5.	6.
1. Mobile retail services	1.00					
2. e-Retail function	0.30**	1.00				
3. Retail chain	0.21**	0.11**	1.00			
4. e-Retail market share	0.20**	0.18**	0.08*	1.00		
5. e-Retail order value	−0.03	−0.04	−0.10**	0.07	1.00	
6. e-Retail shopper age	−0.07	0.02	−0.15**	0.08*	−0.01	1.00

* Sig. 0.1 level.
** Sig. 0.05 level.

The control variables include differences between public and private firms as well as market competition. *Public firm* is a dummy variable reflecting whether the firm is publicly traded. Public firms are noted to have better access to resources such as financial capital [55]. We also control for the effects of *merchandize* category, which has considerable effects on the performance and decisions of e-retailers [16]. Specifically, we include 13 dummy variables based on the 14 product markets defined previously (in which the apparel/accessories serve as the base category). Table 3 lists the description and summary statistics of variables. Table 4 shows the frequency table for the two categorical control variables. Table 5 reports the pair-wise Pearson correlation coefficients of our dependent and independent variables.

4. Analysis and results

We specify the following model to test the five research hypotheses:

$$\begin{aligned} MobileRetailServices_i = {} & \gamma_0 + \gamma_1 ERetailFunction_i + \gamma_2 RetailChain_i \\ & + \gamma_3 ERetailMarketShare_i \\ & + \gamma_4 ERetailOrderValue_i \\ & + \gamma_5 ERetailShopperAge_i + \gamma_6 PublicFirm_i \\ & + \sum_{j=7}^{19} \gamma_j MerchandiseCategory_i + \epsilon_i \end{aligned}$$

As the dependent variable – *MobileRetailServices* – is a dichotomous measure, fitting an ordinary linear regression model is not appropriate [30]. We use the logit and probit models for estimation. The logit function is expressed as follows:

$$Pr(MobileRetailServices_i = 1|\boldsymbol{X}_i) = \frac{\exp(\boldsymbol{X}_i\boldsymbol{\gamma})}{1+\exp(\boldsymbol{X}_i\boldsymbol{\gamma})}$$

where $\mathbf{X_i}$ is the vector for independent variables and $\boldsymbol{\gamma}$ is the vector of parameters to be estimated. The probit function is specified as follows:

$$Pr(MobileRetailServices_i = 1|\boldsymbol{X}_i) = \int_{-\infty}^{\boldsymbol{X}_i\boldsymbol{\gamma}} \phi(z)dz$$

where $\phi(z)$ denotes the standard normal density function.

Both the logit and probit functions are symmetric around zero and commonly used for the regression modeling of binary response variables. However, given that the distribution of *MobileRetailServices* is asymmetric (i.e., 152 initiating firms vs. 304 non-initiating firms), we accommodate the skewed distribution by applying the complementary log–log function [13], which is specified as

$$Pr(MobileRetailServices_i = 1|\boldsymbol{X}_i) = 1-\exp\{-\exp(\boldsymbol{X}_i\boldsymbol{\gamma})\}$$

In the presence of excess zeros, we also test the zero-inflated Bernoulli (ZI-Bernoulli) regression model with the logit link for completeness:

$$Pr(MobileRetailServices_i = 0|\boldsymbol{X}_i) = \pi + (1+\pi)\frac{1}{1+\exp(\boldsymbol{X}_i\boldsymbol{\gamma})}$$
$$Pr(MobileRetailServices_i = 0|\boldsymbol{X}_i) = (1-\pi)\frac{\exp(\boldsymbol{X}_i\boldsymbol{\gamma})}{1+\exp(\boldsymbol{X}_i\boldsymbol{\gamma})}$$

where π is an extra parameter used to account for zero inflation. We perform maximum likelihood estimation of the logit, probit, complementary log–log, and ZI-Bernoulli regression models. Table 6 reports the estimation results. The Wald chi-squared test suggests that all of the four models are significantly better than null models. We perform Pregibon's link test and find no evidence of poor model specification. However, the highest value of Akaike information criterion (AIC) and the Vuong test suggest that the more sophisticated ZI-Bernoulli model actually performs worse than the other three models rooted in the ordinary Bernoulli distribution. Therefore, our interpretation is based exclusively on the first three models, particularly, the complementary log–log model with the smallest AIC (512.86).

In sum, the coefficient estimates of *ERetailFunction*, *RetailChain*, and *ERetailMarketShare* are all statistically significant at the level of 0.05 and show fairly strong support for hypotheses H1–H3. However,the estimates of *ERetailOrderValue* and *ERetailShopperAge* provide no statistical support for H4 and H5. The results reveal that a firm with better e-retail functions to provide digitalized services (H1), operating in the form of a retail chain (H2), and/or with stronger e-retail performance in terms of market share (H3) is more likely to initiate mobile retail services. With respect to the two controls, the positive estimate ($p < 0.1$) of *PublicFirm* shows that publically traded firms are more inclined to initiate mobile retail services. The estimates of *merchandize category* indicate that, compared to e-retailers in the apparel/accessories market, e-retailers in computers/electronics, home furnishings, office supplies, and toys/hobbies are less likely to initiate mobile retail services, while mass merchant e-retailers are, on average, more likely to do so ($p < 0.1$).

For the four models in Table 6, we assess a firm's status of initiating mobile retail services in 2010 irrespective of the timing.

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Table 6
Estimation results ($N = 456$).

Model	Logit	Probit	C log–log	ZI-Bernoulli
Constant	1.26 (1.94)	0.69 (1.14)	0.69 (1.55)	2.85 (2.57)
e-Retail function (H1)	0.63*** (0.13)	0.38*** (0.08)	0.50*** (0.09)	0.58*** (0.18)
Retail chain (H2)	0.60** (0.25)	0.36** (0.15)	0.50*** (0.19)	0.58* (0.32)
e-Retail market share (H3)	0.07** (0.03)	0.04*** (0.01)	0.05*** (0.01)	0.24* (0.13)
e-Retail order value (H4)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
e-Retail shopper age (H5)	−0.05 (0.05)	−0.03 (0.03)	−0.05 (0.04)	−0.09 (0.06)
Public firm	0.45* (0.27)	0.27* (0.16)	0.32* (0.20)	0.35 (0.37)
Books/Music/Video	0.62 (0.57)	0.38 (0.33)	0.41 (0.38)	0.76 (0.73)
Computers/Electronics	−0.84* (0.45)	−0.49* (0.26)	−0.68* (0.36)	−0.91* (0.53)
Flowers/Gifts	0.18 (0.83)	0.10 (0.50)	0.34 (0.60)	−1.07 (1.34)
Food/Drug	−0.23 (0.55)	−0.14 (0.33)	−0.03 (0.42)	−1.06 (0.90)
Hardware/Home improvement	−0.93 (0.68)	−0.54 (0.38)	−0.91 (0.62)	−0.46 (0.77)
Health/Beauty	−0.74 (0.57)	−0.44 (0.32)	−0.54 (0.47)	−0.79 (0.65)
Home furnishings	−1.22** (0.51)	−0.72** (0.29)	−0.94** (0.44)	−1.56** (0.64)
Jewelry	−0.62 (0.74)	−0.36 (0.43)	−0.48 (0.54)	−1.54 (1.12)
Mass merchant	0.77 (0.49)	0.49* (0.29)	0.59* (0.32)	0.92 (0.66)
Office supplies	−1.89** (0.79)	−1.13** (0.43)	−1.43** (0.61)	−3.13* (1.68)
Specialty/Non-Apparel	−0.42 (0.41)	−0.25 (0.24)	−0.28 (0.33)	−0.75 (0.51)
Sporting goods	−0.71 (0.49)	−0.44 (0.29)	−0.45 (0.38)	−1.18* (0.68)
Toys/Hobbies	−2.18*** (0.74)	−1.32*** (0.39)	−1.63*** (0.63)	−3.46** (1.52)
Log-likelihood	−236.87	−236.66	−236.43	−235.86
AIC	513.74	513.32	512.86	515.72
Wald χ^2	86.61	100.72	105.32	108.78
P-Value	0.00	0.00	0.00	0.00

Standard errors are in parentheses.
* Sig. 0.1 level.
** Sig. 0.05 level.
*** Sig. 0.01 level.

However, it is possible that the propensity for initiation varies with year. To ensure the reliability of our findings, we collect available data on the timing of initiation for 422 of 456 e-retailers in our sample. Fig. 2 illustrates the Kaplan–Meier survival curve [30] of the probability of initiating mobile retail services for the 422 e-retailers from 2007 to 2010. The curve indicates an increase in the initiation rate over the 4-year period. Less than 10% of firms initiated m-retail services in 2007, whereas around 25% of firms started m-retail services in 2010.

Using the longitudinal data on the timing of initiation, we fit the logit, probit, cloglog, and ZI-Bernoulli models with year dummies to account for the discrete time effects [48]. This exercise serves to check the robustness of the results of hypothesis testing. The limitation of this exercise is that only cross-sectional data in 2010 are available for e-retailer characteristics (i.e., independent variables) that explain a firm's initiation decision. In this respect, as the time period (2007–2010) is short during which these independent variables are not likely to change significantly, we assume the same values for e-retail function, firm type, e-retail order value, and e-retail shopper age of a firm across the 4 years. To reflect the variations in e-retail sales over the years, we obtain the e-retail sales of the whole market from 2007 to 2010 and calculate the annual growth rate of the market over this period. We then use a firm's e-retail sales in 2010 as the baseline, and derive e-retail sales in 2007, 2008, and 2009 by the market's annual growth rates. Because the regressors are assumed to be of constant value, this robustness check is deemed not perfect but still informative.

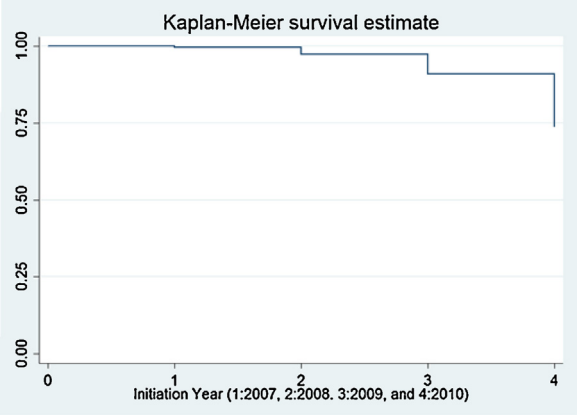

Fig. 2. Kaplan–Meier survival curve of the initiation probability.

Table 7 reports the results of this robustness check. Consistent with the findings in Table 6, the coefficient estimates of *ERetailFunction*, *RetailChain*, and *ERetailMarketShare* consistently support H1, H2, and H3. Considering 2010 as the base year, we find the three year dummies to be negative and significant. These negative signs of the estimated time parameters indicate an increase in the probability of initiation over the years, which is consistent with the nonparametric curve shown in Fig. 2.

5. Discussion

First, we discuss the practical and research implications. Then we discuss the potential limitations of our study while highlighting directions for future research.

5.1. Practical implications

As of 2010, around 80% of multichannel retailers still did not have clearly defined operation strategies for initiating mobile retail services [20]. Even in 2013, when mobilizing had become a necessary step for firms, only 12% of retailers fully implemented m-commerce platforms, as indicated in a survey by Baird and Kilcourse [5]. Despite the reported low adoption of mobilizing, in late 2013, several retailers reported preparing mobile channel investment plans for the next 3 years [4] and the need for managers to have guidelines for launching mobile retail services. As it is exploratory, our empirical study on the operational and customer dimensions of e-retailer characteristics aims to help managers better understand the cross-channel initiatives taken by

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Table 7
Robustness check ($N = 1443$).

Model	Logit	Probit	C log–log	ZI-Bernoulli
Constant	0.20 (2.01)	0.12 (1.00)	−0.08 (1.85)	0.20 (2.06)
e-Retail function (H1)	0.66*** (0.11)	0.33*** (0.06)	0.59*** (0.09)	0.65*** (0.12)
Retail chain (H2)	0.81*** (0.27)	0.38*** (0.14)	0.79*** (0.25)	0.81*** (0.26)
e-Retail market share (H3)	0.07*** (0.02)	0.04*** (0.01)	0.06*** (0.02)	0.07*** (0.02)
e-Retail order value (H4)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
e-Retail shopper age (H5)	−0.05 (0.05)	−0.03 (0.03)	−0.05 (0.05)	−0.05 (0.05)
Public firm	0.57** (0.28)	0.31** (0.15)	0.48** (0.25)	0.57** (0.28)
Books/Music/Video	−0.48 (0.70)	−0.24 (0.35)	−0.40 (0.63)	−0.48 (0.67)
Computers/Electronics	−0.92* (0.48)	−0.40* (0.25)	−0.82* (0.42)	−0.92* (0.48)
Flowers/Gifts	−0.21 (0.98)	−0.21 (0.51)	−0.03 (0.96)	−0.21 (1.15)
Food/Drug	0.19 (0.59)	0.07 (0.30)	0.27 (0.53)	0.19 (0.59)
Hardware/Home improvement	−0.77 (0.66)	−0.38 (0.32)	−0.77 (0.65)	−0.77 (0.60)
Health/Beauty	−0.73 (0.57)	−0.34 (0.29)	−0.59 (0.51)	−0.73 (0.56)
Home furnishings	−1.39** (0.57)	−0.75*** (0.28)	−1.19** (0.53)	−1.39** (0.62)
Jewelry	−1.04 (0.88)	−0.50 (0.42)	−0.95 (0.73)	−1.04 (0.20)
Mass merchant	0.38 (0.42)	0.28 (0.23)	0.37 (0.33)	0.38 (0.43)
Office supplies	−1.87** (0.91)	−0.92** (0.44)	−1.64** (0.72)	−1.87** (0.94)
Specialty/Non-Apparel	−0.27 (0.45)	−0.11 (0.23)	−0.21 (0.40)	−0.27 (0.44)
Sporting goods	−0.72 (0.50)	−0.38 (0.26)	−0.57 (0.43)	−0.72 (0.53)
Toys/Hobbies	−1.87*** (0.71)	−1.05*** (0.37)	−1.48** (0.67)	−1.87 (0.93)
Year 2007	−4.45*** (0.78)	−2.04*** (0.33)	−4.16*** (0.74)	−4.45*** (0.75)
Year 2008	−2.84*** (0.39)	−1.43*** (0.19)	−2.58*** (0.36)	−2.84*** (0.40)
Year 2009	−1.56*** (0.28)	−0.81*** (0.14)	−1.41*** (0.24)	−1.56*** (0.27)
Log-likelihood	−259.90	−261.96	−258.76	−259.90
AIC	565.80	569.92	563.52	567.80
Wald χ^2	149.60	142.74	182.50	227.57
P-Value	0.00	0.00	0.00	0.00

Standard errors are in parentheses.
* Sig. 0.1 level.
** Sig. 0.05 level.
*** Sig. 0.01 level.

other firms to transition from e-retailing to m-retailing. Interestingly, we find that the two e-retailer characteristics related to customers – *e-retail order value* and *e-retail shopper age* – are not significantly associated with firms' initiatives toward m-retail services. By contrast, the three operational e-retailer characteristics – *e-retail function*, *e-retail type*, and *e-retail market share* – do have a significant impact on initiating m-retailing.

A key implication is that, while the immaturity of the mobile market, unclear business value, and lack of apparent customer needs might prevent firms from initiating mobile services in the early stages [23,39,65], the wide use of mobile devices and the growth of m-commerce in recent years have compelled firms to enter the mobile domain. In present day, customers carry their mobile devices everywhere, and can use their smartphones to make purchases while waiting in line at Starbucks, to become aware of daily discounts while shopping at the local store, and to check prices from Amazon while browsing at BestBuy. The seamless experience of both the digital and physical domains through mobile devices has become more of a necessity than a strategic advantage. As supported by our empirical findings, firms with operational resources are inclined to join the new mobile market. The influence of customer attributes on a firm's adoption need not be discounted altogether. Instead, it is more appropriate to consider that due to the recent emergence of m-commerce, firms are inclined to grasp quickly at the additional sales opportunities if they have comprehensive e-retail functions to provide digitalized services, are the type of e-retailers with physical stores complementing their virtual services (i.e., retail chains), or perform well in the market of their specialized field (i.e., high market share and economies of scale/scope). In other words, as firms sense that they have an operational edge to fuel channel expansion and beat their competitors, they are willing to initiate mobile retail services even when their order value or shopper age may not fit best with m-retailing. This point is further supported by the fact that public firms with more resources/funds in our sample are more likely to initiate m-retailing.

In addition to the operational dimension, there are variations in market demands as customers have different opinions toward mobile retailing and have different preferences for certain types of products purchased through mobile devices. Retailers that accumulate customers and resources matched with market preferences of m-commerce should exploit this, as the idea of anytime/anywhere mobile shopping can be more appealing to their target customers. For example, target customers of American Eagle are mostly young adults adept at using smartphones and are thus more willing to make purchases via mobile devices. In addition, the low price of products is one of the key criteria for customers' instant purchase decisions via mobile retail services. Although our data do not predict that firms with such price characteristics are more likely to step into the new mobile market, these firms may expand market shares if they cater to such preferences of their customer bases.

It is worth investigating further the finding that retail chains – a type of e-retailers – are more likely to initiate mobile retail services. In contrast to web-only retailers (a type of e-retailers without physical stores), retail chains represent another type of e-retailers with physical stores complementary to their online services. The emergence of m-commerce creates a unique opportunity for retail chains to exploit multichannel formats and better serve customers by creating synergies between mobile services and physical outlets [12]. As a type of e-retailers, retail chains are more likely to adopt m-retailing simply because they take the opportunity of extending their experiences learned from integrating physical and e-retail operations to the m-retail domain. For example, customers can pick up/exchange/return purchases made through e-commerce sites at the nearest physical stores. The cross-channel services are still effective (and perhaps even more so) in the m-retail context. In addition,

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the nature of mobility and location awareness of mobile data services further enhances the integration of physical and virtual stores. For example, customers can browse mobile sites at any time and place, use mobile sites/apps to check in-store inventories on the go, and visit the nearest physical outlets to check out a product to ensure its fit and purchase the product immediately without having to wait for delivery. Multichannel retail chains are motivated to initiate m-retailing because of the expected benefits [35].

Cross-channel synergies have been discussed since the beginning of e-commerce. With the advent of m-commerce, omnichannel retailing has also emerged recently as a concept [12]. Customers are able to shop for and purchase the same items through many different channels, especially on mobile devices that bring the Internet to customers 24 hours a day, 7 days a week regardless of their location, even when they are on the move [8,44]. As a result, customers are able to interact with retailers at multiple touch points and are exposed to a rich mix of off-line sensory information and online content at the same time. Brynjolfsson et al. [12] also comment that mobile devices and applications are key enabling technologies of omnichannel retailing. With characteristics such as ubiquity and mobility, cross-channel retailing practices developed in the e-commerce context such as "click and collect," "order in-store, deliver home," "order online, return to store," and "showrooming" can be further enhanced by mobile retailing services.

In addition to mobility enabled by mobile technologies, an integrated order fulfillment capability is another key factor in the provision of omnichannel retailing services at the time and location of the customers' choice. When customers check product information using smartphones, they seek to know whether local stores have inventories and if the items are unavailable at the moment, when the product can be shipped to the stores. These services would not be feasible without system-wide inventory visibility across different channels. A recent survey by Retail Systems Research indicates that 93% of retailers recognize the importance of cross-channel visibility, but only 45% of them have implemented this capability [5]. Firms that have accumulated such operational excellence in e-retailing are certainly able to extend the advantage to the growing mobile market.

5.2. Academic implications

Firms actively search for innovations that can help them attract new customers and generate more revenues. While radical and incremental innovations have been well discussed in previous studies, modular innovation that is disguised by the changes in core components but is still dependent on existing operations is seldom examined in the literature. Our empirical investigation shows that the modular innovation from e-retailing to m-retailing, which changes the core component of service delivery but retains the essential operations, actually provides more opportunities for well-entrenched firms. Early studies on m-commerce have mainly discussed the differences between e-commerce and m-commerce in terms of technical implementation, time differential, and location constraints. The mobility and personal nature of mobile devices indeed change the mode of service delivery. However, as both e-retailing and m-retailing involve cyber transactions over the Internet, supporting capabilities such as transparent order fulfillment and established customer trust are critical to a firm's e-commerce performance and its initiation of m-commerce as well. Rooted in the theoretical perspective of modular innovation, our study shows that established firms perceive the advantages of the cross-fertilization between e-retail capabilities and m-retailing and thus take initiatives to offer mobile retail services with the growth of the market.

Berry et al. [10] propose a matrix to devise strategies for service innovations that can attract new customers and even create a new market. They suggest firms think along two dimensions: the type of benefits offered and the degree of service separability. In the first dimension, a firm can innovate by offering a new core benefit or a new delivery benefit that makes the service more accessible to customers. The second dimension indicates that firms are limited by whether the service must be produced and consumed simultaneously when delivering services. Within the matrix, firms can propose a service innovation that offers a new core benefit focused on servicing consumers as it is inseparable. Alternatively and more relevant to our study, firms can invest in a service innovation that provides a new core benefit by making an originally inseparable service into a separable service (e.g., online care through the Internet). The transition from e-retailing to m-retailing falls into the matrix by innovating the mode of service delivery. Due to its separable nature and new delivery benefit, m-retailing allows customers to enjoy the innovative service at any time and place. The match of the matrix and m-retailing emphasizes the importance of m-retailing as a service innovation that provides opportunity for growth. More importantly, we intend to inquire which type of firms is more likely to take the initiative and what the associated competitive implications are. Our study answers the key questions of m-retail initiation from the perspective of both the nature of the innovation and the inherent resources a firm possesses.

5.3. Research limitations

Given its exploratory nature, our study has several limitations. Many of these limitations are due to the unavailability of data and can thus be addressed in future research when more data are made available. First, the cross-sectional research design limits our ability to make a causal inference. We address the limitation by performing a robustness check using longitudinal information on the timing of initiation of mobile retail services for 422 firms from 2007 to 2010. Yet, the robustness analysis is still limited by the unavailability of longitudinal data for independent variables. A better understanding of antecedents and consequences will require a complete panel data analysis.

Second, the operation and customer dimensions we assess are by no means exhaustive. For instance, learning externalities and bandwagon effects on other firms' decisions to initiate mobile retailing may be present. Future research can explore the extent to which a firm's initiation is influenced by its peers. A follow-up study can also address the types of firms that are prone to influences of prior initiators, although this will require data on the history of firms' initiatives toward m-commerce.

Third, our study focuses exclusively on the binary measure of initiating mobile retail services. Subsequent studies on m-commerce could consider going beyond the conventional dichotomy of "adoption versus non-adoption" by incorporating firms' extent of adoption and business value into research models, as technology/innovation diffusion involves not only initiation but also routinization [50]. For example, researchers may attempt to explore firms' extent of initiating mobile services in terms of system implementation choices, which provide a more granular view of the extent of adoption. This level of analysis is more detailed and relevant to the actual decision making of firms, although this would require further data collection and comprehensive analysis.

Fourth, our sample is composed of the top 500 e-retailers in North America. Empirical researchers often contend with this limited sample source, as firm-level secondary data are usually available for only large and/or public firms. Nevertheless, our sample still has fair generalizability, given that these top 500

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e-retailers make up 75% of the total e-retail sales in the online retail market of North America. Therefore, our findings on firms' initiatives toward mobile retail services remain representative of a broad population of e-retailers.

Finally, practitioners have begun to recognize and discuss the potential cannibalization between e-retailing and m-retailing, as mobile devices such as large-screen tablets make mobile shopping more convenient. However, it is difficult to assess this cannibalization issue under our cross-sectional setting. Alternatively, as both e-retail and m-retail markets are currently growing [11], it is plausible that firms with growing e-retail sales may also enjoy the growth of m-retail sales, leading to an increase in the overall sales. Future studies can extend the focus to the performance of a firm as a whole, preferably with data over several years. This will lead to a deeper understanding of the overall impact of the additional m-retail channel and contribute to the literature of multichannel retailing management.

6. Conclusion

Driven by the proliferation of wireless capability, many existing studies stress the distinct features of m-commerce in contrast to e-commerce. However, the replacement of the service delivery interface from e-retailing to m-retailing does not change the importance of business processes from inventory tracking, payment checking, to order fulfilling. Thus, we adopt the concept of modular innovation to empirically assess the association between e-retailer characteristics and mobile retail services. We observe that the attributes of retail firms in e-commerce have considerable impact on the firms' decisions to activate m-commerce. The transition or extension from e-retailing to m-retailing is a service innovation that attracts new customers and creates a new market channel by enhancing the mode of service delivery. Our finding suggests that the link between e-commerce and m-commerce can be crucial to facilitating the service innovation for both e-retailers and online marketers. We encourage more research to further explore this link and elucidate the close association between e-commerce and m-commerce, both theoretically and empirically.

Appendix A. e-Retail function list

360° spin	Microsites	Widgets
Affiliate program	Mouseover	Wish list
Auction	Online circular	Zoom
Blogs	Online gift certificates	Account status/History
Catalog quick order	Outlet center	Buy online/Pick up in store
Color switching	Preorders	Click to call
Coupons/Rebates	Product comparisons	Currency converter
Customer reviews	Product customization	Estimated shipping date
Daily/Seasonal specials	Product ratings	Express checkout
Dynamic imaging	Product recommendations	Free return shipping
E-mail a friend	Product wikis	Live chat/E-mail
Enlarged product view	Registry	Order confirmation
Frequent buyer program	RSS feed	Order status
Frequently asked questions	Site personalization	Prepaid labels
Gadgets	Social networking	Rain checks
Guided navigation	Store locator	Real-time inventory check
Interactive catalog	Syndicated content	Ship to multiple addresses
Interactive kiosks	Top sellers	Shipping cost calculator
Mapping	Videocasts	Shipment tracking
Mash-ups	What's new	Toll-free number

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