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Research on the Impact of Logistics Services on Sales in the Omni-Channel Retail Environment

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Abstract

With the flourishing of the omni-channel retailing, many retailers integrating online channels with their physical retail networks. Some new forms of logistics services have emerged in the omni-channel retail process. Many large department stores have launched BOPS (buy-online-and-pick-up-in-store) services, such as Walmart and Macy's. Identifying the impact of logistics service quality on the sales of goods in the context of omni-channel retailing can help retailers enhance their competitiveness and improve their performance. The purpose of this study is to reveal the major factors of logistics service quality that impact the product sales performance in the omnichannel environment. A multiple regression model is built to explore every factor's contribution to sales. The results confirm that factors such as ship-to-store service, delivery speed, logistics service price, customer rating had a significant impact on sales performance, and this impact varies by product categories.

Keywords

Logistics service, sales, regression analysis.

1. Introduction

As customers become accustomed to online shopping, brick-and-mortar retailers have increasingly supplemented their commodities on online platform. Identifying the impact of logistics service quality on the sales in the context of omni-channel retailing can help brick-and-mortar retailers enhance their competitiveness and improve their performance. This paper studies the impact of logistics services quality on the sales of goods of bricks and mortar retailers in the omni-channel retail environment. First, it reviews the logistics service quality scales at various stages and summarized the factors of logistics service quality perception in the omni-channel environment. Secondly, this paper chooses the dependent variables, independent variables and control variables. Then the research hypothesis is proposed. After that, we develop the webpage analysis and data grabbing program, collect product characteristic information from Walmart. Finally, we establish the analytical model and get some conclusions through multiple linear regression analysis.

For conducting the analysis, we chose Walmart as the target company for two reasons. First, it is well known that Walmart is the world's largest offline retailer, with annual revenues of nearly $500 billion. To make up for the disadvantages of online retail, Walmart spent $3 billion taking over Jet.com in 2016, a move which improved its comprehensive e-commerce capabilities significantly[1]. Then Walmart has expanded its online retail business through a series of mergers and acquisitions. Now it has formed a relatively complete online system, becoming the second largest e-commerce retailer in the United States. Second, Walmart provides an online marketplace and launches new logistics service for better service. Such as 2day-shipping, ship-

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to-store strategies[2]. Different goods have different requirements for logistics, this may lead to an essential difference between the Product types. In short, Walmart is one of the primary online retailers, and its mature offline retail experience makes it especially suitable to be employed in exploring the logistics Services between different product categories.

Many retailers made efforts to improve the ability of channel integration. This has made more varied and better order fulfillment options available for online purchases. Most of the large retailers provided customers with the option to buy online and pick up in store. Retailers surveyed by Forrester Research (2014)[3] reported that allowing all customers to buy online and pick up at the store was considered the most important of all omnichannel implementation projects. We are interested in whether the improvement of logistics services such as BOPS and delivery speed has a positive impact on sales, and whether different types of goods have different requirements for logistics services. Regarding the research on omni-channel retail strategies initiated by traditional brick-and-mortar retailers, most of the existing related research papers are mainly about whether the option of "Buy Online and Pick up at Store" should be added to the existing store channel portfolio. However, there has been no other academic literature focusing on the impact of logistics services on Sales using large-scale real data, and we attempt to fill this gap.

2. Research Design

2.1. Literature Review

2.1.1. Logistics Service Quality

In the omnichannel environment, where products are delivered to the store and to the home, logistics service have become an important factor for retailers and their customers. Rakowski (1982)[4] proposed to organize customer service with three different approaches: time period, operational attributes, and functional areas. In operational attributes, Rakowski separates objective performance indicators (speed, availability, accuracy, consistency, and product performance) from subjective customer expectations (convenience, flexibility, personalized attention, and information). There are two elements in logistics services: customer marketing services (MCS) and logistics distribution services (PDS). In practice, these two elements are mutual correctives to meet customer needs. This perspective is seen as the knowledge base for integrating marketing and logistics activities (Mentzer 1989)[5].

From the perspective of customers, Bienstock (1996)[6] research results have expanded the scope of service quality research, explored the components of logistics service quality, and conducted data inspection to form the final PDSQ scale. The most detailed components of logistics service quality were identified in 2001. Considering the two aspects of physical service quality and customer service quality, Mentzer and Flint (2001)[7] divided the entire logistics service process into two categories of nine dimensions: order placement—personnel contact quality, order release quantities, information quality, ordering procedures, and order receipt—order accuracy, order condition, order quality, order discrepancy handling, timeliness.

The research of the logistics service quality scale has shifted from the early logistics service provider orientation to the customer orientation. The current research is mainly focused on the relationship between logistics service quality and customer satisfaction.

2.1.2. The Omnichannel Retail

Digitalization has pushed retailers to redefine their business models towards omnichannel retail. In the omnichannel environment, retailers integrate multiple channels to provide customers a seamless shopping experience. The omnichannel retail can be defined as a synchronous operating model in which all channels of the company are consistent and show customers a single consistent way of doing business. (Bernon et al., 2016)[8]. Integration

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concerns the point of view of the retailer, whose consumer data, pricing and inventory are integrated across all channels and the controlled company, and their goods and services are the same across all channels (Beck & Rygl, 2015)[9]. According to Brynjolfsson, Hu, and Rahman (2013)[10], the advanced technology blurs the distinction between store and online operations. It's common to find that consumers selecting products in the store and then buying online, or browsing online before completing a purchase in a brick and mortar store. Allowing customers to buy online and pick up at the store is considered the most important one in the omnichannel implementation projects (Forrester Research 2014). Retailers benefit from allowing customers to pick up their online orders in store. Gao, Su (2016)[11] studied the impact of buy online and pick up in store (BOPS) on store operations, and found that BOPS attracts customers to store, thereby improving previously poorly sold products Sales.

Above all, we can find that the core of omni-channel retail is consumer-centric. The convenience of omni-channel retail allows customers to easily complete the purchase, however finally the satisfaction level of the shopping experience is reflected through logistics distribution. Logistics is the foundation and ultimate embodiment of omni-channel retail and the fundamental guarantee for the realization of the "customer-centric" concept. So, for retailers, in the increasingly fierce online and offline competition environment, they urgently need the support of advanced logistics service.

2.2. Data Collection and Filtering Process

We use the web crawler technology to collect two major categories (Electronics products, PersonalCare products) in the Walmart platform. With the Walmart Open API , we were able to easily determine several features of any product, e.g., ship-to-store, number of reviews, and logistics fee. In detail, the data collection process was as follows. It should be noted that each category considered in this research can be subdivided into hundreds of subcategories. Our research sample included the products listed in the first 100 pages of each subcategory. Then we use web crawler technology to collect all of the corresponding product IDs in August, 2018. According to the needs of research, we capture two types of products from September 1, 2018 to October 31, 2018. Finally, after deleting the products with incomplete information including seller type, category, and price, we included 13,770 products in the empirical study.

2.3. Research Hypothesis

Different type goods have different sensitivities to logistics services. The heavier goods may have higher requirements in convenience, and fragile goods require higher security in transportation. Thirumalai (2005)[12] studied the customer satisfaction with order fulfillment in retail supply chains, he classified the products and found that the impact of different product delivery speeds on sales was different.

H1: Commodity types significantly regulate the impact of logistics services on sales.

The delivery speed factor measures the time from shipment to arrival. Logistics excellence makes consumers satisfied so that they will keep using the online shopping malls. Most previous studies have found that the speed of logistics has a positive and significant impact on sales. In an e-commerce shopping environment, customers are more sensitive to delivery times. Lee and Whang (2001)[13]believe that the quality of logistics services related to the timeliness of delivery in the "last mile shipping" is an important factor. Based on previous research, we propose the hypotheses:

H2a: Delivery speed has a significant positive impact on product sales.

H2b: The effect of delivery speed on product sales is significantly different between product categories.

As the "ship-to-store" option is becoming more popular among shoppers, many retailers see it as a way to appeal new customers. Customers can enjoy instant and convenient shopping

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service without shipping and delivery changes. BOPS can help attract more customers to the store and thus boost the sales of products. Yonghwa Park (2009)[14] visited a number of international express logistics service companies and took the convenience as the dimensions of logistics service quality. Customers' items have already been picked and packed by store staff by the time they arrive, they can take it at the pick-up counter in handy. Ship-to-store is a form of logistics convenience.

H3a: Ship-to-store has a positive and significant impact on product sales.

H3b: The effect of Ship-to-store on product sales is significantly different between product categories.

Freight is one of the main complaints of online retailing and have a significant negative impact on customers' purchasing decisions. Customers are almost twice as sensitive to freight rates as product prices (Brynjolfsson and Michael Smith, 2000)[15]. The shipping cost of the Walmart platform varies by products. After data cleaning, it can be divided into two types: free shipping and shipping cost of $ 5.99.

H4a: The price of logistics services has a significant negative impact on sales.

H4b: The impact of logistics service prices on product sales is significantly different between product categories.

The customerRating of a product refers to the customer's satisfaction of the product. Generally, there are 5 standards which are expressed in the form of 1 to 5 stars. The higher the score, the better the evaluation. Chevalier and Mayzlin (2006)[16] studied the impact of online reviews on book sales and found that the higher review score, the higher the sales of books. Based on the above research, here put forward hypotheses:

H5a: customerRating has a significant positive impact on product sales.

H5b: The impact of customerRating on product sales is significantly different between product categories.

Table 1. Variable description table

Variable type	Variable symbol	Variable definitions
Explained variable	numReviews	The data comes from Walmart platform. We replace product sales with online reviews.
Explanatory variables	Is twoday shipping	Whether the item is eligible for two-day delivery. "TRUE" or "FALSE".
Explanatory variables	Ship to store	Whether the item can be delivered to the nearest Walmart store for free. "TRUE" or "FALSE".
Explanatory variables	standardShiprate	Commodity freight. it can be divided into two types: free shipping and shipping cost of $ 5.99.
Explanatory variables	customerRating	The average star rating of products. It is expressed in the form of 1 star to 5 stars.
Explanatory variables	salePrice	Sale Price

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2.4. Descriptive Statistics

Before performing multiple regression, this paper first makes descriptive statistics of the main variables, analyzing the data distribution, concentration trend, and volatility. Correlation analysis is used to determine whether there is multicollinearity between the variables, and to ensure that the results of multivariate linearity are more accurate and convincing. Finally, with product sales as the dependent variable, a multivariate linear regression was performed to investigate whether the respective variables have a significant effect on the sales of the products.

Descriptive statistical analysis is a basic statistical method to describe the relationship between variables. The description table contains the average, maximum, minimum, standard deviation, etc.

Table 2. Descriptive statistics (Electronics products)

	Mean	S.D.	Max	Min
numReviews	54	323	10344	1
Ship to store	0.5	0.26	1	0
Istwodayshipping	0.5	0.49	1	0
standardShipRate	3.3	2.98	5.99	0
customerRating	4.1	2.98	5	1
salePrice	82.1	155	3499	0.98

Notes: S.D. is an abbreviation of “standard deviation”

Table 3. Descriptive statistics (PersonalCare products)

	Mean	S.D.	Max	Min
numReviews	298	2196	97309	1
Ship to store	0.5	0.35	1	0
Istwodayshipping	0.5	0.36	1	0
standardShipRate	5.8	1.06	5.99	0
customerRating	4.3	0.72	5	1
salePrice	9.7	155	399.94	0.27

Notes: S.D. is an abbreviation of “standard deviation”

The average sales of electronic products are 54, the maximum is 97309 and the minimum is 1. The average sales of personalCare products are 298, the maximum is 10344 and the minimum is 1. From this we can clearly see that there is a clear gap between the maximum and minimum values. In addition, its high standard deviation indicates a high degree of dispersion in sales and the sales fluctuates greatly.

The average star rating is above 4 points, indicating that the overall score is high. In existing research, Chen and Wu (2004)[17] studied the reviews on Amazon.com. Statistics suggest that more than 70% book reviews are four stars or more; Resnick (2012)[18] also found that negative reviews accounted for only 0.3% when collecting reviews on eBay. From the descriptive statistical results of our data and the existing research, it has been shown that consumers give high scores on online shopping.

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2.5. Correlation Analysis

Correlation analysis is the basis and premise of regression analysis. Only through correlation analysis can we determine whether there is a quantitative dependency relationship between the variables. For models with more than two explanatory variables, the correlation coefficient between the explanatory variables can be used to determine whether there is a significant linear relationship between them. Generally speaking, if the correlation coefficient of the two explanatory variables is relatively high, for example, it is greater than 0.8, it can be considered that there is severe multiple co-liner relation between variables.

Table 4. The Correlation coefficient matrix (Electronics products)

	numReviews	Ship to store	Istwoday shipping	standard ShipRate	customer Rating	salePrice
numReviews	1					
Ship to store	0.07**	1				
	.000					
Istwodayshipping	0.12**	-0.05**	1			
	.000	.000				
standardShipRate	-0.14**	-0.08**	0.02	1		
	.000	.000	0.05			
customerRating	0.05**	0.02	0.05**	-0.01	1	
	.000	0.12	.000	0.61		
salePrice	0.15**	0.08**	-0.03*	-0.46**	0.03*	1
	.000	.000	0.01	.000	0.01	

Notes: Pearson Correlation.**, and * denote coefficient significance at 1%, and 5%, respectively.

For electronic products, Ship-to-store, Istwodayshipping and customerRating are positively correlated with the sales at a significance level of 0.01. While logistics price is negatively related to the sales. The small correlation coefficient between the variables indicates that there is no multiple co-liner relation between variables.

Table 5. The Correlation coefficient matrix (PersonalCare products)

	numReviews	Ship to store	Istwoday shipping	standard ShipRate	customer Rating	salePrice
numReviews	1					
Ship to store	0	1				
	.000					
Istwodayshipping	0.16**	0.01	1			
	.000	0.35				
standardShipRate	-0.01	0	0.05**	1		
	0.5	.0.8	.000			
customerRating	0.06**	0	0.04**	0.04**	1	
	.000	0.84	.000	.000		
salePrice	-0.02	0.01	-0.04**	-0.71**	-0.03*	1
	0.18	0.27	.000	.000	0.01	

Notes: Pearson Correlation.**, and * denote coefficient significance at 1%, and 5%, respectively.

As can be seen from Table 5, with regard to personal care products, Istwodayshipping and customerRating are positively correlated with the sales at a significance level of 0.01. However, the " ship-to-store " service has no significant relationship with product sales. According to the

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official introduction of Walmart, after the implementation of the free two-day delivery service, the sales of shampoos increased by 500% and the sales of makeup item increased by 190%. It is speculated that PersonalCare products have higher requirements for logistics speed, but are not highly relevant to pick-up services.

According to the previous correlation analysis, we can see the correlation coefficients are small, and the VIF values of the variables are all around 1, indicating that there is no obvious multicollinearity in the independent variables.

2.6. Regression Analysis

Using the package "glm" of statistical software R, a generalized linear model is conducted to carry the regression. First read the surveyed data into a workbench, then shifting the independent variables to dummy variables. The "glm" function is used to perform poisson regression in R, the specific form is:

glm (y~ x1+ x2, family = poisson (link = "log"), data = dataframe)

Table 6. The Results of regression analysis for Electronics products

	Estimate	Std. Error	z value	Pr(>|z|)
Intercept	-0.03465	0.07848	-0.44	0.6588
Ship to storeTRUE	0.24559	0.03904	6.29	3.1e-10 ***
IstwodayshippingTRUE	0.21942	0.01818	12.07	< 2e-16***
StandardShipRate5.99	-0.0867	0.00504	-2.87	0.0041**
customerRating	0.04188	0.00948	4.42	9.9e-06 ***
salePrice	0.07344	0.01189	6.18	6.6e-10 ***

Notes: **Estimate is significant at P < 0.01 level, ***Estimate is significant at P < 0.001 level

In poisson regression, the dependent variable is modeled as the log of the conditional mean. It is usually easier to interpret regression coefficients at the initial scale of the dependent variable, so we use the "exp (coef ())" function to get the exponential coefficient of the model.

The regression result of Electronics products shows:

1. Ship-to-store, Istwodayshipping are significantly positive affecting sales. This means that these logistics service variables have a strong appeal to consumers. According to the size of the standardization coefficient, we are able to determine the most important variables: Ship-to-store has a greater positive effect than Istwodayshipping. Therefore H2a, H3a hypothesis is validated. Keeping other variables unchanged, when the product suitable for Ship-to-store, the corresponding expected sales is 1.28 times of the products that don't meet the pickup requirement. Electronic products are mostly computers, mobile phones, cameras, etc. Consumers can go to physical sites to experience the performance of the product. If there is a problem with the product or it does not meet the customer's requirements, it can be processed or returned at the same time. The Ship-to-store function in the omni-channel environment allows consumers to enjoy the same price online and avoid the hidden danger of damage during the transportation.

2. The logistics service price have a negative impact on sales. Compared with free shipping, the shipping costs $5.99 has a negative impact on product sales. It shows that the hypothesis H4a is accepted. When the product shipping costs $5.99, the corresponding expected sales will be multiplied by 0.9 times, that is, keeping other variables unchanged, the sales of products which are charged $5.99 will be reduced by 10%.

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3. customerRating is positively affecting the sales. This shows that the higher is the product rating, the more sales of Electronics products. Hypothesis H5a is accepted. Products of high score can enhance consumers' willingness to buy, because the higher the consumer score, the more guaranteed the product quality and the seller's reputation. At the same time, it also shows that the lower price of the product, the fewer the sales may be. Searching goods like Electronics products with higher prices are often brands with higher attention and are more attractive to consumers.

Table 7. The Results of regression analysis for PersonalCare products

	Estimate	Std. Error	z value	Pr(>|z|)
Intercept	0.820180	0.070889	11.57	< 2e-16***
Ship to storeTRUE	-0.000185	0.018023	-0.01	0.9918
IstwodayshippingTRUE	0.325444	0.019759	16.47	< 2e-16***
StandardShipRate5.99	-0.134231	0.007163	-3.13	0.0018 **
customerRating	0.057871	0.009322	6.21	5.4e-10 ***
salePrice	-0.027233	0.010410	-2.62	0.0089 **

Notes: **Estimate is significant at P < 0.01 level, ***Estimate is significant at P < 0.001 level

The regression result of PersonalCare products shows:

1. Free two-day delivery is significantly positively affecting sales. This means that the delivery speed is more attractive to consumers and accepts the assumption H2a. According to the official introduction of Walmart, the two-day delivery strategy increases in sales Shampoo item with 500%, makeup item with 190%. PersonalCare products are shampoos, body lotion, and other urgently needed products, which require faster logistics speed. If maintains other variables to be invariable, the corresponding expected sales of PersonalCare products which delivered within two days is 1.38 times that of other PersonalCare products.

2.The function of Ship-to-store for PersonalCare products is not significant. Compared with high-tech Electronic products, consumers do not need to consider too much when purchasing such daily supplies. People have large randomness when purchasing, so they just buy it nearby. The assumption H3a is rejected.

3.The same as Electronics products, the logistics service price has a negative impact on sales. When the product shipping costs $5.99, the corresponding expected sales will be multiplied by 0.87 times, that is, keeping other variables invariable, the sales of products with freight will be reduced by 13% compared to free shipping products.

4.Unlike Electronics goods, the price of PersonalCare products is negatively related to the sales. Analysis shows that the price changing a unit, the sales is expected to decrease by 3%. This is because daily necessities have a short life, if they are overpriced, consumers will reject or reduce purchases.

Through comparative analysis, the type of goods significantly regulates the impact of logistics services on sales, Therefore H1 hypothesis is validated. PersonalCare products such as shampoos have higher requirements for delivery speed. Consumers often choose products with " Istwodayshipping" logo for shopping. However, the Electronics products are more dependent on whether they can be picked up at store.

3. Conclusion

This paper studies the impact of logistics services quality on the sales of bricks and mortar retailers in the omni-channel retail environment. We collect product characteristic information

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from Walmart, and then establishes the analytical model and get some conclusions through multiple linear regression analysis. The main conclusions are as follows:

The comprehensive improvement of receiving convenience is not necessary, but it is important for specific type products. Even though ship-to-store is a popular fulfillment option among customers, we find that brick-and-mortar retailers need to be cautious when implementing it to all types of products.

With the continuous improvement of people's living standards, product prices are not the only consideration and people gradually pay more attention to other factors such as quality and delivery speed. The impact of price on sales is different. For the Electronic products, when people decide to buy it, he will no longer consider the price. For daily necessities, consumers are more sensitive to the price. If goods of this type are overpriced, it will lose potential consumers.

customerRating is positively related to both categories of goods. We found that even the product rating appears an “J” shape, it has a positive effect on sales. The research product contains 13,770 data, large samples make up a large sales range. The impact of extremely high-value samples is becoming smaller.

When laying out “the last mile shipping” logistics strategy, the retailers should take corresponding logistics service measures according to the different categories of goods. More importantly, for some retailers like Walmart, which generate most of their revenues from offline retail, how to coordinate online and offline product delivery strategy for optimizing company profits becomes a crucial issue.

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