IJACT 20-3-7

Empirical Analysis on Comparison between Self-checkout and Regular Staffed-checkout lanes in a Poland Retail Store

Jin Kyung Kwak

Associate Prof. of Business Administration, Ewha Womans University, Seoul, South Korea
E-mail : jkkwak@ewha.ac.kr

Abstract

Customer satisfaction in retail stores are considerably affected by checkout services. Self-checkout counters have been installed in order to reduce waiting times at checkout in retail stores. However, it is uncertain whether the self-checkout lanes actually decrease the average waiting time of customers. Rather, there are some problems associated with self-checkout lanes such as theft or service failure due to technological problems. This study analyzes comparison between self-checkout and regular staffed-checkout lanes, based on the dataset collected from a retail store in Poland. As a result, we observe that the average transaction times were longer at the self-checkout lanes though fewer products were purchased than at the staffed-checkout lanes. In addition, the customers who buy more products tend to use self-checkouts less frequently. We also check that transaction times are proportional to the number of products customers purchase, and that both the time to scan one item and the fixed time related to checkout are significantly longer at the self-checkout counters. As there has been very few research on the effectiveness of self-checkouts, this study can be the first step to investigate managerial insights on checkout services in retail stores.

Keywords: Self-checkout Technology, Empirical Analysis, Checkout Data of a Poland Retail Store, Retail Operations

1. INTRODUCTION

Customer satisfaction in retail stores is considerably affected by waiting at the checkout counters. These days many retailers have introduced express or self-checkout counters in order to reduce average waiting time of customers. Despite the increase of retailers pursuing such diversification of checkout counters, there has been relatively fewer research on the advantage of express or self-checkout counters. Several studies rather pointed out that there are some drawbacks of installing them. [1] observed that the benefit of having express checkout lanes may be reduced when there are fewer customer arrivals per hour or when the average checkout service time is shorter. Self-checkouts are not preferred by older people who have technical difficulty [2] and may induce more thefts [3, 4]. Still, most customers appreciate the retailers' efforts on diversification of checkout lanes, which reveals how much the retailers concern customers' convenience.

In particular, self-checkout counters can reduce perceived wait time of customers by making them feel that they control the checkout services themselves [5]. As the machines replace the human clerks, self-checkout counters also can reduce labor costs [6]. In the 2000s, more and more retailers started to install self-checkout counters. In the early year (2001), 6% of supermarkets already provided self-checkout lanes in the United States [7]. However, a survey [8] disclosed that two thirds of customers do not like self-checkout lanes.

In this study, by using the actual data, we aim to compare the two types of checkout counters – self-checkouts and regular staffed-checkouts – to investigate whether there is a significant difference between the two. So far, there have not been any studies on comparing these two cashier types. Most existing literatures have focused on the merit or the side effect of self-checkout lanes by surveys. This study analyzes the actual transaction data of checkout services from a supermarket and compares the two cashier types objectively. In addition, we attempt to verify the relationship between the purchasing quantity and the ratio of self-checkout usage or the transaction time. We do not conclude which cashier type of checkouts is more desirable under any circumstances. Rather, we try to develop a premise about the two cashier types by analyzing the real data for further studies.

According to the empirical analysis, we observe that the average transaction times were longer at the self-checkout lanes though fewer products were purchased than at the staffed-checkout lanes. Additionally, the customers who buy more products tend to use self-checkout less frequently. We also check that transaction times are proportional to the number of products customers purchase, and that both the time to scan one item and the fixed time related to checkout services are significantly longer at the self-checkout counters.

The remainder of this study is organized as follows. Section 2 reviews several relevant literatures and Section 3 analyzes the comparison between the self and staffed checkout lanes by the actual data. Section 4 provides the discussions and concluding remarks.

2. LITERATURE REVIEW

Many existing literatures about self-checkout lanes have focused on why customers choose self-checkout counters. After the self-checkout counters became prevalent, some periodicals have stated the disadvantage of this new type of cashier. There have been few studies on the performance of installing self-checkout lanes, not to mention no study with the actual transaction data of checkout services.

[9] explored the effect of psychological expectation about self-checkouts on customer satisfaction. According to the survey provided by [10], 79% of customers expect self-checkout lanes in grocery stores. [11] found out, through a survey in Singapore, that there was no demographical difference between users and non-users of self-checkout counters, but users prefer self-checkouts because they expect the checkout time would be reduced. [12] analyzed the survey results via structural equation modelling and indicated that time pressure, basket size, coupons and queue length influence customers' decisions to use self-checkout lanes. [13] analyzed the factors affecting customers' choice of self-checkouts and found that perceived waiting time, perceived task complexity, and companion influence are the three situational factors through a mixed qualitative research design. Customers expect the self-checkout counters reduce the waiting time and use them [14].

While self-checkout counters have been used in many markets, several shortcomings were observed including theft. According to [3], a U.K. survey from 2014 suggested that about 20% of shoppers acknowledged stealing items at self-checkout and about 60% of these did it because of the technical reason (they couldn't get an item to scan). More employees than consumers are dissatisfied with self-checkouts because they feel that increased theft and job loss is more detrimental than increased efficiency [15]. In addition, a report revealed that lack of merchandising at self-checkouts decrease sales of supermarkets in New York [16].

In spite of these possible problems, many retailers expect to increase customer satisfaction by installing self-checkout lanes successfully. [17] empirically analyzed that the service quality of self-checkouts positively influences loyalty through customer satisfaction. In [18], experts provided their opinions on self-checkouts: self-checkouts are good systems for customer convenience, but they have some issues such as technical problems, so we need to be careful about layout designs and take efforts to maintain high service quality. [19] studied service quality of self-checkouts through structural equation modelling.

Most literatures have focused on the theoretical and practical pros and cons of self-checkouts while this study analyzes the comparison between self-checkout and staffed-checkout lanes by using the actual transaction information data. This study also investigates the relationship between purchasing quantity and transaction time as well.

3. ANALYSIS

3.1   Data

We analyze the open data provided by [20] who collected the transaction information at a large supermarket in a city of southern Poland from December 7th to 19th, 2017, from February 13th to 26th, 2019, and from March 28th to April 10th, 2019. As Poland prohibits operations on three Sundays per month in 2019, there is no data for February 17th and for April 7th in our data sample. This raw data contains information about cashier type (staffed/self), cashier ID, start time and end time of checkout transaction, transaction time, idle time, number of items purchased, payment type (cash/card), sales amount of items purchased, and log of cashiers for each transaction. The transaction time starts when the first item is scanned, and ends when the customer completes payment. The transaction time is not exactly the same as the checkout service time, as the transaction time does not include bagging time. However, it does not affect the implication of this study as we focus on the comparison between two cashier-types, and not on the waiting-related performances. The total number of transactions in the data was 163,268, in which 40,062 (24.54%) occurred at the self-checkout lanes. Total number of checkout employees was 65, and the number of self-checkout counters was 6.

3.2   Comparison between Self-checkouts and Staffed-checkouts

Table 1 shows the mean and the median of transaction time, number of items purchased, and sales of items purchased as well as the ratio of payment by cash or by card for each cashier type.

**Table 1. Comparison of transaction information by cashier type**

Cashier type	# of Data	Transaction time (sec)		# of items purchased		Sales of items purchased		Ratio of payment	
		Mean	Median	Mean	Median	Mean	Median	Cash	Card
Staffed	123,206	62.04	50	17.66	12	82.36	53.80	0.5497	0.4482
Self	40,062	99.51	77	8.98	6	42.72	27.30	0.4185	0.5746

As a result of T-test, the differences in transaction time, number of items purchased, and sales of items purchased between cashier types are significant. The transaction time is observed to be longer for self-checkout counters, while the number of items purchased and sales of items purchased are higher at staffed checkout counters. More customers pay cash at the staffed checkout counters.

Interesting finding is that transaction time was longer at the self-checkout lanes though the customers who used the lanes bought significantly fewer items than the customers at the staffed checkout lanes. It implies that the customers may not be proficient at checkout activity compared to the employees. Though it may be obvious that employees are efficient at checkout services, we need to analyze this phenomenon because stores install self-checkout counters in order to reduce waiting and service times for customers. If the transaction times at self-checkout lanes are too longer than expected, the customer satisfaction about checkout services will be lower.

The number of items purchased is significantly lower at the self-checkout lanes. The customers using staffed checkout lanes bought average 17.66 items (median 12 items) while the customers using self-checkout lanes bought average 8.98 items (median 6 items). The small-buying customers tend to use self-checkout counters more frequently.

The ratios of self-checkout usage per number of items purchased are illustrated in Figure 1. Figure 1 shows that, as the number of items purchased increases, the ratio of self-checkout usage is observed to decrease. For example, about half of the customers buying only one item use self-checkout lanes while less than one fifth of customers who buy more than 20 items use self-checkout lanes. Installing self-checkout lanes is intended for customers' convenience, but if it reduces the so-called impulse buying, it may be detrimental to the retail stores.
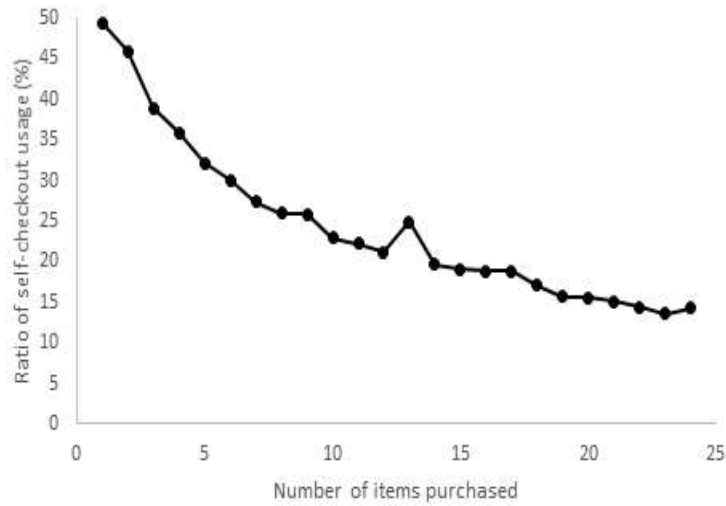
Figure 1. Relationship between purchasing quantity and ratio of self-checkout usage

3.3   Relationship between Purchasing Quantity and Transaction Time

It is expected that the transaction time is proportional to the number of items purchased. In this study, we verify the relationship with the data and analyze the difference between the staffed and self-checkout counters. The regression model (1) we have used for the analysis is as follows.

$$T_{ij} = \alpha_i + \beta_i N_{ij} + \varepsilon_i \tag{1}$$

T_{ij}: Transaction time of transaction j at cashier type i (sec)
N_{ij}: Number of items of transaction j at cashier type i

The results of the regression analysis are summarized in Table 2.

Table 2. Regression results for the relationship between the number of items purchased and the transaction time

Cashier Type	Estimates		adjusted R square	p-value
	α	β		
Aggregate	36.514	2.2358	0.366	<.0001
Staffed	23.258	2.1962	0.642	<.0001
Self	33.985	7.2966	0.642	<.0001

β can be interpreted as the checkout time per item, and α can be interpreted as a fixed time for each checkout service including payment. As a result of the empirical analysis, the fixed service time of self-checkout is longer by about 10 seconds and the checkout time per item of self-checkout is longer by about 5 seconds than those of staffed checkouts.

4. MANAGERIAL IMPLICTATIONS AND CONCLUSION

Considering that checkout services substantially affect customer satisfaction in retail stores, we need to investigate whether the self-checkout lanes can do the intended job effectively. By analyzing the actual checkout transaction data from a large supermarket, we found out the significant differences between self-checkout and regular staffed-checkout lanes.

We observe that the customers who use the self-checkout counters tend to buy fewer items but have longer checkout time than those who use the staffed-checkout counters. It may be of question whether the installation of self-checkout counters actually reduces the waiting time of customers. In order to maximize the benefit from self-checkouts, we need to decrease the transaction time at the self-checkout lanes. Previous studies stated that customers may avoid self-checkouts because of technical difficulty [2] and that theft occurs due to the failure of scanning jobs [3]. Customers are not as efficient as skilled staffs. [21] explored the role of self-checkout attendants who can help customers with technical difficulty. [22] also studied the role of self-checkout attendants for recovery of customers' failure at self-checkout counters. If we design self-checkout lanes in a user-friendly structure, it can solve the technological problems. For example, the screens at the self-checkout counters can show with pictures how to enter the product codes if customers fail to scan some items. It is crucial that customers feel the usage of self-checkouts is convenient because once they experience failures, they will possibly not use the self-checkout lanes in the future [23].

It is notable that purchasing quantity and purchasing amount are considerably less at self-checkouts than at staffed-checkouts. If the existence of the self-checkout lanes diminishes the motivation of impulse buy, we need to investigate whether the potential loss does not exceed the advantage of having the self-checkout option.

Express checkouts for small-buying customers may become a substitute of self-checkouts. Though self-checkouts usually do not limit the number of items purchased, the average number of products purchased at self-checkouts is turned out significantly lower than that at staffed-checkouts according to our study. Our empirical analysis may provide managerial insights on the threshold number of item limits for express checkout lanes. According to the data used in this study, the usage of self-checkouts was 24.93% for shoppers purchasing 13 items, 19.09% for 15 items, 18.83% for 16 items. It implies that some retailer's express checkout policy for 15 items or less may not be appropriate. Surely we cannot think express checkouts are the perfect substitutes for self-checkouts as they are staffed and we need further exploration to search for an optimal policy on the quantity limit of express checkouts. Subjects such as impact of self-checkouts on reducing customer wait times, optimal ratio of self-checkout lanes, and how to design self-checkout counters in a user-friendly manner are important and can be explored in future studies as well.

In addition, from the actual data, we discovered a tendency that the usage of self-checkout decreases as the number of items a customer buy increases. We also confirmed that the average checkout time is positively related with the number of items bought, and found out that both the time for scanning the item and the fixed checkout time such as processing payment are longer for self-checkout cases.

So far, there are very few research about practical analysis of self-checkout lanes in retail stores. This study pursues various managerial implications about checkout services in retail operations and will give us insights on the diversification of checkout lanes.

REFERENCES

[1] J.K. Kwak, "Analysis On The Effect Of Express Checkouts In Retail Stores," *Journal of Applied Business Research(JABR)*, Vol. 33, No. 4, pp. 767-774, June 2017. DOI: 10.19030/jabr.v33i4.9998

[2] R.B. Larson, "Supermarket self-checkout usage in the United States," *Services Marketing Quarterly*, Vol. 40, No. 2, pp. 141-156, April 2019. DOI:10.1080/15332969.2019.1592861

[3] MMR, "Chains Rethink Self-Checkout Lanes," Vol. 34, No. 6, pp.54, 2017.

[4] C. Guillot, "When No One Is Watching: Combating the potential of theft at the self-checkout," *Stores Magazine*, Vol. 100, No. 5, pp. 44-46, July 2018.

[5] L.S.K. Leung, and M. J. Matanda, "The impact of basic human needs on the use of retailing self-service technologies: A study of self-determination theory," *Journal of Retailing & Consumer Services*, Vol. 20,

No. 6, pp. 549-559, November 2013. DOI:10.1016/j.jretconser.2013.06.003

[6] A. Müller, "Self-service shopping: Advantages for both retailers and customers," *Retail Digest*, pp. 50-53, Winter 2008/2009.

[7] V. Barr, "Self-Scanning Checkout Picks Up Speed in Mass Retail Markets," *Stores Magazine*, Vol. 83, No.8, pp. 66-70, August 2001.

[8] R. Hegarty, "Two thirds of shoppers claim they hate using self-service checkouts," *Grocer*, pp. 8, June 2012.

[9] F. Morimura, and K. Nishioka, "Waiting in Exit-Stage Operations: Expectation for Self-Checkout Systems and Overall Satisfaction," *Journal of Marketing Channels*, Vol. 23, No. 4, pp. 241-254, October-December 2016. DOI:10.1080/1046669X.2016.1224309

[10] KioskMarketplace.com,"Poll: Most consumers expect self-checkout from grocery retailers," pN.PAG-N.PAG, April 2019.

[11] H.K. Leng, and K.N.L. Wee, "An examination of users and non-users of self-checkout counters," *International Review of Retail, Distribution, & Consumer Research*, Vol. 27, No. 1, pp. 94-108, February 2017. DOI:10.1080/09593969.2016.1221842

[12] N.T.M. Demoulin, and S. Djelassi, "An integrated model of self-service technology (SST) usage in a retail context," *International Journal of Retail & Distribution Management*, Vol. 44, No. 5, pp. 540-559, May 2016. DOI:10.1108/IJRDM-08-2015-0122

[13] C. Wang, J. Harris, and P.G. Patterson, "Customer choice of self-service technology: the roles of situational influences and past experience," *Journal of Service Management*, Vol. 23, No. 1, pp. 54-78, March 2012. DOI:10.1108/09564231211208970

[14] Checkout, "Customers Opt For Self-Service Over Cashier Checkouts," Vol. 44, No. 1, pp. 34-35, 2018.

[15] A.L. McWilliams, I. Anitsal, and M. M. Anitsal, "Customers versus employees: How self service technology has affected the U.S. retail industry," *Allied Academies International Conference: Proceedings of the Academy of Marketing Studies (AMS)*, Vol. 21, No. 1, pp. 21, Spring 2016.

[16] MMR, "Self-Scan Customers Spend Less Money," Vol. 3, No. 7, pp. 47, April 2013.

[17] F. Demirci Orel, and A. Kara, "Supermarket self-checkout service quality, customer satisfaction, and loyalty: Emprical evidence from an emergining market," *Journal of Retailing & Consumer Services*, Vol. 21, No. 2, pp. 118-129, March 2014. DOI:10.1016/j.jretconser.2013.07.002

[18] J. Tarnowski, "Self-Checkout: Readers Respond," *Progressive Grocer*, Vol. 90, No. 10, pp. 139-140, October 2011.

[19] I. Anitsal, and R. C. Paige, "An Exploratory Study on Consumer Perception of Service Quality in Technology-Based Self-Service," *Services Marketing Quarterly*, Vol. 27, No. 3, pp. 53-67, 2006. DOI:10.1300/J396v27n03_04

[20] T. Antczak, and R. Weron, "Point of Sale (POS) Data from a Supermarket: Transactions and Cashier Operations," *Data,* Vol. 4, No. 2, pp. 67, May 2019. DOI:10.3390/data4020067

[21] M. Garry, "Self-Checkout Lanes Still Need Oversight," *SN: Supermarket News*, Vol. 56, No. 43, pp. 23, October 2008.

[22] J.E. Collier, M. Breazeale, and A. White, "Giving back the "self" in self service: customer preferences in self-service failure recovery," *Journal of Services Marketing*, Vol. 31, No. 6, pp. 604-617, September 2017. DOI:10.1108/JSM-07-2016-0259

[23] D.F. Carr, "Gotcha! The problems with self-service checkout systems," *Baseline*, No. 27, pp. 49, February 2004.