

The Impact of COVID-19 on Global Retail Consumer Behavior: regression model and graphical approach

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Abstract. During the COVID-19 pandemic, consumers increasingly reduced their visits to offline stores due to safety concerns and the closure of most physical retail stores. As a result, the share of global online retail sales surged significantly. This study uses representative examples from seven retail companies to analyze the changes in their e-commerce sales share before and after the pandemic, utilizing regression models and graph analysis to explore future trends. The main objective is to verify whether the changes in consumer behavior during the pandemic were significant and to provide recommendations for the future development of the retail industry based on the findings. The results show that the pandemic significantly increased the share of e-commerce sales, and this shift in consumer behavior is likely to persist. Therefore, retailers should focus more on developing their online shopping platforms and enhancing the customer experience, elevating the importance of online shopping to at least the same level as offline shopping.

1 Introduction

The coronavirus disease 2019 (COVID-19) pandemic is a global outbreak of coronavirus - an infectious disease caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) [1]. WHO declared a Public Health Emergency of International Concern (PHEIC) on 30 January 2020 and characterized the outbreak as a pandemic globally on 11 March 2020 [1]. On 5 May 2023, the WHO accepted the recommendation that the pandemic no longer fit the definition of a PHEIC, which only means that the global emergency is over for now, but not the pandemic itself. Therefore, this research uses the data from 2020 to represent the timeline since the start of the pandemic.

Consumers' consumption habits have been highly fixed in the past because of their consumption context, how demand and supply were met, and the stability and difficulty of changing. However, with the rise of e-commerce in recent years, traditional consumption habits have been significantly disrupted. Specifically, since the onset of the COVID-19 pandemic, due to safety concerns and in response to policies, more and more people have become accustomed to shopping online rather than visiting physical stores [2, 3]. However, developments worldwide, such as more advanced internet, smarter electronic devices, and a

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more diverse selection of stores, have made online shopping much more convenient in recent years. The fundamental shift in people's consumption habits is still largely due to the impact of the COVID-19 pandemic.

This phenomenon raises various questions, such as whether the pandemic statistically significantly impacted consumer habits, whether these habits have persisted over time, how these findings can help suppliers better meet consumer needs, etc.

This study will focus on validating and evaluating the changes in consumer behavior during the COVID-19 pandemic. It will attempt to provide future development recommendations and retailer planning based on overall patterns. Specifically, it will analyze the percentage and trends of e-commerce sales revenue as a portion of total sales revenue for retailers in seven major global sectors over the past decade, conducting longitudinal and cross-sectional comparisons to identify clear patterns and potential future trends.

2 Theoretical background

Changes in consumer behavior are often attributed to significant changes in the external environment, such as economic crises or social events [4]. According to behavioral economics theory, consumer choices and decisions are influenced by personal preferences and external conditions such as availability and convenience [5]. During the break, many restrictions on offline shopping prompted consumers to spend more time on e-commerce platforms, which is consistent with the Stimulus-Response Theory (S-R Theory), which suggests that external stimuli (e.g., embargoes and security concerns due to the outbreak) can lead to significant changes in consumer behavior [6]. In addition, this phenomenon is framed by the Technology Acceptance Model (TAM), which suggests that when consumers perceive a technology (e.g., online shopping) as convenient and useful to use, they are more likely to accept it and continue to use it [7].

The epidemic's impact on the global e-commerce industry has been extensively examined. For example, Tyrväinen and Karjaluoto found through a meta-analysis that online shopping, especially online grocery shopping, showed significant growth during the epidemic, which showed signs of continuing after the epidemic [8]. Chaudhary's study also showed that consumer behavior during the epidemic fundamentally shifted, with many consumers preferring to shop online, especially during the blockade when online platforms became the primary channel for accessing everyday items [9]. In addition, Kim's study points out that companies must accelerate the transformation of digital sales channels to cope with the long-term changes in consumer habits brought about by the epidemic [10]. Therefore, this study further validates the epidemic's impact on consumer behavior through a regression model and provides a reference for the future development of the retail industry.

3 Method

Two main relationships are descriptive and causal when describing the relationship between variables. When looking at real-world data, sometimes the aim is to describe patterns, and at other times, it is to go a step further and figure out what is causing what, which has become a causal question. Both are essential to understanding different relationships but serve distinct purposes and require different approaches. To further clarify the difference between them based on their definitions, it is always true that if a and b are correlated, they are not necessarily causally related. In contrast, if they are causally related, then they must be associated.

The data used in this research are the e-commerce and total sales revenue from seven large retail companies around the globe between 2016 and 2024, subject to each company's

data availability, including Target, Walmart, Costco, BestBuy, Ace Hardware, Ikea, and Nordstrom. They were collected from each firm’s website and third-party statistics websites such as Statista.

The method used to process the data is to calculate the percentage of sales generated from e-commerce by dividing each company’s e-commerce sales revenue by the total sales revenue each year. The data processing for the model used in this research has now been completed.

The primary statistical model being used in this study is linear regression. Regression can be seen as a statistical method that tries to uncover the association between variables but not causation, which perfectly matches this research’s goal. For example, from a descriptive standpoint, regression estimates the conditional distribution of the dependent variable, Y , given the regressors, X .

A dummy variable, often called a “dummy”, usually takes values of either 0 or 1. It represents specific characteristics or categories like gender, race, or location. In this research, the dummy variable will take values of either 1 or 2 to make the result and process more realistic since they will be used to separate periods. While the values are numeric, the numbers do not convey a quantitative meaning in this context. They merely indicate the absence or presence of a particular characteristic, respectively.

The regression model established is:

$$Percentage_i = \alpha + \beta \times Period_i + \varepsilon \tag{1}$$

The dependent variable, *Percentage*, is the percentage of sales generated by e-commerce for each company in each year.

The independent variable, *Period*, is a dummy variable with value 1 before the pandemic and 2 after the pandemic’s start. To clarify this, the time before the pandemic is set as the base group of the dummy variable, and the time since the pandemic’s start is set as the reference group.

Additionally, this study will plot the e-commerce sales revenue percentage trends over the past decade for seven companies on a single chart (with any missing data for certain years from some companies being omitted). This approach will help identify the overall trend as well as the differences in trends among individual companies.

4 Results

The table 1 presents the results after performing regression calculations with this model.

Firstly, the results of the study can be evaluated by examining the p-values of both variables in the model. As the p value for β equals to 0.0044, it is lower than 0.05. So, at 95% confidence level, the independent variable does affect the dependent variable in this regression model, which means that the percentage of sales generated by e-commerce for each company in each year is significantly related to whether it is before the pandemic or after the start of the pandemic.

Secondly, the calculated coefficient is 0.0066, and the intercept is 0.0927. It represents that after the start of the COVID-19 pandemic, the percentage of sales from e-commerce has increased by 0.0927, which is 9.27% overall. By substituting these two values into the model, a generalized model can be derived:

$$Percentage = 0.0927 + 0.0066 \times Period \tag{2}$$

Table 1. Regression results.

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0.3751							
R Square	0.1407							
Adjusted R Square	0.1248							
Standard Error	0.1165							
Observations	56							
ANOVA		df	SS	MS	F	Significance F		
Regression		1	0.1201	0.1201	8.840300236	0.0044		
Residual		54	0.7334	0.013396				
Total		55	0.8535					
	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	0.0066	0.0487	0.1348	0.8932	-0.0912	0.1043	-0.0912	0.1043
X Variable 1	0.0927	0.0312	2.9733	0.0044	0.0302	0.1552	0.0302	0.1552

The Figure 1 represents seven companies' e-commerce sales revenue percentages over the past decade. It shows that the e-commerce sales revenue for most companies peaked during the pandemic, with notable examples including Nordstrom and BestBuy. Moreover, most companies' percentage of e-commerce sales decreased to some extent compared to their peak during the pandemic. However, they have gradually become relatively stable and are still higher than the percentage before the pandemic.

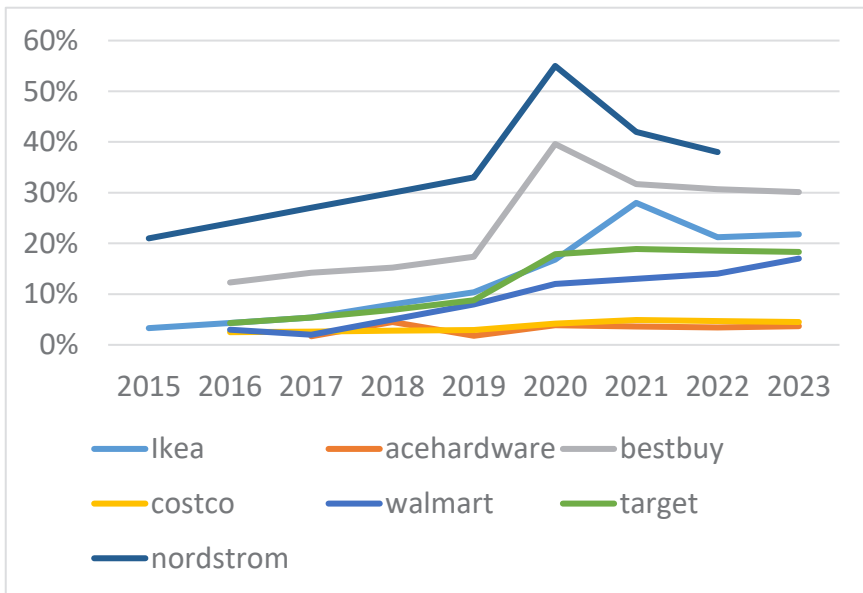


Fig. 1. Percentage of sales/revenue generated from E-commerce

5 Discussion

From the performance of these seven retail companies, it can conclude that the e-commerce sales for most of them have rapidly increased after the outbreak of COVID-19 because consumers prefer shopping online to minimize the probability of being infected. The graphs for companies like Nordstrom, BestBuy, Ikea, and Target show a noticeable structural break during a certain pandemic period, indirectly supporting the significance of the regression experiment results. Although the graphs for other companies do not show such pronounced shifts, they also generally exhibit a steady upward trend.

The result indicates that during the pandemic, consumers' shopping habits shifted from offline to online, and this change was largely driven by various factors related to the pandemic. Although there were some notable decreases after the peak for some companies, this was mainly due to the significant decline in offline shopping during the pandemic. Once the situation stabilized, the overall trend of the e-commerce share remained steadily upward, which can be shown by the graphs that after the decline, firms' recoveries in the e-commerce share were swift in the following year, with most companies returning to a stable or even upward trend again.

Therefore, the results indicate that retailers should try to develop or at least build their online shopping websites to catch up with this trend. Companies that have already developed online shopping should try to make the process more fluent and convenient to attract customers and stay competitive in this market, such as improving their websites, supporting more payment methods, or optimizing their delivery services. These improvements will likely be crucial in the future, as when most sellers have their online shopping websites, it would be quite difficult to differentiate products. This trend has become quite clear, especially after the pandemic; for instance, on the websites of major retail companies, you can find the vast majority of products available on the market, including various brands and batches. As a result, gaining a significant advantage in terms of product diversity is difficult. What attracts customers is their shopping experience.

6 Conclusion

This study found that the pandemic's emergence significantly increased the share of e-commerce sales in the retail industry, and this consumer behavior trend appears likely to continue, which aligns with mainstream societal perceptions. The following facts can explain this. First, during the pandemic, many physical stores closed due to various factors such as the spread of disease, staff shortages, public fear, and government pressure. This led different groups of people to use online shopping voluntarily or involuntarily. Additionally, due to safety concerns, many consumers were reluctant to visit physical stores or even go out, so most people viewed online shopping positively.

After the major danger period of the pandemic passed, consumers maintained their online shopping behavior for two main reasons. First, consumers gradually preferred online shopping, which is more convenient, faster, and less effortful than shopping in physical stores. Second, after a period of use, people became more familiar with the processes of online shopping platforms, leading many who were initially reluctant to learn to use them to acquire this skill passively. Once accustomed to this shopping method, they were often unwilling to change their habits.

The primary significance of this study lies in verifying the shift in consumer behavior due to the pandemic and providing valuable recommendations for the future development of the retail industry.

Finally, future research in this area should focus on comparing the actual data on the share of online sales for these companies in the coming years with the conclusions and predictions

of this study. This comparison will help assess the extent of the differences between the two, thereby validating the feasibility of the previously proposed recommendations and suggesting new development plans and future trends for the industry based on the actual situation.

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