

Article

The Innovation of the Cashierless Store: A Preliminary Analysis in Italy

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Abstract: The retail sector, under the pressure of digitalization and technological innovation, has experienced profound changes in the last decade, and retailers have had to cope with these changes by implementing new business models and competitive strategies with the aim of satisfying the consumers' needs. In the last few decades, the sector has been affected by different new trends, from the birth of supermarkets to the advent of e-commerce, up to the introduction of cashierless stores. The latter represents a new category of store that is totally computer-based and digitalized, in which the use of cameras, sensors and self-shelves minimizes human interaction. Amazon pioneered this emerging concept, with the launch of Amazon Go, but other start-up companies are rapidly entering the cashierless retail market and embracing the challenge. The purpose of this paper is to analyze the knowledge of Italian consumers of cashierless shops, and the relevance of different factors related to this new kind of shops. A questionnaire was sent to a sample of more than 1000 consumers to identify and evaluate the actual situation and knowledge of this phenomenon, which is not yet diffuse in Italy. A statistical analysis, regarding both their knowledge about cashierless stores and the customer experience, is provided to discuss the most relevant factors affecting the customers' perceptions and attitudes, with a comparison per gender and type of users. The results of the provided analysis reveal that the phenomenon is very little known, and this is certainly influenced by the lack of these stores in Italy.

Keywords: cashierless; consumer behaviour; technology; smart payment; survey



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1. Introduction

In the last decade, we have observed a growing trend involving new technologies and an increasing automation of services, with the aim to increase velocity, connectivity and availability of use. Although the areas of application are varied, there is the tendency to reduce the need for human intervention and control in carrying out various operations. Thus, the common goal in applying new technologies is to shorten payment times by using sophisticated algorithms that are able to perform determined functions in less time than a human, thereby reducing the amount of labour and the number of workers. Moreover, the pandemic situation has given rise to accelerations and changes, starting with the (forced and/or obligatory) behaviour of consumers. Linked to the rapid diffusion of different shopping channels, this situation implies new challenges not only for end users but also for retailers who need to adapt to the new, complex environment to remain competitive in a globalized world, where the key element is customer satisfaction. In this competitive framework, the retail sector has changed completely over the last few decades, from the birth of supermarkets to the arise of e-commerce and, eventually, the omnichannel approach to satisfy both online and offline consumers' needs. In the future, retailers will face many challenges related to the introduction of new technologies and innovations that allow consumers to have new, satisfactory shopping experiences. One recent trend in innovative technology is the cashierless concept, which is when a store is completely automatized

and human interaction is very limited. To enter a cashierless store, one must download an application; then, after the registration process, the consumer is free to simply buy products and exit the store without needing to “check out” in the traditional sense, thanks to a combination of artificial intelligence, computer vision, deep-learning and edge computing. The goal of cashierless stores is to allow end users to enter the store and exit as quickly and with as little human contact as possible. This is the main goal not only from the customer’s point of view but also from the retailers. The development of e-commerce and the number of consumers using this shopping mode increased considerably over the last decade, but the emergence of the global COVID-19 pandemic produced an immediate change in consumer behaviours and made avoiding human contact of paramount importance to customers. The work is structured in three parts: after a brief theoretical overview of the world of retail, its evolution and the growing role of technological innovation, the e-commerce mode is introduced. Next, a specific focus on cashierless stores, from the perspectives of both retailers and consumers, is provided. Considering the objective of the paper, after having described the sample, the dimensions relating to cashierless in general, by gender and by type of user were analyzed.

2. Sustainability and Innovation

Sustainable innovation will change the world from both consumer and retailer points of view [1]. Only a few years ago, sustainability and innovation were considered substantially opposed concepts because many technological and industrial innovations had [2] (and, unfortunately, in some cases still have) a negative impact on nature and on people’s well-being. Today, however, innovation can be decisive for improving the environment in a wide number of aspects. Therefore, there is a growing need to develop business models that, in addition to being innovative, are also sustainable. Sustainable innovation requires a shift in the concept of economic development, which is now considered to be development based on the creation of private and social wealth but with the final aim of eliminating the negative impact of this process on ecological systems, human health and the well-being of communities [3]. In other words, sustainable innovation brings together the protection of the environment and natural ecosystems with the paradigm of business innovation, aiming to provide essential goods and services that guarantee the achievement of objectives of social value such as public health, fairness and environmental justice [4]. It is the wave of innovation that pushes society towards clean technology, the green economy and clean trade. Sustainable or eco-friendly innovation is based on using specific criteria for measuring the environmental performance of producers, maintaining transparent communication and meeting a new demand for sustainable products and services. This demand for overall sustainability is linked to different aspects of daily life such as having more sustainable food [5], clothing [6], transport [7], tourism [8,9] and purchasing procedures [10]. Companies, therefore, need to adapt their processes to meet these new demands for goods and services.

3. Italy and Technology, a Brief Overview on Consumers and Retail Industry

In 2021, there are 46.1 million multichannel consumers—users who use eCommerce services or for whom digital has a role in their purchasing process—, equal to 88% of the Italian population over 14 years of age (52%, 6 million) [11]. Digital channels are present in all the consumer’s purchasing process phases, from the discovery of the brand to the “digital conversion”. In 2020, 69% of internet users have learned about new brands online and 76% have used the internet to compare brands of products or services they would like to buy [12]. The multichannel behavior of consumers varies according to the product category: the first sector for digital users is travel, with 71% of consumers obtaining information mainly online about products and 43% buying exclusively online, followed by electronics/IT (70% and 14%) and insurance (46% and 23%). The research shows the social role, given by the consumers, to brands and to ethical and social issues. In fact, 76% believe that brands should take a position on these issues, 73% positively evaluate

companies that have improved sustainability during the last decade and 57% consider strongly these aspects during the decision-making process [13]. Shifting our attention to retail, there is a lack of specialized ICT skills that can be also reflected in the adoption of advanced digital technologies by Italian companies. In particular, the analysis of large volumes of data (Big Data), which is growing rapidly in Europe, stops at 9% in Italy, against 18% in Germany and 22% in France. Conversely, there is a different situation in the cloud services context, with an increase in advanced services from 11 to 32% between 2018 and 2020 against the European growth average of 21%, and of automation for the exchange of commercial documents, driven by the mandatory electronic invoicing introduced in 2018 [14]. Moreover, in 2021, 60.3% of Italian small and medium-sized enterprises (SMEs) reached a basic level of digital intensity (in Europe this level is nearly 56% on average). The European 2030 target is 90%. Considering companies with at least 10 employees, 41.9% have purchased medium-high level cloud computing services and 51.9% reach an intermediate and sophisticated level (the European target, in the 2030, is 75%). The indicators of the Digital Economy Society Index for SMEs that sell online have a slight improvement. In fact, for example, there is only a +5% of companies that use more than one social media [15]. Finally, it is important to underline that in Italy, the culture of self-checkout in supermarkets is now widespread, and some companies of the large-scale retail trade are starting to test the cashierless methodology.

Technology and Gender

The relationship between technology and gender is treated extensively in the literature, both from a practical point of view and from the actual participation in virtual and technological activities. In the literature, there are some papers that deal with this gender issue. Indeed, some scholars have identified a lack of gender differences in computer-mediated support groups. However, Krizek et al. [16] and Bellman et al. [17] have shown that patient support group participants are more likely to be female. Moreover, analysing 3000 news support group postings, Witmer and Katzman [18] found that women have more posts and challenges in their posts than men. In addition, Ben Yisiav et al. [19] affirm that even with comparable innate ability and performance, women may be subject to discrimination. Another study, concerning e-learning capabilities, by Yau and Cheng [20] shows that male students have more confidence than female students when using e-learning technology because gender imbalances in computing are socially constructed and not related to a learner's natural ability. Finally, as argued by Davison and Argyriou [21], there is a technological adoption between genders that can be defined as consistent and this means that the technological differences, considering the gender, both for experiences and for virtual activities, are not very effective.

4. The Evolution of Retail

The retail sector has evolved in many ways over the years, and in the last few decades, it has addressed different and important challenges—from physical stores to e-commerce—in which all of the actors had to adapt to changes in order to remain competitive [22]. Retail, as an economic mode and practice, was born in the 18th century after the first Industrial Revolution in England [23]. Historically, five different waves [24] in response to five different revolutions completely changed our way of life [25,26] from a Schumpeterian perspective. Moreover, we can also observe how each wave has gotten shorter and shorter over the years.

The following table (Table 1) represents Schumpeter's waves.

Table 1. Schumpeter's waves.

Innovation	Period	Wave
Waterpower, Textiles, Iron	1785–1845	First Wave
Steam, Rail, Steel	1845–1900	Second Wave
Electricity, Chemicals, Internal Combustion Engine	1900–1950	Third Wave
Petrochemicals, Electronics, Aviation	1950–1990	Fourth Wave
Digital Networks, Software, New Media	1990–2020	Fifth Wave

All these innovations clearly had an impact on the products available to consumers, who, over the course of the different periods, found themselves faced with different situations and purchasing opportunities. At the beginning of the 19th century, people needed a few small and easily accessible stores, where they could find everything they needed near their residences [27,28]. A few decades later, the first supermarkets were introduced, giving consumers access to a wider number of products, with the possibility of choosing among different brands in a unique shop [29]. At the beginning of the 1990s, another invention and innovation entered into citizens' daily lives with the birth of e-commerce [30]. This radical innovation completely transformed the world of retail, as people could see, choose and buy products directly from their devices and receive them at home, without the need to go to a physical store [31]. E-commerce is one of the most impactful innovations in the retail sector, affecting both consumers and retailers equally. As a response to e-commerce, retailers had to create a new physical market, known as a brick-and-mortar store, in which retailers could merge their online and offline offerings [32].

E-commerce, or electronic commerce, is the buying and selling of products and services through the internet. The development of the Electronic Data Interchange (EDI) allowed the transfer of data from one computer to another, and it started to be used in B2B online shopping. B2C e-commerce became successful when computer use had spread throughout the population, and everyone could access the World Wide Web [33]. With the rise of e-commerce, retailers faced some new challenges, and those who embraced these challenges saw the most benefit from both online and off-line commerce. This is an omnichannel approach, which integrates distribution, promotion and communication channels. It combines physical and online commerce with a target marketing strategy based on understanding which channels customers use or prefer [34]. Consumers move between online and offline to research and buy products, so retailers must understand where to catch the right consumers and how to share the product or promotion that best fits their needs and expectations [35]. The key to a successful omnichannel experience is to employ a modern supply chain that extends delivery across mobile applications, websites, social media and physical stores [36]. To reach this goal, retailers have to break down differences between online and physical stores, managing both of them as one larger system that requires a different management system and a new way of delivering products [37]. In this context, technological innovation and digitalization assume a strategic role in driving innovation in the retail industry.

Like all processes, the digital transformation has taken place overtime [38]. This term includes the transformation of existing technologies or processes, as well as the introduction of new technologies that change the sector in which they are introduced [39]. In general, the main elements that have contributed to all retail sectors are e-commerce and internal systems. E-commerce made an incredible push in a short time, and it has become one of the most common methods of buying. Due to the pandemic, there was a strong acceleration in the number of new users in 2020 [40–42]. As confirmed by numerous authors [38,43–45], this period can be defined as the 4th industrial revolution, where innovation is central to business and technologies are growing faster and faster.

According to this perspective, there are four characteristics that are changing consumers' perspectives:

- Augmented reality: This type of extended reality is a new technology that aims to add new digital and virtual elements into the real world through the help of a camera [46].

- Dynamic pricing: Retailers had to adapt themselves to the phenomenon of dynamic pricing, in particular charging a higher price in times of greater demand. Thanks to dynamic pricing, it is possible to adapt offers to immediate changes in consumer demand, such as seasonal airline pricing and ride-hail surge pricing [47].
- Location intelligence: This goes beyond simple data visualization on maps to analysing location data as an integral part of a business or societal problem. Over 90% of companies use location intelligence for their businesses because geospatial analysis empowers understanding in decision-making processes. As part of the digital transformation, many people and companies are relying on geographic information systems to create an efficient location intelligence [48,49].
- Smart payments: The evolution of smart payment depended on customer satisfaction and the spread of specific technologies among people. The concept of payments has also been implemented using new technologies, such as the mentioned NFC or Wi-Fi or through Bluetooth. Sometimes these methods are inefficient or vulnerable to hackers; therefore, privacy and safety are critical aspects of this characteristic [50–53].

5. An Emerging and Innovative Digital Trend: The Cashierless Store

Innovation and the digital revolution are fundamental to the development of one of the latest and most modern trends: the cashierless store [54]. This is a very innovative topic, developed recently, and for this reason there is a limited availability of literature on it. Even if the adoption of e-commerce has accelerated due to the pandemic, physical stores still have an important role to play in the retail market. A recent survey conducted in the U.S market shows that end users are not ready to completely abandon physical stores [55]. In fact, consumers continue to prefer physical locations; in particular, 34% of respondents stated that the delivery of e-commerce products takes too long, while 25% were not willing to pay shipping fees because they think they are too high. It has also been found that people tend to buy and spend more in a physical store than on e-commerce platforms, and a physical store sells 10 times more than an online store. In addition, 64% of sales are completed in-store, and only 36% through online websites, which underlines the current importance of retailers maintaining a physical location [56]. Digital transformations in the retail market aim to solve problems that affect not only the customer experience but also the retailers' profitability by applying innovative technologies. Retailers who want to be successful and competitive in the long term need to adapt to the new, digital shopping methods in order to provide the experience that customers increasingly expect.

The cashierless store is a disruptive innovation [57] that enables shoppers to buy items in a store where there are no human or automatic cashiers. The aim of a cashierless store is to allow customers to have a fulfilling experience, avoid wasting time and eliminate long queues and long checkout times by introducing a system that creates a simpler shopping experience and keeps track of each customer's selections and preferences without requiring the customer to do anything. The novelty that cashierless technologies offer the retail industry is the possibility for end users to enter a store, shop and exit without waiting in a long queue or having to self-checkout at the exit. This has ushered in a new era of retail, particularly in the grocery field [58]. There are many benefits of this new checkout-free solution for both retailers and customers. From the customers' point of view, the new technologies save them time while shopping and provide a new kind of shopping experience [59].

The role of sustainability must also be considered for these kinds of shops. Attention cannot only be focused on lowering the consumption of paper by eliminating receipts; it is also necessary for the entire shop to be made with sustainable materials and for the products sold to feature sustainable packaging with a lower environmental impact that produces less waste, as claimed by Amazon Go, [59,60].

Disadvantages and Potential Developments of Cashierless Stores

It is also important to analyse the potential negative aspects of the massive adoption of this technology for business structures. In fact, the number of employees in these shops is very low compared to a traditional supermarket. This is certainly the first element to consider, especially from a customer-worker communication aspect. As argued by Polacco and Backes [59], people are emotional creatures who need human interaction. Moreover, according to Davis' [61] analysis of an Accenture study, 77% of US consumers prefer to solve problems by interacting with humans instead of searching for answers online. Cashierless shops limit interpersonal communication between customers and employees, making the purchase a completely independent activity. According to the US Bureau of Labor Statistics, almost 2.7 million people worked in grocery stores in 2016, and it is inevitable that many individuals will be negatively affected by this type of cashierless store because the majority of tasks that were traditionally performed by humans can now be accomplished with an automatic procedure and/or software [59]. However, from a retailer's point of view, employing this technology can lead to significant economic benefits, since the costs related to staffing the checkout area would be notably reduced. In this case, the higher costs derive from expensive technical maintenance, since the technologies used are not cheap, and the risks related to the security of personal information are very high, requiring high IT security standards and privacy to protect consumers. Therefore, from an economic-financial point of view, this technology brings benefits in the medium to long term. It is in fact a "disruptive" technology that will lead to great changes in the world of work as well as in that of distribution, with the creation of new types of jobs. On the one hand, it will have an adverse impact on cashiers; on the other hand, the implementation of this technology will grow the demand for other types of personnel, especially technicians who create, maintain, and implement the system, controllers who monitor customers and customer service representatives who are able to respond to and help the entire population of customers. Finally, it is important to highlight that a cashierless shop is an evolution of the automatic pay station that is already present in a huge number of the best-known supermarkets. Nevertheless, this is a type of shopping that is not widely used by customers globally, demonstrating people's reluctance to use new technologies in their daily lives. To conclude, Polacco and Backes [59] affirmed that consumers choose the best type of shopping experience and not the best technology. Moreover, customers are more interested in convenience and price than they are bothered by waiting in line. Boyle [62] emphasized the fact that it will not be technology that affects purchases, but other factors, such as price and convenience.

6. The Adoption of the Cashierless Concept in the Retail Industry and Its Acceleration during the COVID-19 Pandemic

Amazon pioneered the cashierless concept, being the first company to invent, test and introduce this kind of store in the retail marketplace. Amazon is one of the most highly valued companies in the world, and some years ago decided to introduce Amazon Go [63,64], a cashierless store with innovative new technologies. It took 5 years of tests and implementations to get to where it is now. Amazon Go and the related application Just Walk Away opened their first store in Seattle in 2018. Then, they opened 25 other stores in the US, with the aim of opening 3000 new stores by the end of 2021 [65]. Two years after the first opening, Amazon decided to move on and open a larger store, Amazon Go Grocery, that gave customers the ability to buy not only packaged products but also fresh food [66].

The crisis generated by the COVID-19 pandemic resulted in a high fluctuation of in-store demands. Fashion retail and department stores suffered from this situation, while grocery stores benefited from it. Shoppers overwhelmed supermarkets, and grocery websites crashed due to the high number of users [67]. People avoided going to the markets unless it was necessary, and the adoption of e-commerce spread very quickly [68]. However, with these increases, retailers discovered that they had a rapid saturation of e-commerce demands and problems on the side of the supply chain management. During the first

COVID-19 wave, people needed to wait more than a week for their items to be delivered to them at home. This highlighted two main things: grocery stores are not ready to shift to e-commerce, and people still prefer physical stores to online stores. After the first COVID-19 wave ended, people returned to physical, in-store shopping, and the in-store experience remained crucial. Retailers started to adapt their stores to meet all of the safety measures and offer a positive customer experience as the pandemic wore on. They had to adapt very rapidly to these changes, and it was in this situation that technologies helped them: cashierless payment and self-checkout solutions are only some of the new adoptions [69].

The amount of technological innovation in stores increased over the last year due to the COVID-19 pandemic. To prevent the spread of the virus within stores and to protect both consumers and employees, retailers invested in solutions that eliminate human contact [70,71]. Even as a lot of people moved to e-commerce, physical stores remained fundamental because some items cannot be sold online and sometimes customers need something immediately [72]. Cashierless stores are particularly safe due to the frictionless payment and checkout-free technology, and the application of this new retail model is expected to proliferate not only in grocery stores, but also at airports, stadiums and commercial buildings [54].

In Italy, there are not currently cashierless stores in the retail market, but the situation is expected to evolve rapidly. Italian end users are increasingly aware of the importance of new technologies and how the adoption of them can improve their quality of life. The pandemic has affected their willingness to engage with these new technologies. Being able to enter a physical store but not having to waste time in a queue and reducing contact with other people represent fundamental needs during this pandemic period. The previous theoretical context allows us to identify several elements that differentiate categories of consumers. The percentages presented above reveal how limited the use of this new technology is. Therefore, it is very important to identify data, keywords and concepts that could be relevant for the analysis and that could be common for current, future or potential users. The speed of purchase, innovative payment methods, the role of technology, overall safety, opportunity to avoid queues and consumer customization are all distinctive elements for potential users to evaluate. An end user, even without ever having tried a cashierless shop, can express their attitudes regarding the aforementioned elements. In this way, it is possible to evaluate whether or not the variables' levels of relevance are similar for users who have experienced this new mode of shopping and potential users who have never tested this technology. Furthermore, it is necessary to distinguish between users who define themselves as informed about this new retail store concept and users who have no experience in this regard. For these reasons, the analysis uses the following triple classification of end users:

- Users: Consumers who have had at least one cashierless experience.
- Self-Informed users: Respondents who define themselves as informed about what cashierless stores are; for this category, no information about the cashierless experience was provided.
- Non-informed users: Respondents who define themselves as not informed about what cashierless stores are; for this category, a precise description of the cashierless experience was provided.

This brings us to our first research question (RQ1): Are the elements indicated and identified as relevant for this technology considered with the same degree of relevance by the three categories of identified users (Users, Informed, Non-Informed)?

Moreover, to understand this phenomenon better by taking into account the theoretical framework concerning technology and gender, the decision to address potential gender disparities brings us to the second research question (RQ2): Within the above-mentioned categories, when divided by gender, does the relevance of the variables remain the same?

7. Methodology

Participants were selected by sharing the questionnaire via a Google module, email and social media. The questionnaire collected different categories of data (qualitative, quantitative, Likert Scale) [73]. More specifically, the questionnaire followed three different paths according to whether or not the respondents identified themselves as users of cashierless stores, were informed about the cashierless store concept or were uninformed about the cashierless store concept. The questionnaire starts with some general questions (gender; age; purchase frequency; store preferences; knowledge of some technologies such as smart payments, e-commerce and augmented reality and knowledge of cashierless stores). If the respondents indicated that they were aware of the cashierless trend, the following question asked how they became aware of it, to which there were two possible answers: they had used it at least once, or they knew about it through word of mouth or other sources (internet, newspaper, advice, etc.). If they selected the first answer, respondents were then asked to evaluate some characteristics that they had experienced when using a cashierless experience. If they chose the second answer, they were asked to imagine how some of the characteristics would affect them as users and to identify which would be the most appreciated. In both cases, respondents were asked question about their knowledge regarding the start-ups that are exploiting cashierless technologies. If the respondents indicated that they did not know what a cashierless store was, a detailed description was provided. Subsequently, they were asked some questions about which characteristics of a cashierless store they might appreciate. At the end, independent of their knowledge of cashierless technologies, every respondent was asked some questions about COVID-19. The data were analysed using R Studio and Excel from a descriptive point of view (Descriptive statistics) and using the independent 2-group Mann–Whitney U Test for RQ1 and the *T*-test for RQ2. The Wilcoxon test and the Mann–Whitney test (also known as the Mann–Whitney U Test) are two of the most powerful non-parametric tests for verifying, in the presence of ordinal values from a continuous distribution, whether two statistical samples come from the same population (for further information, see [74–76]). Consequently, this test is used to verify differences between the three users' categories. A statistically significant test result indicates a difference in importance/relevance for that variable. Subsequently, to evaluate the second research question (RQ2), the *Z*-test was used. It is a statistical test for which the distribution of the test statistic under the null hypothesis can be approximated by a normal distribution [77].

8. Results and Discussion

The sample is composed of 1138 respondents, 552 males and 586 females, divided based on age in Figure 1.

The dissemination of the survey via social media and university email strongly influenced the composition of the sample. Indeed, people between 18 and 30 years old comprise 81% of the sample.

In order to understand users' knowledge of certain technologies (as on Table 2) that are linked—with different degrees of importance—to the cashierless experience, the survey included a question with a list of technological alternatives was provided to respondents. The results are representative of a non-univocal knowledge of the proposed items. In fact, most respondents clearly know about e-commerce but the percentage drops significantly for the second item (smart payment) and, taking into account the focus of paper, only 1/3 of respondents declare to have knowledge of self-checkout. From the perspective of gender, no important differences emerged except for the item related to augmented or virtual reality, which, however, only 18 respondents answered. As regards their frequency of pre-pandemic purchases, as Table 3 shows, a significant number of respondents made purchases less than three times a week. The distribution is uniform according to gender, as there are no differences between men and women. As for the prevailing purchasing methods, physical stores represented 60% of the purchases for the respondent sample without differences between men and women. This result is certainly influenced by the age

of respondents. In fact, when only considering respondents who were 30 years old or older, this percentage rises to 74%.

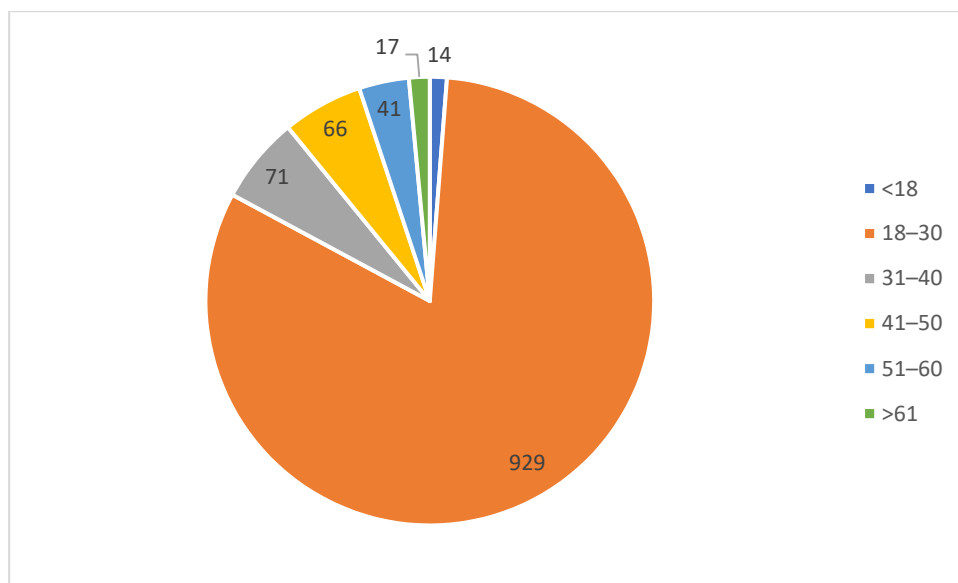


Figure 1. Sample Age.

Table 2. Technologies used.

Alternative	Tot	M	F	%M	%F	% of Knowledge
Self-checkout	380	137	243	36.0%	64.0%	33.0%
Smart payment	465	227	238	49.0%	51.0%	41.0%
E-commerce	881	422	459	48.0%	52.0%	77.0%
Augmented or virtual reality	18	6	12	33.0%	67.0%	2.0%
Other	4	0	4	0.0%	100.0%	0.0%
No knowledge	11	4	7	36.0%	64.0%	1.0%
Not valid answers	18	11	7	61.0%	39.0%	2.0%

Table 3. Shopping frequency.

Sex	Less than 3 Times per Week	3 Times per Week	4 Times per Week	5 Times per Week	More than 5 Times per Week	Online	Shop
M	218	123	142	54	15	225	327
F	231	144	147	54	10	239	347
Under 30 y.o.	401	231	227	72	13	360	584
From 31 to 40 y.o.	19	12	23	11	5	40	30
More than 40 y.o.	29	24	39	25	7	64	60

The survey also investigates whether or not the pandemic outbreak had an impact on the participants' methods and frequency of purchase. The following table shows the responses, divided by gender, relating to changes in the frequency of purchases during the pandemic.

As Table 4 shows, some changes resulted from this question. Indeed, the sample shows not a clear stability concerning the purchase frequency. Only a small part of the respondents affirm to have had no changes. Considering the age, the three groups have values close to three or four, consequently it is possible to state that some frequency changes have occurred in their purchasing habits. a reduction or an increase in frequency. There are also no observable differences between genders. To fully understand what, if anything

changed as a consequence of this period, the following table provides a breakdown of the respondents' behaviour related to their shopping experience during the outbreak.

Table 4. Shopping frequency during the pandemic.

Purchase Frequency during the Pandemic	Female	Male	Under 30 y.o.	From 31 to 40 y.o.	More than 40 y.o.
1 (no changes)	82	82	131	4	29
2	128	126	221	9	24
3	175	177	293	21	38
4	138	104	189	28	25
5 (relevant changes)	64	64	110	11	7

Table 5 shows that for approximately half of the sample there were no changes. However, it is noted that 50% of females and 42% of males replied that they have gained preferences on online shopping. Furthermore, considering the entire sample, only 10% of consumers are focusing their purchasing decision on new digital technologies. Moving on to the analysis for the age group, there is a clear reduction in purchases for consumers over 40, while there is a reduced preference for shops with new digital technology. Only 7% of under 30 s are interested in these ways of shopping and they are also the category that does not seek to reduce cash payments.

Table 5. Shopping Experience during the Pandemic.

Shopping Experience during the Outbreak	Female	Male	Under 30 y.o.	From 31 to 40 y.o.	More than 40 y.o.
No changes in frequency in the physical store	49%	44%	48%	37%	36%
General reduction in purchases	41%	37%	35%	39%	69%
If possible, avoid cash for payments	30%	26%	27%	34%	35%
Preference for shops with new digital technologies	11%	10%	7%	14%	34%
Preference for online shopping	50%	42%	47%	46%	35%
Other	3%	3%	2%	6%	8%
Total Respondent	552	586	943	71	124

Cashierless Experience Analysis

After having described the sample, the inferential analysis is provided here to evaluate the variables, previously identified in the literature, to understand if their relevance is the same for consumers with experience, self-informed users and non-informed users. The sample is made up of 1138 individuals divided as follows:

- A = Consumers with a cashierless experience (73 respondents)
- B = Self-Informed users (317 respondents)
- C = Non-Informed users (745 respondents)

The three categories of respondents were identified via preliminary questions and the difference between category B and category C is a set of information made available to non-informed users. Before answering the same questions relating to the importance of the identified variables, a precise description of cashierless technology and the cashierless experience was provided for category C respondents. For category B (self-informed users), no additional information was provided. The following table (Table 6) presents the results of the Wilcoxon tests for the comparison between the three categories.

Table 6. Inferential analysis: Wilcoxon tests.

Variable	Elements	A vs. B	A vs. C
Velocity	W	10,630	27,537
	<i>p</i> value	0.25	0.77
Payment methods	W	10,899	30,003
	<i>p</i> value	0.42	0.11
Technology	W	10,978	30,865
	<i>p</i> value	0.48	0.04
Overall Safety	W	9657	25,719
	<i>p</i> value	0.02	0.49
Queue	W	9757.5	24,405
	<i>p</i> value	0.03	0.16
Customer Personalization	W	11,054	24,918
	<i>p</i> value	0.54	0.27

The goal of these tests was to analyse whether or not the users' perception of and value given to the identified variables was similar across the three categories of users. The comparison between consumers and self-informed users shows that they assess overall safety and the opportunity not to queue at the end differently. The importance of these two factors derives from experience. While it is possible to have some personal opinions regarding the other categories, perceptions of overall safety and the opportunity not to queue at the end are probably difficult to envision without experience. Another interesting finding is represented by the different significance given to the same variable by consumers and non-informed users. For this second test, there was a singular significant variable: the technology. In this case, five variables out of six were evaluated similarly by the two groups. This result is due to the information that was made available to the group of uninformed users, which made it possible for them to understand this phenomenon. Evaluating the variables, users across all three categories considered speed, payment methods and customer personalization with the same importance and, consequently, without any statistical significance. The other three variables should be further analysed and explained due to the significant differences that emerged from the test. In order to explore the results from the perspective of gender and discover if it is an explanatory variable for these innovative dynamics, the sample was divided into gender, and the sub-samples were then defined according to the three categories mentioned above (consumers, self-informed users and uninformed users). The following table (Table 7) shows the Z-test values for the mean differences between male and female sample respondents.

Table 7. Inferential analysis: Gender Z-Test.

Sample	Velocity	Payment	Technology	Overall safety	Queue	Personalization	Num M	Num F
Consumers	0.43	−0.49	−1.53	0.14	0.16	0.02	33	40
Self-Informed Users	0.1	0.2	0.16	0.24	−0.28	−0.16	156	161
Non-Informed Users	0.48	0.21	−0.38	0.84	0.69	0.81	363	382

The test results in Table 7 (the *p*-values are not all statistically significant; therefore, they have not been reported) make clear that gender is not a differentiating element in determining the importance of the proposed variables. In fact, no empirical evidence emerges to suggest that there is any difference between men and women in terms of their perceptions regarding cashierless characteristics and this is coherent with the paper of Davison and Argyriou [21]. It is important to underline that, as emerged in paragraph 3.1 in the literature, there is not a unique view concerning this topic.

9. Conclusions

The retail sector has experienced several challenges over the last decade, requiring retailers to change their strategy to remain competitive in the marketplace. In the last few years, trends like e-commerce have spread rapidly among consumers, and the emergence of the COVID-19 pandemic accelerated this trend. While, on the one hand, online shopping is becoming more and more relevant, on the other hand, several surveys show that consumers continue to prefer the physical store experience. It is in this scenario that cashierless stores can take hold by combining the benefits of technological innovation with users' preference for the physical shopping experience. For companies that want to evolve and change to survive in the market, the ability to incorporate cashierless technologies in physical stores represents both a new challenge and an opportunity for differentiation and brand positioning.

Nowadays, the customer plays a central role as a protagonist rather than a passive consumer. In this context, consumers' emotions are vital for all retail companies, which need to reinvent shopping and make it as experiential as possible. As a result, marketing strategies are also changing very fast. Products are no longer only objects to be bought and sold; they are also a means through which companies can communicate with their target customers. According to this logic, companies can improve their relationships with their customers by treating each customer as if they are unique and their needs are exclusive. Furthermore, in this case, there is a role for sustainability, in fact as sustained by Polacco [59] some companies such as Amazon have decided to implement sustainability policies directly linked to this product. In this case, it has been making excellent progress in its attempts to develop upon the best energy and environmental methods. The impact of the pandemic on consumers' attitudes and behaviours also emerges from the survey. For instance, while purchase frequency remains stable, the modalities change. Data show a clear increase in digital and e-alternatives instead of the traditional shopping experience in a physical shop. As already mentioned, it is important to remember that this technology is not yet developed in Italy, where the survey was conducted, and this reflects the distribution of respondents. It is well known that, with only 73 respondents having had the opportunity to test the cashierless experience, the results of the paper can be considered preliminary, albeit very interesting. The findings of this study, considering the literature on cashierless technologies in retail markets, can contribute to further understanding of the aspects that need to be analysed in depth, as well as from the entrepreneurial side, in order to improve the consumer experience. The technology, the overall safety of the shops and the opportunity to avoid queues are aspects perceived differently by consumers and potential users. For this reason, companies should pay attention and try to understand the exact dynamics of these variables in the cashierless store market. The comparison by gender, on the other hand, did not lead to any statistically significant results. This means that men and women regard the cashierless phenomenon similarly across the three identified categories of respondents. In conclusion, while cashierless stores have not yet been created in Italy, many changes are rapidly emerging. Italians are more aware of the importance of new technologies and how their adoption can improve their quality life. Considering the geographical context of this analysis, some initiatives (close to cashierless) of large-scale distribution companies has emerged.

As supported by Tiendeo's analysis [78], Conad is testing cashless supermarkets which are nothing new at an international level. Moreover, other supermarkets, such as Carrefour, Auchan and Monoprix are testing some cashierless technologies and due to these aspects, they would try to compete with the e-commerce giants. In practice, some supermarkets have begun to experiment with self-shopping, a customer experience where the customer scans the price barcodes and the end check-out at the cashier is faster than in the past. Moreover, the pandemic has affected people's thinking in this area. Italy may not seem ready for a challenge like this one, but consumers' awareness will change over the coming years, and companies that anticipated the trend will be the leaders who benefit the most from this adoption. Obviously, these innovations, as already mentioned, could lead to a

change in skills requests on the labor market, fewer cashiers will be needed, as even with this type of operations, fewer staff are needed. Nonetheless, it is important to remember that in Italy the cashierless sector was presided over by a Milanese startup, Checkout Technologies, which, however, in May 2020 was acquired by Standard Cognition, a US company based in San Francisco active in the self-checkout sector.

Limitations and Future Developments

There are several important limitations to the current study. First, the work is only a preliminary analysis, as it analyses a phenomenon which, at this moment in Italy, is not yet widespread. Given the innovative nature of the study and the area of interest and investigation, there is a limited availability of papers on the topic. Consequently, a significant number of the respondents in the analysed sample had no experience regarding this technology and purchasing method. Second, the sample is composed of young people, and it cannot be considered representative of Italian society from a social and demographic point of view. This is a very common limitation for online surveys, because it is difficult to reach different age groups in a demographic and representative way. A third limitation of the sample, related to age, is the frequency of purchase. In fact, it is plausible that the respondents use different purchasing methods than a more representative sample of the entire population would use. Finally, regarding the sample, the data are not normally distributed and this affects the analysis in an important way, as it is not possible to effectively use other statistical tests. Furthermore, all of these elements influence the results of the analysis for some questions (e.g., frequency of purchase). Focusing on future developments, it is possible to think of re-proposing the same survey in a foreign country where this technology is widespread and comparing the results. Finally, it will be possible to repropose the same questions in Italy after the opening of a chain of cashierless stores.

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