

Customer preferences regarding green solutions in last-mile logistics

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Abstract

The purpose of the study is to conduct a comprehensive analysis of the last-mile logistical processes associated with e-commerce and to explore the negative externalities arising from these processes. Within the framework of the analysis, the particular emphasis on the surge in online commercial activity coinciding with the emergence of the COVID-19 pandemic, and the subsequent impacts on logistical systems will be emphasized. The rapid growth of online commerce brought about by the emergence of numerous new participants in the market has resulted in a significant increase in order volumes. However, the escalated order volumes have not solely led to positive effects. The surplus parcel deliveries have also brought to light numerous adverse environmental consequences. Alongside the rise in usage of packaging materials, the challenges of parking due to transportation processes, traffic congestion, and heightened emissions of greenhouse gases have all contributed to the emerging set of issues.

During the research, an extensive questionnaire survey was conducted, the purpose of which is to explore the green last mile aspirations and opinions of the final consumer and to statistically analyse the received data. It was placed a special focus on variables such as gender, age, place of residence, educational attainment, income level, as well as the expectations towards green solutions and willingness to pay for additional costs. During the analysis, it was essential that it be prepared on the basis of objective and reliable data, and that the individual relationships and influencing factors be determined.

Keywords: e-commerce, last-mile, sustainability

JEL: R40, M31

Introduction

The epidemiological situation caused by COVID-19 and the consequential legislative restrictions that affected the retail business have significantly altered the customers' behaviour and the online sales channel has become of major importance. New social groups appeared among the online customers, which provided the market operators with an opportunity to strengthen their positions. E-commerce in Hungary had reached HUF 1,046 billion turnover in 2020 (45% increase compared to the previous year), which was 8.5% of the retail sector. Orders increased in number by more than 37%, exceeding 52 million. In terms of average spending in 2020, the average basket value was HUF 17,000, 20% increase on 2019. The number of active online customers reached 3.38 million in 2020, which was 80 thousand more than in the previous year (GKID, 2021).

The year 2021 brought about further increase, so the e-commerce turnover reached HUF 1,200 billion, which was 10.5% of the retail sector. This meant a total 68 million of domestic orders, which, in particular, demonstrates an increase in the frequency of purchases (an average of 20 orders per year). The FMCG sector was the main driver for growths, and this sector showed an increase of 43% in 2021. It is important to note that 78% of the 6.5 million internet users shop online, and 3.7 million of them purchase products as well (GKID, 2022a). However, the year 2022

showed a downturn due to the high inflation rate, the food price increase, the Ukrainian-Russian conflict, and high energy prices (GKID, 2022b). The growth stopped abruptly in 2023, and the turnover of domestic online retail increased to HUF 1,323 billion. This meant 77.1 million orders that came mainly from an increase in the frequency of purchases (an average of 21 occasions per year) (GKID, 2023).

The purpose of our research was to explore the demand for sustainability in case of online orders, and to examine the effect of variables such as income level, educational attainment, and gender on green solutions that are expected in online retail, for instance, the willingness to pay for additional costs or the preferred types of green solutions among the above-mentioned social groups. In this context, the below hypotheses have been formulated:

H1: Customers who order from webstores expect green solutions when it comes to last-mile logistics

H2: Consumers who have higher income or qualification level are more patient with the delivery time

H3: Consumers who have higher income or qualification level have higher expectations for green solutions in the field of logistics

Literature

All eyes had already been focused on sustainability challenges of logistics and transportation in the 1990s, and from the 2010s, e-commerce also became highlighted in research (Golicic, Boertsler, & Ellram, 2010). Sustainability has three base components: an ecological, an economical, and a sociological. All three aspects are present in the processes of e-commerce logistics. Changes in product price and service fee belong to financial sustainability, and demand shifts are also associated with this aspect (the effects of e-commerce on Brick and Mortar market). It deserves to be examined what effects the improvement of service level has on other markets and how developments of Industry 4.0 and Logistics 4.0 appear, as they are able to trigger positive financial impact through the improvement of effectiveness. From the perspective of sociological sustainability, it should be brought to focus that how e-commerce is affected by improvements in the quality of life. Here we might think about the extension of conveniences, difficulties with transportation, or problems with noise, dust, and parking. (Viu-Roig & Alvarez-Palau, 2020).

Many studies and essays highlight the effects of a fast-growing e-commerce market on the emission of greenhouse gases. The increasing number of vehicles and service conveniences, such as delivery within a short time (on the same day or in an hour) reinforce the impact. Transportation is one of the main emitters of greenhouse gases, as we mentioned in the previous chapter. (Nogueira, Rangel, & Shimoda, 2021). In e-commerce, the last phase is one of the most problematic parts of the supply chain. The highest cost is generated in this phase, and the negative effects also come to the greatest degree.

A study divides the sustainability challenges of e-commerce into four groups: from the perspective of economy and on micro economical level, product price, production costs and incomes can be mentioned, while on a macro economical level, an increase in productivity or economic growth plays a part. Quality of life, welfare, well-being, and human activities are considered as social impacts. From an ecological point of view, the utilisation of natural resources, pollution, and impacts on climate should be considered. The fourth factor, technology, also appears, that includes process and service innovations (Viu-Roig & Alvarez-Palau, 2020).

An announcement made by the World Economic Forum in 2020 highlighted that the trends predicted a 36% increase in the number of delivery vehicles between 2019 and 2030, in addition, a further increase of 6 billion tons in emissions caused by e-commerce and a rise of 21% in traffic congestions were awaited. (Deloison et al., 2020).

A study carried out by Siegfried et al. investigates the ecological challenges of e-commerce. They claim that one of the negative factors is caused by fast delivery time and small products. Customers would like to get the products as soon as possible, and they order from different retailers, the supply chain of which spans across continents. Transportation of goods happens through several distribution and logistics centres and different means of transport. It is common that the consumer orders products from different platforms, so the delivery requires more vehicles, which is of a sustainability concern. When the phenomenon of panic buying disappeared, a new customer type emerged that requires the shopping to be sustainable and the customer's behaviour is also influenced by this expectation. (Siegfried, 2021), (Ignat & Chankov, 2020). Among these conscious consumers, the aspects of social and ecological sustainability, together with social responsibility and ethical consumption, come more and more into the foreground. Dias, et al., 2022) (Theodor, et al., 2022), (D'Adamo, et al., 2021). Consumer expectation for sustainable shopping keeps growing and a group of consumers is willing to pay more to meet this expectation, and this willingness is proportionally higher among women (Caspersen, et al., 2021).

The research done by Reacty Digital in 2021 highlighted the importance of environmental awareness in e-commerce. 38% of 500 respondents considered online ordering to be a rather environmentally friendly form of shopping. The majority (61%) thinks that a webstore is more appealing if the store clearly indicates its efforts towards green solutions. 12% of 18–79-year-olds said that it was not unprecedented to cancel a purchase for not finding it green enough (Reacty, 2022). Póka and Lányi (2022) also examined consumer expectations for sustainability in their essay. The respondents, regardless of their educational background, consider green solutions to be important when it comes to online shopping. However, related costs should be covered by retailers. (Póka & Lányi, 2022). In the research done by Reacty Digital in 2022 the sustainability picture presented considerably more strict expectations. According to 31% of the respondents, online shopping is more environmentally friendly than offline shopping. At the same time, the research confirms that the younger the consumer is, the more important it is for him to have green solutions at the retailer. Presenting these efforts and aspirations on the website is useful. 15% of 18–79-year-olds had already refused to order a product, as they did not consider the retailer or the manufacturer to be sustainable. Every second respondent chooses a webstore that transports goods in an environmentally conscious way or uses environmentally friendly packaging (Reacty D. 2023).

Vakulenko et. al. points out in their study that the last-mile solutions in e-commerce have high impact on customer satisfaction by the means of service level (Vakulenko, et al., 2018). Increasing customer expectations reflect in the service fee, the accuracy and speed of delivery, and in the time to receive the delivery. However, the smooth functioning of these factors requires effective “last-mile” processes (Dias, et al., 2022). Punctual delivery is the minimum requirement for e-shopping, so last-mile processes are needed to be improved to maintain competitiveness, while the delivery time is required to be reduced and the time slots should be tightened (one-hour slots are available at almost all market operators) (Bjørngen, et al., 2022), (Dias, et al., 2022). Providers of logistical services face a challenge that the majority of customers prefer to receive their deliveries in the evening hours when they are at home for sure (Otter, et al., 2017). Unsuccessful delivery causes inconvenience for the customer and the service provider as well (extra costs, sustainability issues, disappointment). However, this was less of a problem at the starting period of COVID-19, but

when the restrictions had been terminated, the number of unsuccessful delivery attempts started to increase, so last-mile solutions had to be aimed at developing this indicator, too.

Material and methodology

Our questionnaire of 14 questions was available on social media platforms from 11 August to 24 August, 2023. The research consisted of Likert scale questionnaires and closed questions. We received 209 answers within the above-indicated period. Three out of the 209 respondents were excluded, as their answers revealed that they had not used e-commerce services. For data analysis, Excel and SPSS software were applied. The chosen analytical methods included cross-tabulation analysis, Kruskal-Wallis and Man-Whitney tests.

We chose cross-tabulation analysis because it is a well-known and widely applied method that is used for examining the relation between two or more variables and also shows the variables' cumulative frequency distribution. The analysis is simple and the results are easy to interpret. In the cross-tabulation analysis we examine if there is correlation between two variables nominal or ordinal (Gyulavári et al., 2017).

The Kruskal-Wallis test was applied for examining the difference between the medians of each group, as this test is aimed at comparing the samples of three or more independent populations. These samples are the results of the same dependent variable measured in different groups. For this, we took samples from different groups and carried out the same measurement for the samples. We compared the medians of the resulting variables to determine the differences between the results of each independent measurement. The criterion for testing is that the samples are from non-nominal distribution, so the observed variable has either to be continuous (metric scale) or be measured on an ordinal scale. However, for examining gender-based differences, this test was not applied (as we had only two variables), but the Mann-Whitney test was carried out.

Table 1 demonstrates the distribution of respondents by gender, place of residence, educational attainment, and income level:

Table 1: Distribution of respondents by gender, age, place of residence, educational attainment, and income level

Female	128	62%
Male	78	38%
18-29 years	10	5%
30-39 years	39	19%
40-49 years	93	45%
50-59 years	44	21%
60+ years	20	10%
Capital city	38	18%
County seat	103	50%
City	41	20%
Town	17	8%
Village	7	3%
Postgraduate studies	13	6%
Higher education	105	51%
Matura exam	66	32%

Vocational qualification	20	10%
Primary school education	2	1%
More than HUF 800,000	50	24%
HUF 700,001 - 800,000	25	12%
HUF 600,001 - 700,000	22	11%
HUF 500,001 - 600,000	27	13%
HUF 400,001 - 500,000	28	14%
HUF 300,001 - 400,000	31	15%
Less than HUF 300,000	23	11%

Source of data: The authors' own research

Results

Results of this research show that the majority of the participants has strict expectations about the delivery time, as these people are willing to wait maximum 2 days from order to delivery. Distribution by gender is illustrated in the below table (Table 2).

Table 2: Distribution by gender regarding the waiting time

		Can be more than two days	Maximum two days	Maximum one day	Less than one day	Less than two hours
Gender	Male	11.7%	21.4%	2.4%	1.0%	1.5%
	Female	19.9%	34.0%	6.3%	1.5%	0.5%
Total		31.6%	55.3%	8.7%	2.4%	1.9%

Source of data: The authors' own research

To compare the medians of the two groups (men and women), we carried out the Mann-Whitney test in SPSS. As the Mann-Whitney test shows ($Z=-0.221$, $p=0.825$), there is no significant difference in the waiting time between men and women. This means that the majority of respondents is willing to wait maximum 2 days to receive the ordered product.

Desk research highlighted that the green solutions are considered to be more and more important at webstores, so we asked about this topic, too. The first figure shows the answers.

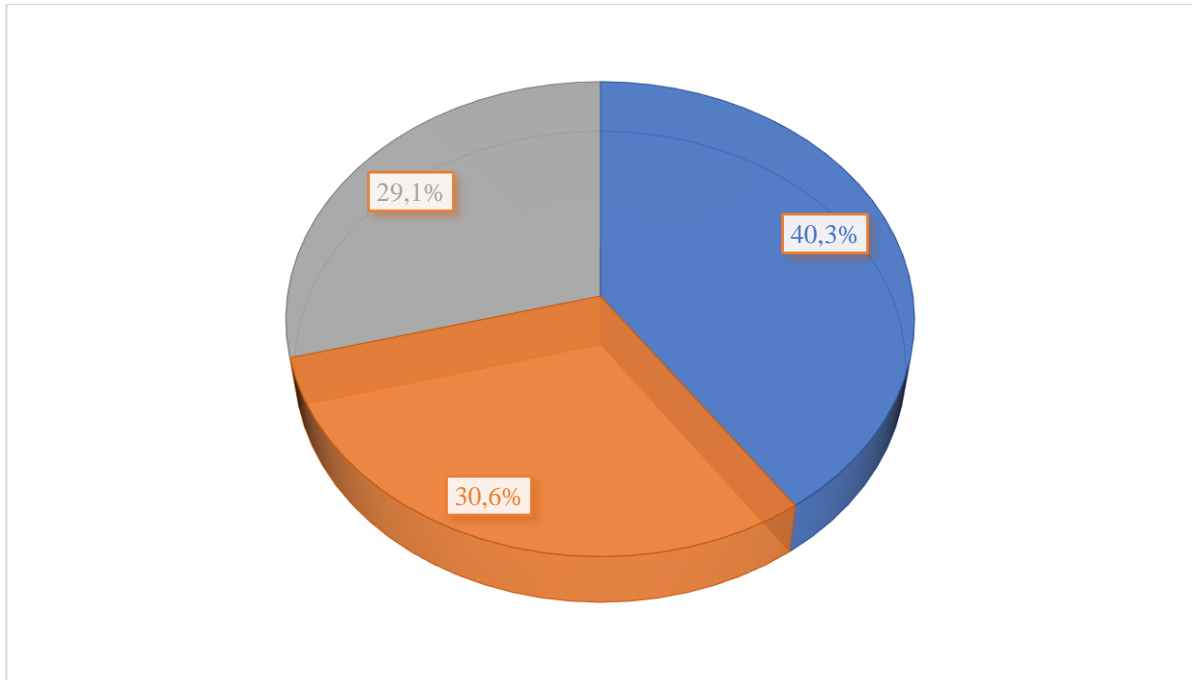


Figure 1: Are green solutions important?

Source of data: The authors' own research

The blue colour shows those customers who expects green solutions, the orange who maybe expects and grey one who don't. The results show that the responding consumers attach crucial importance to green solutions.

The importance of the logistical service provider in selecting a webstore is shown in the 3rd cross-table.

Table 2: The importance of the logistical service provider

		Yes	No	Maybe
No	Male	12.1%	19.4%	6.3%
	Female	27.2%	27.2%	7.8%
Total		39.3%	46.6%	14.1%

Source of data: The authors' own research

To compare the medians of the two groups (men and women), we carried out the Mann-Whitney test in SPSS. The test results show ($Z=-1.481$, $p=0.139$) that there is no significant difference in the importance of the logistical service provider between men and women.

If we would like to examine this phenomenon by income level, we have to apply the Kruskal-Wallis test. The test results show ($H=13.609$ $p=0.34$) that there is no significant difference in the importance of the logistical service provider by income level.

Examination by age groups has to be done by applying the Kruskal-Wallis test again. The test results show ($H=8.085$ $p=0.089$) that there is no significant difference in the importance of the logistical service provider by age.

Based on the Kruskal-Wallis test run in SPSS the result is $H=4.603$ $p=0.330$, so no derogation is detectable.

In sum, 39% of online shoppers who participated in this research thought it was important to which service provider the logistical processes can be linked, 46% did not consider the service provider to be important, and the rest had no firm stance on this matter. This means that an increasing proportion of customers link the logistical service provider to the service level of the webstore, but this opinion has not yet achieved dominance. Between these views, there is no difference by gender, educational attainment, or income level.

Our succeeding investigation addresses what sort of green solutions are expected by customers from the logistical services (Figure 2).

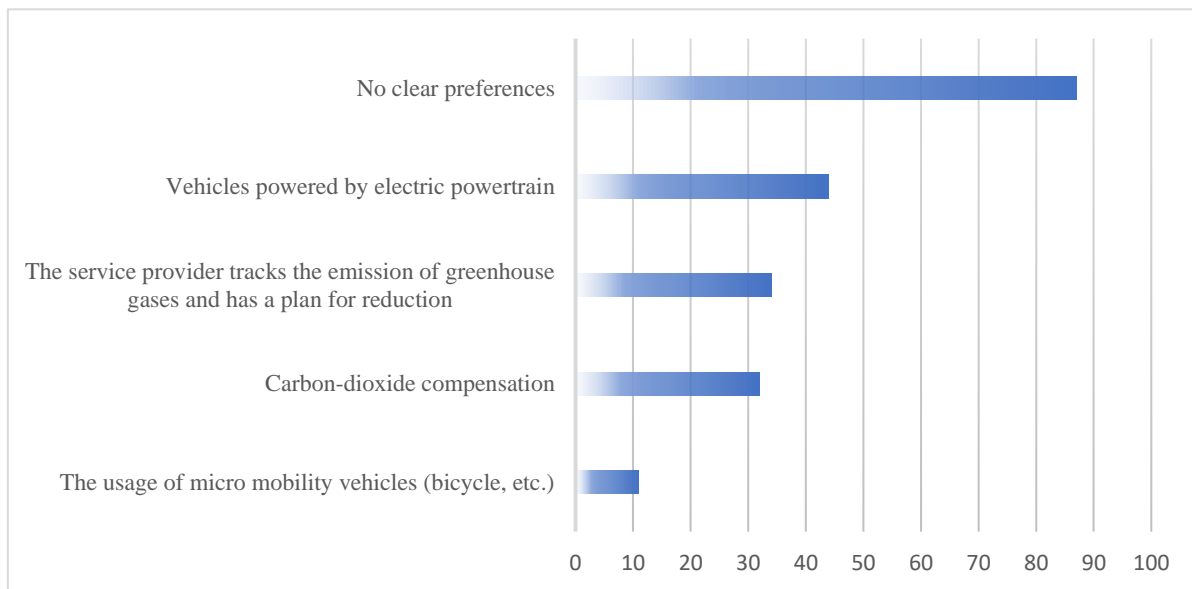


Figure 2: Preferences in green solutions

Source of data: The authors' own research

We can observe that a significant share of customers has no clear preferences, but electric powertrain, carbon dioxide compensation, and reporting of greenhouse gases are mentioned almost to the same extent.

By applying the Mann-Whitney test, we observe if there are differences by gender. As the test results show ($Z=-1.328$, $p=0.184$), there is no significant difference in the preferences between men and women.

Examination by income level was carried out by applying the Kruskal-Wallis test. The results of the Kruskal-Wellis test show ($H=4.233$ $p=0.645$) that there is no significant difference in the preference for a certain type of green solutions by income level.

In case of the examination by age groups, we applied the Kruskal-Wallis test again, the result of which shows ($H=4.754$ $p=0.314$) that there is no significant difference in the preferences by age groups.

With regard to educational attainment, again, the Kruskal-Wallis test can be used. Based on the test run in SPSS, the result ($H=3.604$ $p=0.462$) shows that there is no significant difference in preferences by educational attainment.

The data above shows that while the respondents expect green solutions, the majority have no clear preferences in terms of what solutions are expected. In this matter, no significant differences can be traced by age, income, or educational attainment.

The next chapter examines how much extra cost are the respondents willing to pay in order to make green solutions implemented in online shopping. Figure 3 presents the summarised results.

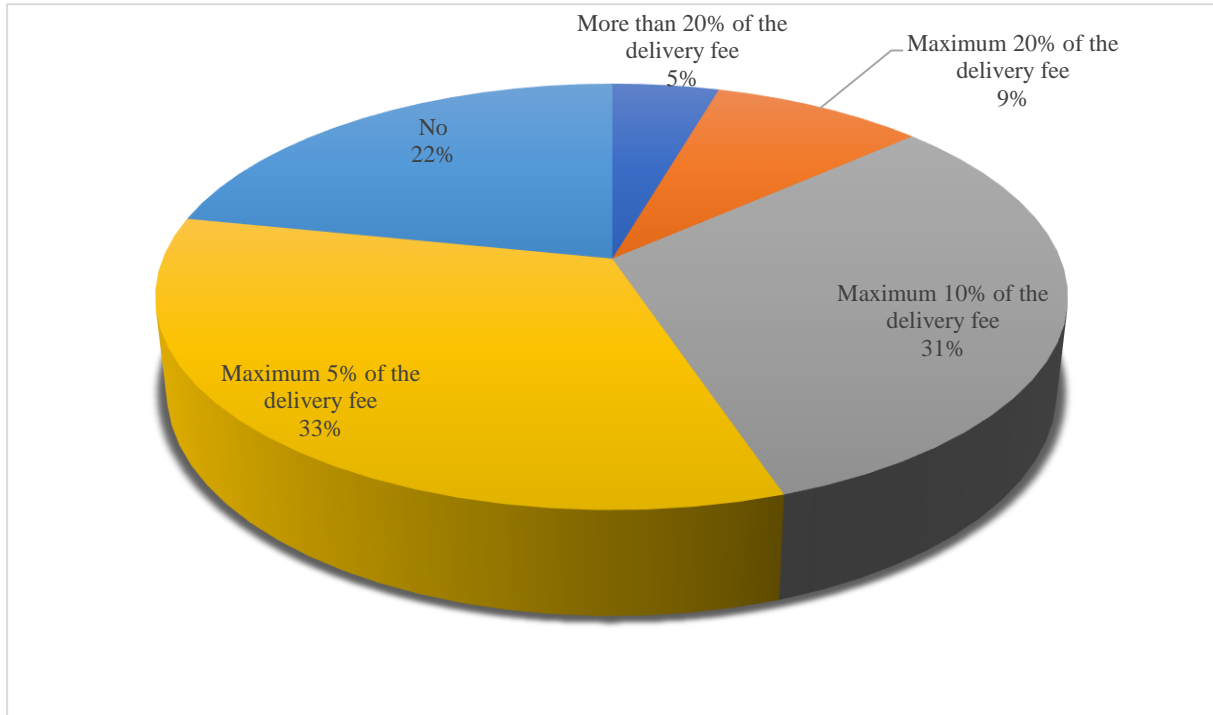


Figure 3: Willingness to pay for extra costs

Source of data: The authors' own research

Unlike previous studies show, the majority of people that filled in the questionnaire is willing to pay for extra costs to render logistical solutions green.

By applying the Mann-Whitney test, we observe if there are differences by gender. As the test results show ($Z=-1.981$, $p=0.148$), there is no significant difference in the willingness of men and women to pay for extra costs.

Examination by income level was carried out by applying the Kruskal-Wallis test. The test results show ($H=4.754$, $p=0.315$) that there is no significant difference in the willingness to pay for extra costs by income level.

In case of the Kruskal-Wallis test made by age groups, the results show ($H=6.072$, $p=0.194$) that there is no significant difference in the preferences by age groups.

With regard to educational attainment, again, the Kruskal-Wallis test can be used. Based on the test run in SPSS, the result ($H=5.788$, $p=0.216$) shows that there is no significant difference in the willingness to pay for extra costs by educational attainment.

Revising the available data, we see that participants have willingness to pay for extra costs to support green solutions and there is no difference by gender, educational attainment, or income level.

We have examined the respondents who wanted to receive the ordered products within maximum two days or even less, and compared the results with the distribution of all research participants. See Table 4.

Table 4: Comparing the distribution of all research participant to those who would like to get the ordered products within 2 days

Female	128	87	68.00%
Male	78	54	69.20%
18-29 years	10	8	80.00%
30-39 years	39	29	74.40%
40-49 years	93	64	68.80%
50-59 years	44	32	72.70%
60+ years	20	8	40.00%
Capital city	38	32	84.20%
County seat	103	63	61.20%
City	30	41	73.20%
Town	17	11	64.70%
Village	7	5	71.40%
Postgraduate studies	13	8	61.50%
Higher education	105	69	65.70%
Matura exam	66	47	71.20%
Vocational qualification	20	16	80.00%
Primary school education	2	1	50.00%
More than HUF 800,000	50	33	66.00%
HUF 700,001 - 800,000	25	20	80.00%
HUF 600,001 - 700,000	22	13	59.10%
HUF 500,001 - 600,000	27	17	63.00%
HUF 400,001 - 500,000	28	19	67.90%
HUF 300,001 - 400,000	31	22	71.00%
Less than HUF 300,000	23	17	73.90%

Source of data: The authors' own research

Interesting that the grouping by place of residence demonstrates sharp differences. From among all respondents, people who accept the order delivery beyond two days live mostly here.

Analyses performed are suitable for hypothesis testing that is summarised in Table 5.

Table 5: Results of hypotheses testing

H1: Customers who order from webstores expect green solutions when it comes to last-mile logistics	Proved
H2: Consumers who have higher income or qualification level have more patient with the delivery time	Not proved
H3: Consumers who have higher income or qualification have higher expectations for green solutions in the field of logistics	Not proved

Source of data: The authors' own research

Conclusions and suggestions

As we stated in the introduction part, e-commerce witnessed turbulences over the past years. During COVID-19 it was growing in popularity; therefore, more and more market operators made inroads into this market. This resulted in growing customer expectations, and the continuous improvement of service quality became one of the most important criteria of competitiveness. The after-pandemic period kept having positive effects on the market of e-commerce. However, soaring inflation and the economic crises disrupted the retail market, the prices increased and the consumption declined. The market share of e-commerce got reduced. This situation also meant that the “fight” for the customers intensified, and the main element of this competition, beside the prices, was the improvement of logistical processes. Service level, good quality products, and reduced delivery time were important factors of customer satisfaction. The presence of green solutions is also of key importance. Electrical powertrains, carbon credits, and emission reports might be crucial tools to attract customers. However, these solutions do not come cheap. Our research introduced the Hungarian trends of e-commerce over the past few years. The literature review drew attention to the challenges of last-mile logistics. We gave an insight into some publications about the field of last-mile logistics. In our (non-representative) research, we examined the attitude of 206 respondents towards the functions of delivery.

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