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MATHEMATICAL ANALYSIS OF THE INFLUENCING FACTORS OF MOBILE COMMERCE ACCORDING TO CONSUMER GENERATIONS AND EU REGIONS

***Abstract.** The paper investigates trends in the use of mobile commerce at EU-27 level, rendering a hierarchy of factors that influence consumer behavior on each generation. In order to validate the research hypotheses, an econometric model is developed based on the analysis of the determining factors by using the correlation coefficients and the regression function. The frequency, the specific characteristics of m-commerce, the maximum amount spent, and the method of purchase used are also analyzed. The study also indicates differences by age groups at EU-27 level. The results show that there is a strong, positive, and direct correlation between the variables that influence m-commerce (between 0.57 and 0.89). R-squared indicates that the analyzed factors influence m-commerce in proportion of 94%. Therefore, the forecasted future trends contribute to the identification of new trends for companies and society in an environment characterized by opportunities and risks.*

***Keywords:** m-commerce, mobile phones users, websites, access to Internet, Internet purchases, simulation.*

JEL Classification: C02, C11, C45, C46, C63

1. Introduction

The development of technology has led to the evolution of mobile devices and instruments that have been a motivating factor in the development of mobile commerce. Mobile commerce has become a necessary tool for the development of any business, especially in the current context of the COVID-19. Thus, online shopping has become essential even though many have initially been reluctant to use e-commerce (Wiradeni et. al., 2020). Factors such as consumer confidence in m-commerce (Cui et. al., 2020; Zhang et al., 2021), age, accessibility, and ease of use, social influence, motivation, habit, and effectiveness are also aspects that will be submitted to analysis (Ngubelanga and Duffett, 2021). Mobile commerce is using mobile devices - mobile phones and tablets, and virtual space represents an opportunity for all the companies, as it is considered a space without borders (Han et al., 2021).

In recent years, there has been a global growing trend of online commerce and implicitly of mobile commerce, so in 2018 over 1.79 billion consumers concluded online transactions, of which 63.50% representing the share of sales in mobile commerce, the turnover obtained of these sales exceeding the threshold of 1.8 trillion dollars (statista.com). Globally, China is the leading country in the e-commerce sales volume with \$ 636 billion, followed by the United States with sales of \$ 504 billion, the United Kingdom with \$ 86 billion, Japan with \$ 81 billion and Germany with an annual turnover of \$ 70 billion (linea.com). At the same time, online shopping has evolved rapidly, especially with COVID-19 restrictions. Thus, in 2020, 89% of people aged 16 to 74 in the EU used the internet, of which 72% bought or ordered goods or services. Online shopping increased by 4% compared to 2019 (eurostat.com). In Romania, online shopping has increased by over 27% in the period 2015-2020. However, before the current health crisis due to the COVID-19 virus, only 45% of Romanian Internet users made at least one online purchase. Before the COVID-19 pandemics, Romanian consumers used to search for information about the desired products on their mobile devices, while the actual transaction took place in physical stores (Dincă et. al., 2021). Mobile commerce is the most common, simple form of online commerce, and it is used much more often than computers, either for convenience or speed (Varzaru et al, 2021). According to globally available statistics, there are over 6.4 billion smartphone users, which means that over 80% of the total population owns a mobile device and about 53% of online commerce is done using a smartphone (statista.com).

This research investigates future trends in mobile commerce in the EU-27 countries, as well as the key factors influencing the use of mobile commerce from the perspective of users ranked by specific generations (Z, Y, X). Thus, in this article the behavioral intention of these generations regarding the use of mobile commerce will be analyzed through the prism of five variables: individuals internet

use, internet access, internet purchases by individuals, websites and functionalities, mobile phone subscribers, and the global economy.

The novelty of the research lies in the analysis performed on each generation, on European regions on the use of m-commerce, and future trends in the evolution of m-commerce at the EU-27 level are projected through statistical correlations. The study demonstrates its utility being based on real responses from the EU m-commerce users and making future trends using mathematical modeling.

This study begins with an Introduction, where m-commerce is analyzed as a continuous evolving process in the business field. The paper then elaborates on the methodology used in the analysis on generations, and a comparison between EU regions, in order to observe the future trend of m-commerce. The results obtained are presented and discussed and finally, conclusions are drawn and a discussion is carried out to find future opportunities and the risks for society, the technological and economic environment, and governmental policies.

2. Methodology

The present research used simulations and modeling techniques based on Markov chains in order to forecast future trends for m-commerce behaviors of generations and on regions from EU-27 countries. The research has as main goal to analyze the future m-commerce tendencies at European level. Other objectives of this study are: i) to analyze the influential factors on m-commerce at EU-27 countries level using a regression function; ii) to analyze the influence of each generation on using m-commerce and observe a possible future trend; iii) to analyze some reasons for using / not using m-commerce on European regions; iv) to analyze the characteristics linked by the use on m-commerce in Europe.

The main drivers of the m-commerce development are information technology and teleshopping technologies, popularity, use of internet, smartphones, and mobile applications (Saritas et al., 2021) Starting from this, we build groups of influence depending on: i) the use of technologies (X_1 and X_2); ii) the total value of online purchases, due to its interdependency (m-commerce is part of e-commerce) (X_3); iii) the number of websites used to make m-commerce purchases (X_4); iv) the number of mobile phone subscribers which are used as support to make m-commerce (X_5). Data for the analyzed variables are used from Eurostat (Y , X_1 - X_4) and the global economy (X_5), data being comprised between 2011-2020. The goal was to observe the influence each factor could have on m-commerce on EU-27 countries' level.

Thus, a regression function was implemented, and the analyzed factors are Y = Individuals- mobile internet access, X_1 = individuals- internet use, X_2 =internet access, X_3 =internet purchases by individuals, X_4 =websites and functionalities, X_5 = Mobile phone subscribers, in millions.

Table 1. The influential factors on m-commerce

Year	Y	X ₁	X ₂	X ₃	X ₄	X ₅
2011	19	71	95	29	68	403
2012	22	74	96	31	70	408
2013	22	75	96	33	72	412
2014	27	78	97	36	73	407
2015	29	80	97	38	74	406
2016	25	82	97	61	76	410
2017	32	84	97	44	76	415
2018	27	85	97	46	76	416
2019	39	87	97	49	77	415
2020	41	89	98	51	77	417

Source: www.eurostat.com; www.theglobaleconomy.com

Based on the main objective of this research, namely the analysis of future trends in the use of mobile trade at EU-27 level and by age categories, the following research hypotheses were proposed:

H1- there is a positive and high relationship between the m-commerce and its influential factors

H2- being more inclined to using internet on mobile phone, young generations are more willing to buy using m-commerce.

H3- more purchases are made on smartphone in the S-W EU than in N-C EU, especially for Z generation.

Making calculations based on regression function and Markov chains, the research hypothesis will be confirmed or infirmed, according to the calculation below.

3. Results

During this research, a descriptive analysis of the relationship between the evolution of mobile commerce and five independent variables (individuals internet use, internet access, internet purchases by individuals, websites and functionalities, mobile phone subscribers, and the global economy) was performed with the intention to observe trends in the use of m-commerce in the next period of time.

3.1. Analyzing the influential factors on m-commerce

To determine the dependence of m-commerce on its influential factors, R-squared test was used. Thus, y is depending on its influential factors in proportion of 94.12% being very close to 1. The influence is very powerful, so the factors were well chosen in the analysis. Thus, H₁ - between the m-commerce and its influential factors there is a positive and high relationship that is totally fulfilled.

The regression function is:

$$y = I_0 + S_1 \times X_1 + \dots + S_5 \times X_5$$

According to our calculations, the following formula is resulting:

$$y = -0.2882 + 2.0548 X_1 + 0.7823 X_2 - 0.2381 X_3 - 1.0587 X_4 - 0.30248 X_5$$

Thus, in order to increase with a monetary unit, the X_1 will get an increase of 2.0548 monetary units of “Y”, X_2 will get an increase of 0.7823, X_3 will get a decrease with 0.2381, X_4 will get a decrease of 1.0587, and X_5 a decrease of 0.30248. Making Pearson correlation between y and each influential variable (X_1 - X_5), results that the strongest correlation is between Y and X_1 (0.89), followed by Y and X_2 (0.81) and Y and X_4 (0.80). The other two independent variables are above average (X_3 with 0.57 and X_5 with 0.69). Making the Pearson correlation and t stat, we may add that: i) the largest influence (0.895475) of X_1 (internet use) on y (m-commerce) is explained like, the more we use internet, the more we could buy online using mobile commerce. So, the mobile phone is a technological asset which may help buying online; ii) the second influence is of X_2 (internet access) on Y (m-commerce), and could be explained as follows: the more we access internet and see e-mail offers and reduced prices, the more we could buy online using mobile phone; iii) the third influence and a strong one is of X_4 (website) on Y (m-commerce) is explained thus: the more we visit the official website of an e-buyer, the more we could buy and use m-commerce. As it can be observed, the number of mobile phone subscribers (X_5) is a lot above average but not so strong an influence on m-commerce (0.699801). This could be explained as follows: the increased number of mobile phones is not triggering a greater number of mobile purchases, unless the users are followers of websites commerce influence, or e-mail advertising. The principle according to which „What you see is what you get” becomes valid again.

Analyzing t Stat, one can observe that each independent variable has an impact on m-commerce (being negative), the main significant determinants being: X_5 (-234.099), X_1 (-50.6481) and X_2 (-32.9259). So, the number of phone subscribers and access and use of internet are very important factors in influencing m-commerce evolution. Between all the analyzed variables, there are only positive and strong correlations (comprised between 0.72 and 0.96) and only two above the average (between X_3 and X_5 - 0.59 and between X_2 and X_5 -0.66). Again, these results indicate that the influential factors on m-commerce were well chosen.

3.2. Analyzing the influence of each generation per European regions on using m-commerce and observe a possible future trend

The Markov chains forecasting method was also used to observe the trends for the period 2021-2025 regarding the 4 generations and the two comparison groups from EU-27 level. According to a study made in 2015 by PayPal, mobile commerce in Europe is showing different results per region. Mobile commerce is, for example, more popular in the eastern and southern part of Europe than it is in

Northern Europe or Scandinavia (in a year Turkey indicated that 53% of online shoppers have bought online via a smartphone, while in the Netherlands this share was just 17 percent and in Sweden was 21 percent) (ecommercenews.eu). We started from this idea, and we wanted to demonstrate if it is also valid for the comparison of two European regions: countries from South-Western EU and North-Central EU. Data were extracted from Eurostat and were applied to the following age groups: 16-24 years, 25-34 years, 35-44 years, and 45-54 years (Eurostat.com).

The analyzed characteristics are (in our calculations the first two are summed up easy for calculations): i) no need to use mobile internet away from home or work and don't know how to use mobile internet or its use is too complicated (denoted as No+Don't use I); ii) inconvenience of using small screen on a handled device (denoted as Small screen); iii) too expensive to use mobile internet (denoted as Too exp); iv) unavailability of broadband or slow connection (denoted as Slow conn). Stochastic calculation was used and then probabilities calculations, in order to use Markov chains and a possible forecasted trend was observed for 2021-2025. According to existing studies at the national level, the generations are regarded as 16-24 year (generation Z or digital natives), 25-34 years (generation Y or Millennia's or friends with computers and Facebook and Internet), 35-44 years (the early generation X or MTV generation), and 45-54 years (the late generation X, limit to generation baby boomers) (orange.ro)

3.2.1. Analyzing generation Z (16-24 years) trend (N-C EU/ S-W EU)

Generation Z is considered as the early adopters of mobile commerce (Verma et al., 2021), being formed by teenagers and young adults (Meghisan et al, 2021, p.1459-1460), who are using more Internet from mobile phone than from desktop. A study made by Episerver (2020) indicated that 49% from Z generation prefer using smartphones when buying online. AdColony report (2020) indicates that 97% of Generation Z has a smartphone, but only 69% has a computer. According to Global Web Index (2020) generation Z (78%) is saying that phones are the most important devices for online shopping. Generation Z is preferring to use QR codes in proportion of 41% (being the biggest) (Global Web Index, 2020).

The next matrix values were obtained from using stochastic calculation.

Table 2. Z Generation - the matrix, vector line and future trend

Char/N-C EU	N-C EU group										
	Neth	Swe	Pol	Ger	Vector line (2019)	2020	2021	2022	2023	2024	2025
No+Don't	0.08	0.06	0.44	0.42	0.64	0.07	0.12	0.13	0.12	0.12	0.12
Small screen	0	0.3	0.3	0.4	0.05	0.08	0.05	0.04	0.05	0.05	0.05
Too exp	0.07	0.07	0.38	0.48	0.26	0.42	0.39	0.40	0.39	0.40	0.39
Slow conn	0.2	0	0.4	0.4	0.05	0.43	0.44	0.43	0.44	0.43	0.44

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S-W EU group											
Char/S-W EU	Ita	Spa	Fra	Irl	Vector line (2019)	2020	2021	2022	2023	2024	2025
No+Don't	0.5	0.18	0.2	0.12	0.64	0.38	0.28	0.23	0.21	0.20	0.19
Small screen	0	0.5	0.5	0	0.05	0.23	0.33	0.31	0.32	0.33	0.33
Too exp	0.14	0.33	0.39	0.14	0.26	0.28	0.30	0.38	0.39	0.40	0.40
Slow conn	0.5	0	0.5	0	0.05	0.11	0.09	0.08	0.08	0.07	0.08

Note- No+Don't- no need to use mobile internet away from home or work and don't know how to use mobile internet or its use is too complicated; small screen- inconvenience of using small screen on a handled device; too exp- too expensive to use mobile internet; slow conn- unavailability of broadband or connection to slow.

The following data were observed for Z generation: i) for Nordic and Central European group the characteristics „too expensive to use internet” and „slow connection” for m-commerce (is rising from 0.26 to 0.39 and respectively from 0.005 to 0.44) will be problems in the future, and „don't know to use internet for m-commerce” will not be a problem anymore, due to the development of e-skills (decreasing from 0.64 to 0.12); ii) Southern and Western European groups are not worried about a slow connection (from 0.05 to 0.08), but for too expensive connection (from 0.28 to 0.40) and the small screen of the device used (from 0.05 to 0.33). As it is observed for No need or Don't know how to use internet for m-commerce, S-W EU customers have a low value compared to N-C EU customers (0.19 compared to 0.12). Thus, hypothesis H3- purchases are more made on smartphone in the S-W EU than in N-C EU is fulfilled for Z generation.

3.2.2. Analyzing Y generation (25-34 years) trend (N-C EU/ S-W EU)

A study made by Episerver (2020) indicated that 45% from Y generation prefer using smartphones when buying online, being on the first place, and 65% use mobile devices when buying online, in a proportion of A study made by Global Web Index, (2020) and that for generation Y (74%) the phones are the most important devices for online shopping.

Table 3. Y Generation - the matrix, vector line and future trend

N-C EU group											
Char/N-C EU	Neth	Swe	Pol	Ger	Vector line (2019)	2020	2021	2022	2023	2024	2025
No+Don't	0.16	0.1	0.4	0.34	0.73	0.17	0.12	0.10	0.10	0.10	0.10
Small screen	0.2	0.2	0.2	0.4	0.06	0.10	0.15	0.17	0.18	0.17	0.17
Too exp	0.2	0.04	0.24	0.52	0.19	0.35	0.26	0.25	0.25	0.26	0.026
Slow conn	0	0.25	0.25	0.5	0.02	0.38	0.47	0.48	0.47	0.47	0.47

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S-W EU group											
Char/S-W EU	Ita	Spa	Fra	Irl	Vector line (2019)	2020	2021	2022	2023	2024	2025
No+Don't	0.36	0.24	0.26	0.14	0.73	0.30	0.20	0.17	0.16	0.17	0.16
Small screen	0	0.6	0.4	0	0.06	0.22	0.24	0.22	0.20	0.19	0.19
Too exp	0.14	0	0.72	0.14	0.19	0.36	0.47	0.51	0.53	0.54	0.55
Slow conn	0.33	0.33	0.34	0	0.02	0.12	0.09	0.10	0.11	0.10	0.10

Note- No+Don't- no need to use mobile internet away from home or work and don't know how to use mobile internet or its use is too complicated; small screen- inconvenience of using small screen on a handled device; too exp- too expensive to use mobile internet; slow conn- unavailability of broadband or connection to slow.

Analyzing the Y generation, a greater gap for knowing how to use the internet for m-commerce (from 0.73 to 0.10) is perceived. And again S-W EU compared to N-C EU is better positioned for this characteristic. For slow connection at this generation was obtained a lower level, being a real problem (from 0.02 to 0.47 for N-C EU group compared to 0.16 for S-W EU group).

3.2.3. Analyzing early X gen (35-44 years) trend (N-C EU/ S-W EU)

According to the Global Web Index (2020) X generation (for 61%) is saying that phones are the most important devices for online shopping and perceive mobile activities as complicated (Sharms et al., 2020). A study made by (Varzaru et al., 2021), indicated that only one-third of all X Generation respondents have a favorable attitude towards the use of m-commerce (33.3% of respondents) (73.9% for gen Z).

Table 4. Early X generation - the matrix, vector line and future trend

N-C EU group											
Char/N-C EU	Neth	Swe	Pol	Ger	Vector line (2019)	2020	2021	2022	2023	2024	2025
No+Don't	0.2	0.09	0.32	0.39	0.75	0.21	0.19	0.19	0.19	0.19	0.19
Small screen	0.23	0.07	0.23	0.47	0.05	0.09	0.12	0.13	0.12	0.13	0.13
Too exp	0.23	0.1	0.16	0.51	0.16	0.28	0.21	0.20	0.21	0.20	0.20
Slow conn	0.16	0.17	0.17	0.50	0.04	0.42	0.48	0.48	0.48	0.48	0.48
S-W EU group											
Char/S-W EU	Ita	Spa	Fra	Irl	Vector line (2019)	2020	2021	2022	2023	2024	2025
No+Don't	0.29	0.27	0.29	0.2	0.75	0.23	0.12	0.09	0.06	0.07	0.06
Small screen	0	0.57	0.29	0.14	0.05	0.29	0.37	0.41	0.41	0.41	0.41
Too exp	0.04	0.32	0.5	0.14	0.16	0.33	0.39	0.42	0.40	0.40	0.40
Slow conn	0.25	0.25	0.5	0	0.04	0.15	0.16	0.08	0.13	0.12	0.13

Note- No+Don't- no need to use mobile internet away from home or work and don't know how to use mobile internet or its use is too complicated; small screen- inconvenience of using small screen on a handled device; too exp- too expensive to use mobile internet; slow conn- unavailability of broadband or connection to slow.

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Looking at these data, we may observe that for the early X generation the real problems are the small screen and the fact that they don't know how to use the internet for m-commerce and the internet connection is too expensive, especially for the S-W EU group.

3.2.4. Analyzing late X generation (45-54 years) trend (N-C EU/ S-W EU)

According to the Global Web Index, X generation (for 61%) is saying that phones are the most important devices for online shopping. Epserver study (2020) add that late X generation use mobile devices when buying online in a proportion of 33%, and Global Web Index adds that for them the phones are the most important devices for online shopping for just 37%.

Table 5. Generation late X- the matrix, vector line and future trend

N-C EU group											
Char/N-C EU	Neth	Swe	Pol	Ger	Vector line (2019)	2020	2021	2022	2023	2024	2025
No+Don't	0.24	0.13	0.24	0.39	0.75	0.23	0.19	0.18	0.19	0.18	0.18
Small screen	0.18	0.18	0.17	0.47	0.08	0.13	0.19	0.20	0.21	0.20	0.20
Too exp	0.23	0.07	0.11	0.59	0.14	0.21	0.16	0.16	0.15	0.16	0.16
Slow conn	0.14	0.29	0.14	0.43	0.03	0.43	0.46	0.46	0.45	0.46	0.46
S-W EU group											
Char/S-W EU	Ita	Spa	Fra	Irl	Vector line (2019)	2020	2021	2022	2023	2024	2025
No+Don't	0.24	0.26	0.34	0.16	0.75	0.19	0.10	0.08	0.07	0.06	0.06
Small screen	0	0.34	0.55	0.11	0.08	0.28	0.30	0.31	0.32	0.32	0.32
Too exp	0.05	0.32	0.53	0.1	0.14	0.39	0.50	0.51	0.52	0.52	0.52
Slow conn	0.25	0.25	0.5	0	0.03	0.14	0.10	0.1	0.09	0.1	0.1

Note- No+Don't- no need to use mobile internet away from home or work and don't know how to use mobile internet or its use is too complicated; small screen- inconvenience of using small screen on a handled device; too exp- too expensive to use mobile internet; slow conn- unavailability of broadband or connection to slow.

It may be observed the late X generation from N-C EU group is not influenced in using m-commerce by the cost, but on slow connection (from 0.03 to a forecasted 0.46 in 2025) and by the small screen (from 0.08 to a forecasted 0.20 in 2025). As for the late X generation from S-W EU group we may observe that it is more influenced by the small screen (0.32) than the N-C EU group (0.20), and by the cost (0.52) than the N-C EU group (0.16), slow connection not being such a problem into the foreseeable future for S-W EU group (0.1) than the N-C EU group (0.46).

Thus, H2- young generations being more inclined on using the internet on mobile phones, are also more willing to buy using m-commerce, and H2 is fulfilled in the present (0.64 for Z generation) but not in the forecasted 5 years from the

future. The smallest value of no need to use m-commerce is obtained in the first group by generation early Y (0.10) and, indeed the smallest value in the second group is obtained by both generation X. So, the need to use m-commerce is the opposite of what we calculated and H_2 is not fulfilled. The generations who are using m-commerce is for N-C group the Y generation and for S-W group the X generations, due to the status, the wages obtained, the willing to buy for their kids and family in pandemic times.

3.3. Analyzing the reasons of using/not using m-commerce at EU level

This analysis started from the following data: i) with just 2.3% of mobile visits converting to sales, compared to 4.8% for desktop (salecycle.com); ii) applied to the European market, which is increasing; iii) m-commerce experience is characterized by a clear imagery, simplified site navigation and content that has been designed specifically for mobile; iv) using a small desktop version for m-commerce means smaller words, distorted product images and cramped menus when viewed, slower load times, and automatically the abandonment, which lead to rates by 75%. A recent study on m-commerce reflected the importance of the mobile phone and found that while 31.1% of e-commerce traffic is on mobile phones in the UK, this rate stood at just 8.3% for Poland (Europa.eu). Data were taken from European Mobile Commerce Study (made in November 2018) (newsroom.mastercard.com). The responses from this report were extracted and using stochastic calculation to observe a possible future trend and a possible gap between the 2 compared zones.

Table 6. Frequency of using mobile phone to shop online

	N-C EU group										
	Neth	Swe	Pol	Ger	Vector line (2019)	2020	2021	2022	2023	2024	2025
Once+>once/week	0.18	0.21	0.3	0.31	0.43	0.24	0.31	0.29	0.29	0.29	0.29
One/month+one/semester	0.27	0.27	0.24	0.22	0.46	0.25	0.27	0.26	0.26	0.26	0.26
Once/year	0.38	0.30	0.16	0.16	0.07	0.26	0.22	0.23	0.22	0.23	0.23
<once/year	0.38	0.29	0.19	0.14	0.04	0.25	0.20	0.22	0.23	0.22	0.22
	S-W EU group										
	Ita	Spa	Fra	Irl	Vector line (2019)	2020	2021	2022	2023	2024	2025
Once+>once/week	0.27	0.27	0.21	0.25	0.43	0.25	0.24	0.24	0.24	0.24	0.24
One/month+one/semester	0.24	0.24	0.27	0.25	0.46	0.24	0.22	0.22	0.22	0.22	0.22
Once/year	0.23	0.23	0.27	0.25	0.07	0.26	0.27	0.27	0.27	0.27	0.27
<once/year	0.24	0.14	0.33	0.29	0.04	0.25	0.27	0.27	0.27	0.27	0.27

Comparing the 2 groups we observe that the frequency of using m-commerce in the next 5 forecasted years will decrease for one per week or once per

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month and will increase the way of using it once per year, a more increasing way being for S-W EU group. Thus, m-commerce is made largely once a month, it is fulfilled in the present (0,46) and not fulfilled in the next 5 forecasted years (0,24 for S-W group and 0,26 for N-C group).

Table 7. Key drivers in mobile online shopping

N-C EU group											
	Neth	Swe	Pol	Ger	Vector line (2019)	2020	2021	2022	2023	2024	2025
Speed	0.21	0.1	0.36	0.33	0.36	0.21	0.21	0.21	0.21	0.21	0.21
One click	0.20	0.18	0.31	0.31	0.27	0.19	0.21	0.23	0.23	0.23	0.23
Easy	0.18	0.31	0.25	0.26	0.25	0.31	0.29	0.30	0.30	0.30	0.30
Security	0.26	0.28	0.28	0.18	0.12	0.29	0.29	0.26	0.26	0.26	0.26
S-W EU group											
	Ita	Spa	Fra	Irl	Vector line (2019)	2020	2021	2022	2023	2024	2025
Speed	0.30	0.24	0.23	0.23	0.36	0.28	0.27	0.26	0.26	0.26	0.26
One click	0.28	0.32	0.16	0.24	0.27	0.27	0.27	0.27	0.27	0.27	0.27
Easy	0.30	0.27	0.18	0.25	0.25	0.20	0.21	0.22	0.22	0.22	0.22
Security	0.20	0.26	0.26	0.28	0.12	0.25	0.25	0.25	0.25	0.25	0.25

Comparing the 2 groups the S-W EU group is preferring to use m-commerce for speed (0.26 than 0.21) and for the thing that is at one click away (0.27 than 0.23), better than the N-C EU group. For easy (0.30 than 0.22) and security (0.26 than 0.25), the N-C group is preferring m-commerce more than the S-W group.

Table 8. The maximum value spent on purchases made from mobile devices

N-C EU group											
	Neth	Swe	Pol	Ger	Vector line (2019)	2020	2021	2022	2023	2024	2025
<59 Eur	0.28	0.22	0.33	0.17	0.35	0.18	0.19	0.20	0.20	0.20	0.20
60-117 Eur	0.25	0.21	0.29	0.25	0.26	0.25	0.28	0.27	0.27	0.27	0.27
118-234 Eur	0.16	0.27	0.25	0.32	0.19	0.27	0.25	0.26	0.26	0.26	0.26
235 Eur	0.12	0.37	0.19	0.32	0.2	0.30	0.28	0.27	0.27	0.27	0.27
S-W EU group											
	Ita	Spa	Fra	Irl	Vector line (2019)	2020	2021	2022	2023	2024	2025
<59 Eur	0.26	0.22	0.27	0.25	0.35	0.26	0.25	0.26	0.26	0.26	0.26
60-117 Eur	0.24	0.23	0.26	0.27	0.26	0.26	0.27	0.26	0.27	0.27	0.27
118-234 Eur	0.27	0.32	0.16	0.25	0.19	0.23	0.21	0.22	0.22	0.22	0.22
>235 Eur	0.27	0.31	0.18	0.24	0.2	0.25	0.27	0.26	0.25	0.25	0.25

Comparing the 2 groups the S-W EU group is preferring to use m-commerce for speed (0.26 than 0.21) and for the thing that is at one click away (0.27 than 0.23), better than the N-C EU group. For easy (0.30 than 0.22) and security (0.26 than 0.25), the N-C group is preferring more m-commerce than the S-W group. Thus, the hypothesis that m-commerce is chosen for speed (0.36 in the present) is fulfilled and in the forecasted future especially more in S-W EU (0.26) than in N-C EU (0.21) where the hypothesis mentioned is fulfilled only partially, because the first group prefers m-commerce more for easy and the second group prefers m-commerce for the one click away.

Table 9. Way of shopping

	N-C EU group										
	Neth	Swe	Pol	Ger	Vector line (2019)	2020	2021	2022	2023	2024	2025
In shop	0.28	0.26	0.24	0.22	0.52	0.25	0.23	0.24	0.23	0.24	0.24
On laptop	0.25	0.24	0.26	0.25	0.24	0.25	0.24	0.24	0.24	0.24	0.24
On smartphone	0.19	0.24	0.24	0.33	0.17	0.25	0.26	0.26	0.26	0.26	0.26
Online, but otherwise	0.23	0.23	0.29	0.25	0.07	0.25	0.27	0.26	0.27	0.26	0.26
	S-W EU group										
	Ita	Spa	Fra	Irl	Vector line (2019)	2020	2021	2022	2023	2024	2025
In shop	0.24	0.25	0.25	0.26	0.52	0.25	0.25	0.25	0.25	0.25	0.25
On laptop	0.27	0.23	0.30	0.2	0.24	0.25	0.24	0.25	0.25	0.25	0.25
On smartphone	0.26	0.25	0.20	0.29	0.17	0.25	0.25	0.24	0.24	0.24	0.24
Online, but otherwise	0.24	0.28	0.21	0.27	0.07	0.25	0.26	0.26	0.26	0.26	0.26

As we may observe, the first option in 2019 was making purchases in shops, physically (0.52), and using m-commerce was the third option (0.17), after using the laptop for online purchases (0.24). On the next forecasted 5 years, it is supposed that purchasers will prefer buying more using m-commerce and online.

Thus, the hypothesis that m-commerce will be the first option used in shopping is partially fulfilled. Only for the first group would be the first option, but for the others groups would be the last option. As we may observe in the forecasted future will be an equalization among the ways of buying, physical or virtual.

4. Conclusion and discussion

Mobile phones being available to individuals all time, the m-commerce became the simplest and easiest way for e-commerce. The mobile phone offers us convenience and comfort in buying online, pleasure and speed. The originality of this study consists in analyzing the preference of m-commerce not only for one or many generations, as other studies, based only on surveys made on local level (Meghisan et al., 2021; Tamale et al., 2020; Ngubelanga & Duffett, 2021). Our

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study is based on using data from EU-27 countries level, based on using modeling and simulation, in order to have a broader image on preferences of m-commerce, on generations, on different characteristics, and on EU regions. In this study we carry out an analysis regarding the influence some independent variables could have on m-commerce at EU-27 level. We also analyzed the influence of each generation per European regions on using m-commerce and observed a possible future trend.

Analyzing the influence of independent variables on m-commerce, we found out that internet use (x1) has the largest influence (0.895475), the second influence is of internet access (x2) (0.81), the third influence is of X₄ (website) (0.8690), x5 (mobile phone subscribers) is influencing m-commerce with (0.6998) and the weakest influence, but above average is of x3 (internet purchases by individuals). According to the above mentioned values of R-squared, H1 (between the m-commerce and its influential factors there is a positive and high relationship) is totally fulfilled. There are only positive and strong correlations between the independent variables (comprised between 0.72 and 0.96) and only two above the average (between X₃ and X₅- 0.59 and between X₂ and X₅-0.66). Again, these results indicate that the influential factors on m-commerce were well chosen.

Thus, H₂- young generations being more inclined on using internet on mobile phones, they are more willing to buy using m-commerce, which is an aspect that is fulfilled in the present (0.64 for Z generation) but not in the following forecasted 5 years. The smallest value of no need to use m-commerce is obtained in the first group by generation early Y (0.10) and, indeed the smallest value in the second group is obtained by both generation X. So, the need to use m-commerce, is the opposite of what we calculated and H₂ is not fulfilled. The generations who are using m-commerce is for N-C group the Y generation and for S-W group the X generations, due to the status, the wages obtained, the willing to buy for their kids and family in pandemic times.

According to the forecasted calculations, the following behavior on m-commerce for the Z generation is observed: i) for Nordic and Central European group the characteristics „too expensive to use internet” and „slow connection” for m-commerce (is rising from 0.26 to 0.39 and respectively from 0.005 to 0.44) will be problems in the future, and „don’t know to use internet for m-commerce” will not be a problem anymore, due the development of the e-skills (decreasing from 0.64 to 0.12); ii) for Southern and Western European group, they are not worried for slow connection (from 0.05 to 0.08), but for too expensive (from 0.28 to 0.40) and for small screen (from 0.05 to 0.33). As it is observed for No need or Don’t know how to use internet for m-commerce, S-W EU customers have a low value compared to N-C EU customers (0.19 compared to 0.12). Thus, hypothesis H3-purchases are more made on smartphone in the S-W EU than in N-C EU is fulfilled for Z generation. It is demonstrated that m-commerce is more popular in the eastern and southern part of Europe than it is in Northern Europe or Scandinavia (ecommercenews.eu). Starting from this idea we wanted to demonstrate if it is also

valid for the comparison of two European regions: countries from South-Western EU and North-Central EU. Comparing the 2 groups we observe that: the frequency of using m-commerce in the next 5 forecasted years will decrease to one per week or once per month and will increase the way of using it once per year, a more increasing way being for S-W EU group. For the analyzed characteristics, we notice that comparing the 2 groups, the S-W EU group prefers to use m-commerce for speed (0.26 than 0.21) and for work that is one click away (0.27 than 0.23), than N-C EU group. For convenience (0.30 than 0.22) and security (0.26 than 0.25), the N-C group is preferring m-commerce than the S-W group. Thus, m-commerce is chosen for speed (0.36 in the present) is fulfilled and in the forecasted future is more in S-W EU (0.26) than in N-C EU (0.21) is fulfilled only partially, because the first group prefer m-commerce more for convenience and the second group for one click away. For the maximum spending value for m-commerce, for N-C EU group are preferred the m-commerce spend between 59-117 Eur and above 35 Eur. For the other group are preferred the spend between 59-117 Eur and under 59 Eur. As we may conclude, for a forecasted future the larger spend are preferred by N-C EU group. So, the average amount for m-commerce is between 59-117 Eur is true only for S-W EU group, thus is partially fulfilled. In the present, the shopping below 59 Eur is preferred. For the way to make shopping, we may observe the first option in 2019 was make purchases in shop, physically (0.52), on the forecasted next 5 years is supposed to prefer buying more using m-commerce. Thus, m-commerce will be the first option used in shopping is partially fulfilled.

As far as the theoretical implications are concerned, our article is contributing the theory in m-commerce literature, by analyzing specific characteristics on generations and regions and practice, by implementing modeling and simulation on macro level (EU-27 countries). This study discovered some trends in different generation's behavior using m-commerce and, also on regions. These results may be used to provide some ideas based on these forecasted trends for managers. For companies, these results and future trends may be a first step in analyzing their offer, website, and preferences in order to have a win-win relation. Another implication for managers brought by this study is improving the relationship with m-customers. Our study had as limitation the limited data at the macro level regarding m-commerce trends and studies. Our study made a small but important step for improved analytical models of m-commerce, based on surveys and official registered data at EU-27 level. The obtained results were based on econometric models and forecasting models. This model may be used to observe future trends and offer the opportunity to invest in this new field, which provided to be a useful tool in pandemic times.

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