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Comparative analyses of digital payment methods from the pre and post COVID-19 perspective

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Abstract

The major purpose of this research is to analyze and assess effect of COVID-19 impact on the frequency of using digital payment methods. The research was divided into five sections: volume and frequency of payment methods, payment methods characteristic and their fulfilment, technological trust of payment methods, expected changes in digital payment in the next 5 years, implementation of restrictions related to COVID-19 for the after the epidemic period. The post COVID-19 study was conducted in March 2022 in the form of a survey among university students. Data for pre COVID-19 study come from the author’s article "Digital payment methods within Polish students - leading decision characteristics" from 2020 (survey conducted in November 2019). Main conclusions of the study (compared to pre COVID-19): there has been a significant reduction of popularity of cash payments, payments made via e-banking (web access), payments made with physical credit / debit card; has been a noticeable decline in the number of transactions made by respondents; respondents do not support forcing others to use only digital payment methods; despite the massive use of digital payments, respondents expect the spread of technologies ensuring anonymity in digital payments in the future.

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Keywords: digital payment; payment methods;
1. Introduction

Unexpected changes in the business environment can cause significant changes that were not predicted by experts or by the managers. COVID-19 is a very good example of a global phenomenon that has significantly changed consumer behavior, business and leisure activities. Real-world delivery of products and access to services such as restaurants have changed. These phenomena are also related to changes in the methods of paying for products and services. At company and government level, there are change initiatives with regard to the new payment options. Many Central Banks are considering development of CBDC (Central Bank Digital Currency). According to IMF [1] “(...) around 100 countries are exploring CBDCs at one level or another. Some researching, some testing, and a few already distributing CBDC to the public”. Changes are necessary at the level of legal regulations, tax changes, changes in the ways banks operate, as well as changes in the methods of payment by consumers. Such a fundamental change is not possible without the approval of citizens, hence Central Banks as well as other national and international institutions are interested in examining consumer sentiment. European Central Bank (ECB) published in 2022 report a covering citizens’ attitudes to new payment methods and the Digital Euro. According to this research [2] for consumers “a new payment method would need to offer benefits that simplify life, such as allowing them to combine multiple payment methods into one, giving financial oversight of all their accounts, providing spending reports or enabling them to set spending limits”. In other countries like USA discussion with stakeholders is on central level, with possibility to answer predefined questions [3], [4]. Bank of Canada provides analyses addressing different issues like expiring CBDC [5], role of Central Bank [6], payment efficiency or bank costs [7] as well as usage of electronic payment data in real time [8].

The topic of widespread use of digital payments is also analyzed by researchers. Main areas which are investigated are: privacy of digital payment [9], level of acceptance of digital payment [10], [11] and biometrics [12], [13]. During COVID-19, the way of purchasing products and services was completely remodeled. E-commerce became the preferred sales model, and products were delivered by couriers. Hence, preference was given to payment methods that limited the possibility of getting infected, by eliminating or limiting cash payments.

Increasing the popularity of digital payments is possible only if the necessary infrastructure is provided. The necessary elements are: customer-side mobile platform, communication infrastructure (4G and 5G), availability of global or local mobile payment standards and skills of customers. Smartphones are currently the most common mobile platform. In 2021 in Poland according to Office of Electronic Communications in Poland [14] 78% of adults use smartphone, in this group 95% of consumers below 44 year use smartphone. According to information from telecommunication operators [15], 5G coverage in Poland covers 19 million people, which constitutes 47.9% of the population. In the case of the popularization of the use of mobile payments there are the following observations covering first quarter of 2022 [16]:

- the largest banks operating on the Polish market had over 20.1 million customers (52.6% of population) using financial services via mobile devices,
- in above group there where nearly 11.2 million mobile only customers (29.3% of population),
- both groups of customers increased by 3 million year-on-year.

According to the provided data customers consumers operate in an environment where it is up to them to decide whether they will use electronic payments or not. In this article the author will analyze the answers of students, i.e. people with appropriate competences and resources to use new technologies, including electronic payments. Researchers are focused on different perspectives of skills of students: common skills [17], ICT skills [18], “technologies that provoke the development of the academic and professional interaction’ skills in master’ students training” [19]. More general research of students is related to e-commerce [20], [21], [22]. The purpose of comparing research before and after COVID-19 was to capture the changes that occurred in the behavior of students. In November 2019 author has conducted survey related to digital payment methods, so just 4 months before lockdown due to COVID-19 (March 2020). In Poland, the number of COVID-19 cases has been decreasing since the spring of 2022, hence from 16th of May, 2022, “the state of the epidemic was abolished and the state of epidemic threat will apply. The incidence of COVID-19 will be monitored in a similar way to the flu today.” [23] Author’s survey was carried out in March 2022, with the restrictions related to COVID-19 constantly being reduced. This allows the comparison of the respondents' approach to mobile payments before and after COVID-19. The
The distinguishing element of the study below is the use of a set of questions from the pre-COVID-19 version, while questions regarding the attitude to the use of technology in order to implement the restrictions have been added.

The analysis of students' skills allows to predict future patterns of the performance of professional duties, as well as future patterns of the use of information technology at work and for private purposes. This gives an opportunity to understand what the business conditions related to digital payments themselves will look like, but also privacy issues, real-time data processing at the national or global level, and for companies with access to data to take appropriate pro-competitive actions.

The following research questions were asked in the article:
- to what extent has the use of payment methods changed due to the occurrence of COVID-19?
- what forms of digital payments have grown in popularity compared to pre-COVID-19?
- what is the attitude of the respondents to implementing restrictions related to COVID-19 for the period after the epidemic, from perspective of technology?

2. Methodology

The survey at the end of COVID-19 was conducted in March 2022. 418 respondents took part in the survey, of which 361 gave full answers, these forms were analyzed in the article. The convenient sampling was used to select the research sample. Respondents were students of University of Warsaw, Faculty of Management. The research sample includes undergraduate and graduate students of full-time and part-time Management studies and Financial Management and Accounting studies from this University.

The survey was conducted using the CAWI method (Computer-assisted web interviewing). Depending on the device used by the respondents and the answers given, an appropriate question sheet was generated, in order to clearly present the questions and to maintain the logic of the research. The form consisted of 37 questions, divided into 4 groups.

The following steps were taken to complete the research:
1. Definition of the focus group based on the knowledge and experience of the respondents,
2. Launching of the test version of the survey, discussion and verification of formulated questions with the focus group,
3. Launching the final version of the survey with use of infrastructure of University of Warsaw, Faculty of Management,
4. Dissemination of access data to online survey among respondents,
5. Survey data collection and analysis of results,
6. Formulating conclusions and answering research questions

77.56% of respondents were 20 or 21 years old. 69.25% of the respondents are women, 30.75% are men, it’s typical for the profile of study. The question of Place of Origin gave the following answers: 29.36% of respondents live in rural and towns of 10000 inhabitants, 26.87% of respondents live in medium size cities (10001-100000 inhabitants) and accordingly 43.77% in big and very big cities (over 100000 inhabitants). 26.87% of respondents work full-time, 24.10% of respondents work more than half-time, but less than full time, 9.14% of respondents work less than half-time and 39.89% of respondents do not take up paid work (other source of financing, usually parents).

3. Discussion of results

The data used for the comparative analysis of the pre-COVID-19 situation comes from the author’s article "Digital payment methods within Polish students - leading decision characteristics" from 2020. As a reference point for the data from 2019, it is also worth citing national data on digital payments. In the fourth quarter of 2019 the largest banks operating on the Polish market had over 10.02 million customers (26.3% of population) using financial services via mobile devices [24].

The questions from the first part of the questionnaire covered the frequency of making payments with various methods. In 2022, the most used payment methods were: payments made via m-banking (mobile app, e.g. IKO PKO BP, mBank PL) (80%), payments made with physical credit/debit card (70%), payments made via e-wallet (smartphone, computer, tablet, e.g. Google Pay, Apple Pay, Visa Checkout, Masterpass) (60%), payments made via...
e-banking (web access) (57%), cash payments (54%) (Table 1). The least popular payment methods are: payments made directly in the bank branch or in the post office (10%), payments made via cryptocurrency card (e.g. Bitcoin) / e-wallet (1%) and payments made via cryptocurrency card (e.g. Bitcoin) / mobile app (1%). Compared to the situation before COVID-19, the number of people who did not use a given form of payment at all increased by 35 percentage points for cash payments, payments made via e-banking (web access) by 27 percentage points, payments made with physical credit/debit card by 21 percentage points, payments made directly in the bank branch or in the post office by 7 percentage points. The number of people who started using a given form of payment increased for two methods: payments made via e-wallet (smartphone, computer, tablet), e.g. Google Pay, Apple Pay (21 percentage points), payments made via m-banking (mobile app), e.g. IKO PKO BP, mBank PL (8 percentage points). Overall, there has been a noticeable decline in the number of transactions made by respondents, this applies not only to cash but also to digital payments. Increases in the number of transactions are visible for a group of 1-2 transactions a day for 5 payment methods, and in the case of 3-6 transactions a day, increases are actually visible only for payments made via e-wallet.

Table 1. Frequency of financial transactions on weekly basis (pre-COVID-19 and post-COVID-19 perspective)

|                                | 0 | 1-2 | 3-6 | 7-10 | 11-20 | 21-30 | More |
|--------------------------------|---|-----|-----|------|-------|-------|------|
|                                | 2019 | 2019 | 2019 | 2019 | 2019 | 2019 | 2019 |
| 1 Number of cash payments      | 11% | 28% | 31% | 16% | 9% | 6% | 2% |
|                               | 46% | 45% | 7% | 2% | 0% | 0% | 0% |
| 2 Number of payments made directly in the bank branch or in the post office | 83% | 9% | 7% | 1% | 1% | 0% | 0% |
|                               | 90% | 7% | 2% | 1% | 0% | 0% | 0% |
| 3 Number of payments made via e-banking (web access) | 16% | 35% | 34% | 10% | 5% | 1% | 1% |
|                               | 43% | 47% | 7% | 3% | 0% | 0% | 0% |
| 4 Number of payments made with physical credit/debit card | 9% | 5% | 21% | 28% | 24% | 8% | 6% |
|                               | 50% | 41% | 22% | 4% | 2% | 0% | 0% |
| 5 Number of payments made via m-banking (mobile app). IKO PKO BP, mBank PL | 28% | 29% | 14% | 7% | 2% | 2% |
|                               | 20% | 52% | 20% | 5% | 2% | 1% | 0% |
| 6 Number of payments made via e-wallet (smartphone, computer, tablet), e.g. Google Pay, Apple Pay, Visa Checkout, Masterpass | 61% | 10% | 11% | 8% | 7% | 2% | 2% |
|                               | 40% | 28% | 22% | 7% | 2% | 1% | 0% |
| 7 Number of payments made via cryptocurrency card (e.g. Bitcoin) / mobile app eg. Coinbase Card | 99% | 1% | 0% | 0% | 0% | 0% | 0% |
|                               | 99% | 1% | 0% | 0% | 0% | 0% | 0% |
| 8 Number of payments made via cryptocurrency card (e.g. Bitcoin) / e-wallet e.g. Wirex | 99% | 1% | 1% | 0% | 0% | 0% | 0% |

Another perspective of analysis is related to expectations and their fulfilment while using different payment methods by respondents. Respondents had 5 characteristics to assess with relevant answers. In this article there were investigated only lowest and highest levels of fulfillment of mentioned characteristics. For all payment methods there is an increase in the lowest rankings (very poor or not deployed / provided) for almost all characteristics compared to the pre-COVID-19 assessment (Table 2). Privacy is a characteristic that had the lowest grade increase of 10 percentage points or more for almost all payment methods (for payments made via m-banking it had an increase of 9 percentage points). This demonstrates respondents’ growing awareness of this area regarding digital payments and it can be expected to be an important element in the evaluation of the use of payment methods in the future. Two methods of payments, payments made via cryptocurrency card (e.g. Bitcoin) / mobile app and cryptocurrency card e-wallet, had the increase of lowest grades in all characteristics. This indicates an increase in
awareness of the blockchain technology. Another two payment methods, cash payments and payments made directly in the bank branch or in the post office, had the increase of lowest grades in 5 from 7 characteristics. Importantly, cash payment is seen as the lowest rated after COVID-19. In this case, there has been an increase in lowest ratings by over 30 percentage points in 4 categories (payment speed, convenience of payment, theft protection, simplicity of expenses control (statement)). This indicates a major negative shift in the approach to using cash in respondent’s daily life.

Table 2. Payment methods’ characteristics rated with the lowest grade - very poor or not deployed/provided (pre-COVID-19 and post-COVID-19 perspective)

| Fulfillment of payment method's characteristics | payment speed 2019 / 2022 | convenience of payment 2019 / 2022 | reliability of payment methods 2019 / 2022 | theft protection 2019 / 2022 | privacy 2019 / 2022 | number of points accepting a given form of payment 2019 / 2022 | simplicity of expenses control (statement) 2019 / 2022 |
|-----------------------------------------------|--------------------------|-----------------------------------|---------------------------------------------|--------------------------|-------------------|-----------------------------------------------|-----------------------------------------------|
| cash payments                                 | 5%                       | 13%                               | 2%                                          | 21%                      | 1%                | 1%                                            | 9%                                           |
| payments made directly in the bank branch or in the post office | 38%                       | 57%                               | 7%                                          | 57%                      | 20%               | 3%                                            | 43%                                          |
| payments made via e-banking (web access)      | 30%                       | 42%                               | 5%                                          | 1%                       | 19%               | 7%                                            | 5%                                           |
| payments made via e-wallet (smartphone, computer, tablet), e.g. Google Pay, Apple Pay, Visa Checkout, Masterpass | 1%                        | 1%                                | 0%                                          | 1%                       | 12%               | 1%                                            | 0%                                           |
| payments made with physical credit/debit card | 0%                        | 0%                                | 1%                                          | 0%                       | 12%               | 0%                                            | 2%                                           |
| payments made via m-banking (mobile app). IKO PKO BP, mBank PL | 0%                        | 0%                                | 0%                                          | 1%                       | 10%               | 1%                                            | 1%                                           |
| payments made via e-wallet (smartphone, computer, tablet), e.g. Google Pay, Apple Pay, Visa Checkout, Masterpass | 0%                        | 0%                                | 2%                                          | 0%                       | 8%                | 22%                                           | 12%                                          |
| payments made via cryptocurrency card (e.g. Bitcoin) / mobile app e.g. Coinbase Card | 0%                        | 1%                                | 1%                                          | 2%                       | 11%               | 2%                                            | 1%                                           |
| payments made via e-wallet (smartphone, computer, tablet), e.g. Google Pay, Apple Pay, Visa Checkout, Masterpass | 1%                        | 2%                                | 2%                                          | 9%                       | 24%               | 11%                                           | 9%                                           |
| payments made via cryptocurrency card (e.g. Bitcoin) / mobile app e.g. Coinbase Card | 6%                        | 7%                                | 8%                                          | 6%                       | 6%                | 29%                                           | 10%                                          |
| payments made via cryptocurrency card (e.g. Bitcoin) / e-wallet e.g. Wirex | 20%                       | 24%                               | 36%                                         | 19%                      | 16%               | 78%                                           | 36%                                          |
| payments made via cryptocurrency card (e.g. Bitcoin) / e-wallet e.g. Wirex | 6%                        | 5%                                | 6%                                          | 6%                       | 6%                | 29%                                           | 9%                                           |
| For only two payment methods there is an noticeable increase in the highest grade (very good) characteristics compared to the pre-COVID-19 assessment (Table 3). Payments made via e-wallet (smartphone, computer, tablet), e.g. Google Pay had increase in 4 from 7 characteristics by over 10 percentage points (payment speed, convenience of payment, privacy, number of points accepting a given form of payment). There is a visible increase in respondents' awareness of this payment method. Payments made via m-banking (mobile app) had 2 from 7 characteristics by over 10 percentage points (payment speed, theft protection). 3 payment methods had decrease of characteristics by 10 percentage point or more (cash payments, payments made via e-banking (web access), payments made with physical credit/debit card). Two of this payment methods, cash payments and payments made via e-banking (web access), had the decrease of highest grades in 6 and respectively 5 from 7 characteristics. This is an indication that these methods are not preferred payment methods. In the near future, we can expect that the use of cash payments will drastically decline. Interestingly, e-banking is also likely to face a similar fate, mainly due to the low convenience of payment. The highest satisfaction with payment methods (over 50% of the highest ratings) was found in two characteristics - payment speed and convenience of payment. In this two characteristics three payment methods had over 50% of the highest ratings: payments made with physical credit/debit card, payments made via m-
banking (mobile app) and payments made via e-wallet (smartphone, computer, tablet). In the coming years we can expect that these three payment methods will dominate the market. In the case of payments made via cryptocurrency card (e.g. Bitcoin) mobile app and payments made via cryptocurrency card (e.g. Bitcoin) / e-wallet there were slight differences in assessment pre and post COVID-19. This is mainly due to the low prevalence of these payment methods.

| Fulfilment of payment method's characteristics | payment speed 2019 / 2022 | convenience of payment 2019 / 2022 | reliability of payment methods 2019 / 2022 | theft protection 2019 / 2022 | Privacy 2019 / 2022 | number of points accepting a given form of payment 2019 / 2022 | simplicity of expenses control (statement) 2019 / 2022 |
|-----------------------------------------------|---------------------------|-------------------------------------|------------------------------------------|---------------------------|---------------------|---------------------------------------------------|-----------------------------|
| cash payments                                 | 21% 4%                    | 44% 2%                              | 2%                                       | 50% 77%                    | 17%                 | 13%                                               | 13%                         |
| payments made directly in the bank branch or in the post office | 15% 2%                    | 43% 3%                              | 3%                                       | 46% 67%                    | 13%                 | 13%                                               | 13%                         |
| payments made via e-banking (web access)     | 3% 3%                     | 14% 21%                             | 26% 4%                                   | 8%                         | 19%                 | 56%                                               | 56%                         |
| payments made with physical credit/debit card | 20% 25%                   | 20% 24%                             | 16% 25%                                  | 56% 24%                    | 53%                 | 53%                                               | 53%                         |
| payments made via m-banking (mobile app). IKO PKO BP, mBank PL | 26% 41%                   | 25% 19%                             | 24% 22%                                  | 25% 5%                     | 38%                 | 38%                                               | 38%                         |
| payments made via e-wallet (smartphone, computer, tablet), e.g. Google Pay, Apple Pay, Visa Checkout, Masterpass | 77% 81%                   | 19% 9%                              | 9%                                       | 10% 22%                    | 41%                 | 41%                                               | 41%                         |
| payments made via cryptocurrency card (e.g. Bitcoin) / mobile app e.g. Coinbase Card | 72% 66%                   | 19% 9%                              | 12% 35%                                  | 38% 5%                     | 57%                 | 57%                                               | 57%                         |
| payments made via cryptocurrency card (e.g. Bitcoin) / e-wallet e.g. Wirex | 56% 63%                   | 18% 14%                             | 13% 13%                                  | 48% 48%                    | 31%                 | 31%                                               | 31%                         |
| payments made via cryptocurrency card (e.g. Bitcoin) / mobile app e.g. Coinbase Card | 66% 68%                   | 23% 25%                             | 22% 20%                                  | 57% 57%                    | 34%                 | 34%                                               | 34%                         |
| payments made via cryptocurrency card (e.g. Bitcoin) / e-wallet e.g. Wirex | 67% 67%                   | 20% 19%                             | 19% 21%                                  | 34% 34%                    | 31%                 | 31%                                               | 31%                         |
| payments made via cryptocurrency card (e.g. Bitcoin) / mobile app e.g. Coinbase Card | 51% 52%                   | 12% 12%                             | 8% 9%                                    | 31% 31%                    | 29%                 | 29%                                               | 29%                         |
| payments made via cryptocurrency card (e.g. Bitcoin) / e-wallet e.g. Wirex | 41% 42%                   | 11% 11%                             | 9% 10%                                   | 29% 29%                    | 27%                 | 27%                                               | 27%                         |
| payments made via cryptocurrency card (e.g. Bitcoin) / mobile app e.g. Coinbase Card | 15% 14%                   | 3% 11%                              | 23% 1%                                   | 5% 5%                      | 4%                  | 4%                                                | 4%                          |
| payments made via cryptocurrency card (e.g. Bitcoin) / e-wallet e.g. Wirex | 12% 10%                   | 4% 11%                              | 24% 1%                                   | 6% 6%                      | 5%                  | 5%                                                | 5%                          |
| payments made via cryptocurrency card (e.g. Bitcoin) / mobile app e.g. Coinbase Card | 16% 15%                   | 4% 12%                              | 22% 1%                                   | 6% 6%                      | 4%                  | 4%                                                | 4%                          |
| payments made via cryptocurrency card (e.g. Bitcoin) / e-wallet e.g. Wirex | 12% 10%                   | 4% 11%                              | 24% 1%                                   | 6% 6%                      | 5%                  | 5%                                                | 5%                          |

The level of technological trust is an important element impacting the use of technology, especially when it is associated with financial flows. The three payment methods with the highest level of technological trust in 2022 are respectively: Cash payments (50% of respondents full trust the method), payments made via m-banking (mobile app) (43%), payments made with physical credit/debit card (42%) (Table 4). The biggest drop in technological trust (above 10 percentage points) in 2022 occurred in 2 methods: Cash payments (-13 percentage points) and Payments made directly in the bank branch or in the post office (-13 percentage points). The biggest gains in technological trust (above 10 percentage points) in 2022 occurred in 3 methods: Payments made via m-banking (mobile app) (22 percentage points), payments made via e-wallet (smartphone, computer, tablet), e.g. Google Pay (16 percentage points).

Regarding the respondents' expectations about the future, 3 questions were asked about the use of digital payments in next 5 years (Table 5). Answers from pre and post COVID-19 perspective were rather similar, apart from the expectations related to more widespread use of electronic payments ensuring anonymity. The research indicated increase in 2022 of 9 percentage points, from 55% to 64%, that means that respondents believe that digital payments would allow preserving anonymity.
Table 4. Technological trust of payment methods (pre-COVID-19 and post-COVID-19 perspective)

| Payment Method                                                                 | Do not trust at all 2019 / 2022 | I trust in a very limited way 2019 / 2022 | I trust in majority 2019 / 2022 | I fully trust 2019 / 2022 | I don’t use such product 2019 / 2022 |
|--------------------------------------------------------------------------------|---------------------------------|------------------------------------------|---------------------------------|----------------------------|-------------------------------------|
| Cash payments                                                                   | 1%                              | 4%                                       | 32%                             | 63%                        | 1%                                  |
| Payments made directly in the bank branch or in the post office                  | 0%                              | 8%                                       | 39%                             | 50%                        | 3%                                  |
| Payments made via e-banking (web access)                                        | 1%                              | 6%                                       | 49%                             | 19%                        | 26%                                 |
| Payments made with physical credit/debit card                                   | 0%                              | 5%                                       | 60%                             | 34%                        | 1%                                  |
| Payments made via m-banking (mobile app). IKO PKO BP, mBank PL                   | 0%                              | 3%                                       | 54%                             | 42%                        | 1%                                  |
| Payments made via e-wallet (smartphone, computer, tablet), e.g. Google Pay, Apple Pay, Visa Checkout, Masterpass | 1%                              | 11%                                      | 53%                             | 21%                        | 14%                                 |
| Payments made via cryptocurrency card / mobile app e.g. Coinbase Card           | 0%                              | 2%                                       | 48%                             | 43%                        | 6%                                  |
| Payments made via cryptocurrency card / e-wallet e.g. Wirex                     | 1%                              | 18%                                      | 23%                             | 11%                        | 47%                                 |

Table 5. Expected changes in digital payment in the next 5 years (pre-COVID-19 and post-COVID-19 perspective)

| Expected changes in digital payments | Yes 2019 / 2022 | No 2019 / 2022 |
|-------------------------------------|-----------------|----------------|
| Would you like to completely opt out of cash payments over the next 5 years (for e-payments) | 42%             | 58%             |
| Do you think that in the next 5 years at the state level there will be a resignation from cash payments (for e-payments) | 19%             | 82%             |
| Do you think that electronic payments ensuring anonymity will become more widespread in the next 5 years? | 21%             | 79%             |

The last part of the research were questions assessing respondents’ approach to the use of privacy-intrusive technologies (Table 6). Overall, respondents did not express much support for payment history analyses. Two questions regarding the provision of food and basic goods had the greatest support: counteracting a panic purchasing (32%) and evaluating and meeting the demand for essential products (28%).

Table 6. Attitude of the respondents to implementation of restrictions related to COVID-19 for the after the epidemic period, from perspective of technology

| Should the state during a pandemic analyse the payment history of citizens (including yours)? to counteract a panic purchasing (e.g. preventing the purchase of 200 rolls of toilet paper at a time, 20 packages of toasted bread per household, etc.) | Yes | No |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|----|
| Should the state during a pandemic analyse the payment history of citizens (including yours)? to counteract a panic purchasing (e.g. preventing the purchase of 200 rolls of toilet paper at a time, 20 packages of toasted bread per household, etc.) | 32% | 68% |
to evaluate and meet the demand for essential products in each country's location  28%  78%
to hinder speculation with personal protective equipment (e.g. protective masks, antibacterial fluids, etc.)  14%  86%
to take preventive measures against virus infection due to staying in high-risk places (e.g. buying drinks at a city beach)  12%  88%
to minimize harmful behaviours during quarantine, such as abuse of stimulants (alcohol, cigarettes)  11%  89%

Also respondents were asked question “In connection with COVID-19, should the state force all citizens to make cashless payments (e.g. by setting up prepaid cards to people without a bank account so that they can top up them with cash in CDMs and be able to pay without cash). Only 7% of respondents agreed with forcing citizens to use only digital payment, 93% of respondents disagreed.

4. Conclusion

Current students are future employees, managers, who will make decisions that shape the economy and society. Analyzing their approach to technology, and digital payments in particular, gives an insight into future trends. The research carried out included cash payments, digital payments made using the banking system, e-wallet-based payments as well as blockchain-based payments. Respondents showed little interest in blockchain technology for payments. They preferred legally regulated payment methods.

The article presents a comparative analysis of the digital payments from pre and post COVID-19 perspective. In the fourth quarter of 2019 in Poland there were 10.02 million customers (26.3% of population) using financial services via mobile devices, and in first quarter of 2022 it was respectively 20.1 million customers (52.6% of population). The number of consumers using digital payments in Poland during COVID-19 has doubled. Among the respondents, the increases were much lower, but this is due to the fact that mobile payments were much more popular in this group than in the entire society. Detailed conclusions are listed out below and include answer for research questions:

• in 2022, the most frequently used payment methods were: payments made via m-banking (mobile app) (80%), payments made with physical credit/debit card (70%), payments made via e-wallet (smartphone, computer, tablet, e.g. Google Pay) (60%),
• compared to pre COVID-19, the respondents have mostly given up the use of the following payment methods to the greatest extent: cash payments, payments made via e-banking (web access), payments made with physical credit / debit card,
• compared to pre COVID-19 there has been a noticeable decline in the number of transactions made by respondents, this applies not only to cash but also to digital payments,
• for all payment methods there is an increase in the lowest ratings (very poor or not deployed / provided) for almost all characteristics compared to the pre-COVID-19 assessment,
• cash payment is lowest rated in post COVID-19 perspective (increase in lowest ratings by over 30 percentage points in 4 categories - payment speed, convenience of payment, theft protection, simplicity of expenses control),
• in the near future, we can expect that the use of cash payments will drastically decline, as well as e-banking (web access), mainly due to the low convenience of payment,
• three payment methods had over 50% of the highest ratings (in comparison to pre COVID-19): payments made with physical credit/debit card, payments made via m-banking (mobile app) and payments made via e-wallet (smartphone, computer, tablet). In near future we can expect that this methods will be most frequently used,
• despite the massive use of digital payments, respondents expect the spread of technologies ensuring anonymity in digital payments in the future,
• the biggest drop in technological trust in 2022 occurred in 2 methods: Cash payments and Payments made directly in the bank branch or in the post office. This is directly related to reducing the frequency of use of these payment methods by respondents,
• despite the frequent use of digital payments, respondents do not support forcing others to use only digital payment methods.

Study limitations:
• research is based on the respondents' declaration and not on analysis of their digital payments (due to privacy issues),
• the study only covered management students, including science and technology students could make the results more realistic.

The obtained results indicate the need to conduct in-depth research in relation to mobile payments. It is particularly important to clarify the respondent’s vision regarding the issue of ensuring privacy when using digital payments.

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