

STATE AND PROSPECTS FOR DEVELOPMENT OF THE PAYMENT CARD MARKET IN POLAND

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Abstract

Research background: The development of innovative technologies has contributed to significant changes in the market for payment instruments. These changes have become a challenge for banks and have contributed to the continuous expansion of the products they offer, more technologically advanced, which will provide the customer with a high level of security. Banks, in order to meet customer expectations, are developing and improving the most popular distribution channels for their services, which are undoubtedly payment cards.

Purpose: The aim of the paper is to define and classify non-cash payment instruments in the Polish payment card market from 2009 to 2023, as well as to assess the trends of changes that may occur in the payment card market at the end of 2024 and in 2025.

Research methodology: A study of the payment card market in Poland was carried out, and the factors determining the development of non-cash payments were presented, as well as the directions of its future changes. Development trend (trend) models were used for the study, and then used to forecast the changes that will take place in the payment card market in Poland at the end of 2024 and in 2025. The analysis was carried out using the program STATISTICA 13.3.

Results: Bank customers are increasingly carrying out transactions using electronic payment instruments, the most common form of which are payment cards. The payment card is one of the better options for obtaining funds, as evidenced by the systematic annual increase in the number of such cards issued. The COVID-19 pandemic greatly affected the increase of payment card use in Poland.

Novelty: Further advances in technology will bring new solutions to the payment card market and at the same time develop the digital money market. The COVID-19 pandemic undoubtedly accelerated the payment needs and expectations of consumers, who are more willing to use digital technologies in the new reality. Banks, in turn, see modern technological solutions as achieving a competitive advantage in the market.

Keywords: payment cards, cashless payments, electronic banking

JEL classification: G21

Introduction

Technological advances in the collection, processing, as well as transmission of information electronically have contributed to the virtualization of money and caused significant changes in the payment systems implemented through banks and other financial institutions. A major challenge for the banking sector was the outbreak of the COVID-19 pandemic, which had a significant impact on the global economy in the 21st century. The COVID-19 pandemic changed many aspects of society, which was significantly affected by legislative changes introduced in connection with the pandemic situation. Banks had to adapt to new challenges and consumer expectations in a short period of time. During the initial phase of the pandemic, interest in financial products such as cash loans, credit cards and mortgages declined among bank customers. Due to the restrictions being put in place at the time to limit the spread of the virus, more attention began to be paid to the hygiene of everyday items, including cash. Payment cards then became a safer alternative to cash, which could spread the virus. As a result, store owners began to encourage customers to make cashless payments, and in extreme cases gave up accepting cash. Card operators took advantage of this growing trend, while offering contactless payment options or even transferring the card to a cell phone. In addition, supermarket chains and drugstores, with respect to self-service checkouts, mainly accepted card or m-payments (Otto-Duszczuk, 2020; Cevik, 2020; Polasik 2020; Flögel, Gärtner, 2020; Kaźmierczak, Kotkowski, Maciejewski, 2021; Al-Najjar, Al-Rousan, Al-Najjar, Assous, Al-Najjar, 2021; Huterska, Piotrowska, Szalacha-Jarmużek, 2021; Rybacka, 2023; Korzeniowska, Rutecka-Góra, Swacha-Lech, Waliszewski, 2023).

The development of the payment card market is among the most visible trends in the area of financial innovation. Among other things, solutions are being created based on technology that combines financial functions with environmental protection. For example, Mastercard, as part of its Sustainability Innovation Lab research unit, which opened in 2021, has created a credit card with a CO₂ limit spent by the scale of emissions of purchases made with it (Bruchert, 2021; *Platności gotówkowe i bezgotówkowe – analiza stanu i perspektyw*, 2022).

Technological financial innovations are increasing the potential for further efficiency in the operation and improvement of the liquidity of all financial institutions, as well as those outside the sector. The category of non-bank FinTech entities is becoming increasingly popular, especially their dominant subcategory from the area of payments – the so-called PayTech. PayTechs provide technological solutions and services that are increasingly influencing the operation of traditional banking activities and redefining the way financial services, including payments,

are provided. PayTech initiatives that are already largely popularized in the market in Poland include: Soft POS, deferred payments, mobile payments developed by merchants (e.g. Orlen Pay, Lidl Pay, Zappka Pay), payment card-based public transportation tickets, payment card as a loyalty card (e.g. Zencard, Westfield, Visa Offers, Mastercard Priceless Moments), P2P card-to-payment transfers (email payment, phone transfer), digital wallets (e.g. Visa Checkout, Masterpass), bill payment aggregators (e.g., My Services, Rachunueo, Qlips), highway toll payments (e.g., AutoPay, Skycash), phone bill payments (on Play and Orange networks via SkyCash), and payments using biometrics. Card-based public transportation tickets are the most modern way to pay for public transportation journeys. It is the so-called open payment system (Kaźmierczak, Kotkowski, Maciejewski, 2021; Kotkowski, Polasik, 2021; *Płatności gotówkowe i bezgotówkowe – analiza stanu i perspektyw*, 2022; Korzeniowska, Rutecka-Góra, Swacha-Lech, Waliszewski, 2023).

Further development of the payment card market is fostered by modern information and telecommunications technologies, and the accelerating creation of financial innovations (especially payment innovations), affect the transformation of payment behavior and the companies that accept them (Vanetti, 2010; Vincent, Folorunso, Akinde, 2010).

The purpose of the paper is to analyze and evaluate the functioning of the payment card market in Poland and to present the main directions of changes that may occur in the payment card market at the end of 2024 and in 2025.

It was hypothesized that with the development of innovative technologies there is dynamic development in the payment card and mobile payment market in Poland. The changes caused by the pandemic have become a challenge for banks and have contributed to the continuous expansion of the products on offer, adapted to the growing, ever-changing needs of society.

1. Literature review

A payment card is an electronic payment instrument that authorizes the withdrawal of cash or the placement of a payment order to receive funds through a merchant or clearing agent. The Payment Services Law defines a “payment card as one that authorizes the withdrawal of cash or enables the placement of a payment order through a merchant or clearing agent, accepted by the merchant for the purpose of receiving funds due to the merchant.” According to EU regulations, a payment card as a payment instrument allows a payer to initiate a debit or credit card transaction (Ustawa z dnia 19 sierpnia 2011 r. o usługach płatniczych).

Payment cards are among the most modern forms of payment and come in many forms – both in the form of a plastic card in a wallet and in digital form in an electronic purse placed on a smartphone. BLIK mobile payments have become particularly convenient for online shopping (Bahar, Hobikoglu, 2015; Runnemark, Hedman, Xiao, 2016; Mansour, 2021; Thaker et al., 2021).

Payment cards can be classified based on the number of people involved in card transactions, among other things (Świecka, 2012; Grabowski, 2013):

- for bilateral – accepted through their publisher,
- tripartite – necessary for the cooperation of data of three entities: cardholder, issuer and merchant,
- four-party – the condition required for cooperation in this case are four entities: cardholder, issuer, merchant and payment company.

The roles of merchants and consumers in card payment systems remain unchanged. In the three-party model, the payment organization performs both the role of card issuer and clearing agent. In the four-party model, on the other hand, the payment organization sets the rules of the system. However, it does not itself serve either cardholders or merchants, as this is handled by card-issuing banks and clearing agents. An interchange fee, which is an internal fee, is used to properly allocate costs between the payment card issuing bank and the clearing agent. For non-cash payments, the interchange fee is usually paid by the clearing agent to the payment card issuing bank. (Rochet, Tirole 2003; Evans, Schmalensee, 2007; Rysman, 2009; Ustawa z dnia 29 sierpnia 1997 r. Prawo bankowe).

The classification of payment cards is based on various factors, and the most popular boils down to a division based on the method of settling transactions, namely into (Masiota, 2003, Kowalewska, 2014; Feruś, 2022; Golnik, 2019; Deb, Lodh, 2016; Polasik, 2020):

- debit cards,
- credit cards,
- charge cards (with deferred payment),
- prepaid cards.

Credit cards are cards in the form of pay later, which allow you to make purchases of services and goods on credit up to the limit that is granted by the banking institution. The issuance of this type of card is not necessary with an account at a particular bank. A special account is created into which funds are deposited to reduce the debt. The terms and conditions of the repayment of the loan taken out are more closely defined in the contract concluded. In Poland, the most commonly made cards are undoubtedly debit cards. Debit cards of the *pay*

now type allow non-cash transactions, as well as cash transactions up to the amount of funds in the account. If a card is issued to a customer who has an account with a bank, there is a possibility that the amount of funds held may be exceeded by the transactions performed, resulting in an overdraft on the account. Prepaid *tupu pay before*, *pre-paid* cards can also be found on the modern market. Prepaid cards are issued after a prior transaction of a certain amount, which can then be used in the form of non-cash payments. Often, after spending, the card can be reloaded with a small amount of money. Financial institutions are also increasingly beginning to make cards with a so-called deferred expiration date. *Pay later* charge cards allow the holder to make transactions without committing their own funds to the account. Unlike a credit card, a charge card is issued to an existing ROR account. At the end of the billing period, all transactions are totaled and settled every month. The limit is set for each customer individually (Grabowski, 2013).

Payment cards considering their structure can be divided into (Grabowski, 2013; Feruś, 2022):

- embossed – with the embossed data of the holder, card number, expiration date, handwritten signature of the owner,
- magnetic – with a magnetic strip with the encoded data of the holder and bank account, identification PIN,
- microprocessor cards – have built-in memory and a processor that allow a large amount of data to be stored on the card. They have a better security system for performed transactions compared to a magnetic card,
- hybrid – they contain both a magnetic stripe and a microprocessor, thanks to which it is possible to authorize transactions,
- virtual – as a rule, they do not have a physical form, while the account holder's card number, expiration date, personal information and a three-digit verification code are needed to make transactions.

On the other hand, based on geographical coverage, payment cards can be divided into (Borcuch, 2011):

- local cards (*private label cards*) – covering a city, region, or are connected to the network of a specific bank,
- domestic cards (*domestic cards*) – valid in the country that is the headquarters of a given bank, without the possibility of using them in another country,
- international cards – valid all over the world, regardless of the country of issue. Some of the most recognized international cards are: MasterCard, VISA, China UnionPay.

Payment cards can also be divided by the organization that issues them. Among the most important are (Borcuch, 2011; *System płatniczy w Polsce*, 2019):

- Visa International,
- MasterCard International
- American Express,
- JCB (Japan Credit Bureau),
- Diners Club International.
- China UnionPay.

HCE technology, which has been available in Poland for some time, has also given new solutions to the payment card market. HCE (Host Card Emulation) technology is a solution that extends the capabilities of NFC, eliminating the need for a physical security element (chip) in the device. The operation of HCE is based on a virtual computing cloud, in which a virtual card independent of the mobile network operator is stored. With HCE technology, the phone acts as a contactless card, and the user is able to make payments by bringing the mobile device close to the payment terminal. The condition for making such a payment is constant access to the Internet. The virtual HCE card is connected to the account indicated by the user. As a rule, it is linked to a debit card. Using this technology also requires installing an application of the user's bank on a smartphone. The breakthrough was the use of the HCE card by various companies in 2018 to adapt payment functions into their products. This led to the creation of card-based mobile payments in the form of, among others: Android Pay (later Google Pay), Apple Pay, Garmin Pay, Fitbit Pay. The main idea of card-based mobile payments is to make it as easy as possible to make such payments. Once the credit or debit card information is entered into the account of a particular mobile payment system, payment can be made. The payment process here boils down to authentication with a password, pin or other means of identity identification (such as biometric security) (Kotkowski et al., 2023).

2. Research methodology

In the Polish market we currently have four payment card systems: Visa, Mastercard, Diners Club International and American Express. An alternative to these systems is the BLIK payment scheme, as well as other schemes, such as SkyCash, mPay, Smoopay, YetiPay and Peopay (Bahar, Hobikoglu, 2015; Al-Najjar et al., 2021; Flögel, Gärtner, 2020). These schemes entirely handle the settlement of payments made with instruments offered by payment institutions. Modern and convenient forms of initiating payments for consumers have been

introduced mainly by the banking sector, which, in cooperation with international payment organizations, has provided the possibility of using modern solutions. Poland currently leads in terms of the spread of payment cards using NFC (near-field communication) technology used primarily in payments at POS terminals, vending machines, parking meters or highway toll gates. As a result, the share of contactless payments in the total number of cashless card transactions is significant and growing steadily.

For the analysis of the payment card market in Poland from 2009 to 2023, data made available by the NBP was used. The subject of consideration in the paper are models of the development trend (trend) and an attempt to use them to forecast the changes that will occur in the payment card market in Poland at the end of 2024 and in 2025. The most commonly used method for extracting trends is the analytical method. The development trend is expressed by a specific mathematical function, in which the explanatory variable is the level of the observed phenomenon, and the explanatory variable is the time variable. (Bhaskara, 2010; Hirschman, 2015). A trend analysis using linear regression was conducted using STATISTICA 13.3. The F-Snedecor test and the Shapiro-Wilk normality test, among others, were used to verify the validity of individual models, and the autocorrelation of residuals was assessed using the Durbin-Watson statistic.

The payment card market in Poland is growing steadily. It functions within the national payment system as part of the retail payment system. Modern information and telecommunications technologies promote the further development of the payment card market. According to data presented by the National Bank of Poland, at the end of 2023, there were 45.24 million payment cards in circulation on the Polish market, which is 0.72 million more cards compared to the end of 2022. At the same time, this represents an increase of 1.61%. Analyzing Figure 1, it can be seen that one of the components of this time series is an upward trend, as the values of the observed phenomenon are increasing from year to year. The trend graph can be described by the linear function shown in Table 1. Extrapolating, that is, extending into the future the linear trend observed in 2009–2023, one would expect the number of payment cards issued to reach 46.69 million cards by the end of 2024, and to increase to 47.75 million cards by the end of 2025 (an increase of 1.06 million cards – 2.3%). Using the R^2 coefficient of determination to assess the quality of the estimated model, we can see that the model fit the real data at 94.6%. The parametric F-Snedecor test and the Shapiro-Wilk normality test were used to test the significance of the selection of explanatory variables, and the autocorrelation of the residuals was assessed using the Durbin-Watson statistic. The residuals of the model

have a normal distribution and there is no basis for their autocorrelation, so the model has the desired properties (Table 1).

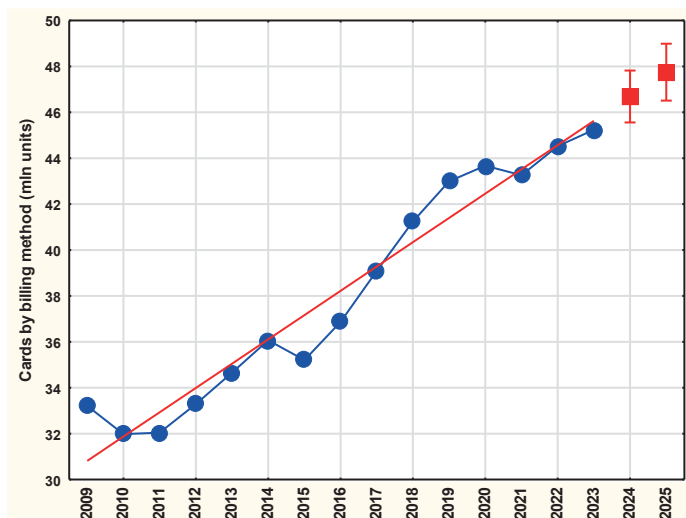


Figure 1. Number of payment cards issued from 2009 to 2023 (in million units)

Source: own compilation based on: Number of payment cards issued in 1998–2023 https://www.nbp.pl/home.aspx?f=/systemplatniczy/karty_platnicze.html.

Table 1. Forecast for 2024–2025 for the number of cards by the billing method (mln units)

Cards by billing method (mln units)		
$(R^2 = 94.6; F(1.13) = 227.52; p_F < 0.0000, d_W = 0.8931144; p_{S-W} = 0.8954; pw = 0.081)$		
Year	Forecast	Confidence interval (90%)
2024	46.69	45.56–47.82
2025	47.75	46.51–48.99

R^2 – coefficient of determination; F – test F-Snedecora, p_F – significance of the whole model (based on test F); p_{S-W} – Shapiro-Wilk normality test; pw – significance of the whole model (based on the Shapiro-Wilk test); d_W – Durbin-Watson statistic.

Source: own study.

Debit cards dominate the market in payment settlements, with a much higher market share compared to the number of credit cards. Analyzing Figure 2, it is possible to note a continuing upward trend in debit cards. At the end of 2023, a total of about 38.47 million debit cards were issued, accounting for about 85.04% of the total issued, which is 1.01 million more cards compared to the end of 2022. Customer interest in debit cards is increasing year on year.

In 2023, compared to 2009, which is the turn of the last fifteen years, the increase is as high as 75.01%. Based on Figure 2 and Table 2, it can be deduced that the linear trend passed the best verification from the classical development trend models, and thus the model's fit to real data was 95.5%. The rest of the model had a normal distribution and showed no autocorrelation. Using the linear trend from Table 2 to extrapolate into the future, we can expect the number of debit cards will increase to 39.52 million by the end of 2024, and to 40.67 million by the end of 2025 (an increase of 1.15 million cards – 2.9%).

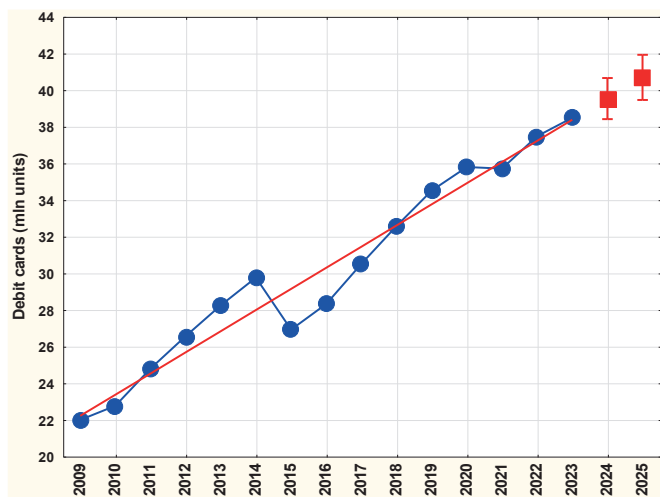


Figure 2. Number of debit cards issued from 2009 to 2023 (in million units)

Source: own compilation based on: Number of payment cards issued in 1998–2023 https://www.nbp.pl/home.aspx?f=/systemplatniczy/karty_platnicze.html.

Table 2. Forecast for 2024–2025 for the number of debit cards (mln units)

Debit cards (mln)		
Linear model ($R^2 = 95.5$; $p < 0.0000$; $F(1.13) = 274.46$, $d_W = 1.2531$; $p_{S-W} = 0.95543$; $p_W = 0.6136$)		
Year	Forecast	Confidence interval (90%)
2024	39.52	38.39–40.64
2025	40.67	39.44–41.90

R^2 – coefficient of determination; F – test F-Snedecora, p_F – significance of the whole model (based on test F); p_{S-W} – Shapiro-Wilk normality test; p_W – significance of the whole model (based on the Shapiro-Wilk test); d_W – Durbin-Watson statistic.

Source: own study.

Debit cards provide the ability to make transactions up to the balance in the bank account associated with the card. Each such transaction is subject to authorization. From the bank's point of view, a debit card is the most secure card, which allows you to control the amount of money you spend.

In second place in terms of number (about 4.91 million units – Figure 3 and Table 3) are credit cards, which accounted for about 10.85% of total payment cards at the end of 2023. The number of credit cards over fifteen years has decreased by 5.95 million units (down 54.78%).

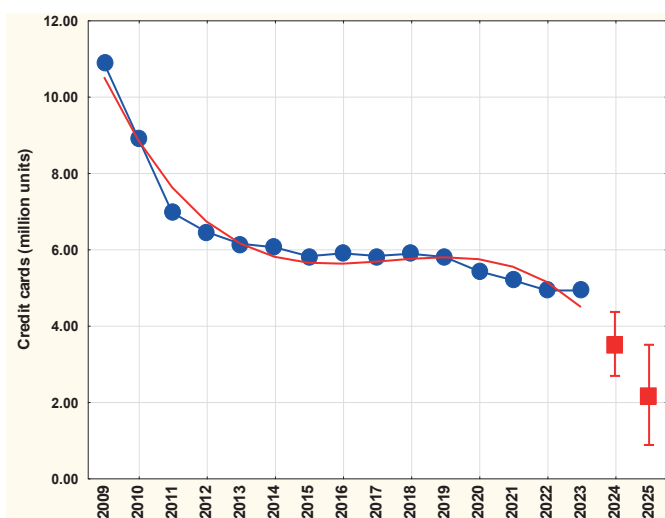


Figure 3. Number of credit cards issued from 2009 to 2023 (in million units)

Source: own compilation based on: Number of payment cards issued in 1998–2023 https://www.nbp.pl/home.aspx?f=/systemplatniczy/karty_platnicze.html.

Table 3. Forecast for 2024–2025 for the number of credit cards (mln units)

Credit cards (mln units)		
Trend in the form of a 3rd degree polynomial ($R^2 = 96.3$; $F(3,11) = 94.92$; $p_F < 0.0000$, $d_W = 1.1356$; $p_{S-W} = 0.7385$; $p_W = 0.0006$)		
Year	Forecast	Confidence interval (90%)
2024	3.51	2.67–4.35
2025	2.17	0.86–3.49

R^2 – coefficient of determination; F – test F-Snedecora, p_F – significance of the whole model (based on test F); p_{S-W} – Shapiro-Wilk normality test; p_W – significance of the whole model (based on the Shapiro-Wilk test); d_W – Durbin-Watson statistic.

Source: own study.

Based on the results presented in Figure 3 and Table 3, it can be concluded that the number of credit cards will decrease significantly from year to year during the study period. The trend in the graph is of a decreasing nature. It can be described by the cubic polynomial function presented in Table 3. Making a forecast of the decreasing trend observed in 2009–2023, it would be expected that at the end of 2024 the number of issued credit cards will be 4.12 million cards, and at the end of 2024 it will fall to 3.51 million cards (a decrease of 1.34 million cards – 38.18%). The coefficient of determination R^2 shows us that the model fits the real data at 96.3%. The tests performed, among others, the F-Snedecor, Durbin-Watson statistics and Shapiro-Wilk normality test, show that the selection of explanatory variables was correct. The residuals of the model have a normal distribution and there is no basis for their autocorrelation, so the model has the desired properties (Table 3).

The last group is made up of charge and prepaid cards, which shows that these are not popular payment market instruments in Poland. Charge cards are the least numerous category of cards (0.4% of the total number of cards).

The number of charge cards issued in Poland in 2009–2023 is shown in Figure 4. It can be seen from the chart that the share of charge cards is decreasing year by year – in 2023, 0.18 million of these cards were issued, and over the analyzed period their share was in the range of 0.40–1.12%. In 2023, it amounted to 0.40% of the total number of issued cards. The number of charge cards issued in 2023, compared to the end of 2022, decreased by 1.73%, and declined by 52.83% over a period of 15 years, confirming that customer interest in such cards is declining.

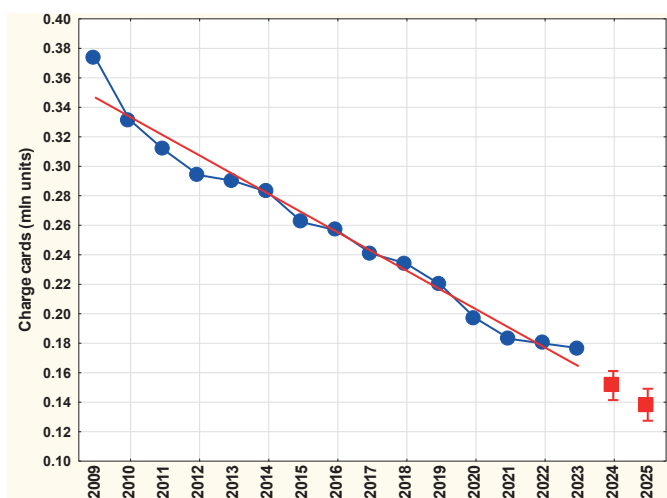


Figure 4. Number of charge cards issued from 2009 to 2023 (in million units)

Source: own compilation based on: Number of payment cards issued in 1998–2023 https://www.nbp.pl/home.aspx?f=/systemplatniczy/karty_platnicze.html.

Table 4. Forecast for 2024–2025 for the number of charge cards (mln units)

Charge cards (mln)		
Linear model ($R^2 = 97.2$; $F(1,13) = 452.38$; $p_F < 0.0000$, $d_W = 1.0893$; $p_{S-W} = 0.9593$; $p_W = 0.6799$)		
Year	Forecast	Confidence interval (90%)
2024	0.15	0.14–0.16
2025	0.14	0.13–0.15

R^2 – coefficient of determination; F – test F-Snedecora, p_F – significance of the whole model (based on test F); p_{S-W} – Shapiro-Wilk normality test; p_W – significance of the whole model (based on the Shapiro-Wilk test); d_W – Durbin-Watson statistic.

Source: own study.

Analyzing the results shown in Figure 4 and Table 4, it can be seen that over the study period, the number of charge cards, like credit cards, shows a decreasing trend, which can be described by the line function shown in Table 4. Extrapolating into the future the observed trend, one would expect the number of issued charge cards to reach 0.15 million cards at the end of 2024, and to fall to 0.14 million cards at the end of 2025 (a decrease of 0.01 million cards – 6.67%). The model estimated in this way is a 97.2% match to actual data.

Summarizing the results of the conducted research (significance tests: F-Snedecor, Durbin-Watson test, Shapiro Wilk normality test, R^2 coefficient of determination and analysis of residuals), it should be concluded that the selection of explanatory variables for the model is correct. The residuals of the model have a normal distribution and there is no basis for their autocorrelation. The model therefore has the desired characteristics (Table 4).

Data collected by banks show that in 2023, about 9.45 billion non-cash transactions were carried out through payment cards, an increase of 0.89 billion transactions (up 10.40%) compared to the end of 2022 (Figure 5). There is also an upward trend comparing 2023 to 2009, where the number of transactions carried out was 1250% higher. This indicates an increase in the propensity of customers in retail payments to use payment cards in non-cash transactions. Interpreting the results shown in Figure 5 and Table 5, it should be noted that the number of non-cash transactions is clearly increasing from year to year during the study period. The trend graph is of an increasing nature and can be described by the linear function shown in Table 5. Extrapolating the observed increasing trend from 2009 to 2023, it can be expected that at the end of 2024 the number of cashless transactions will increase to 8.98 billion transactions, and at the end of 2025 to 9.62 billion transactions (an increase of 0.64 billion transactions – 7.13%). The linear trend model in this case fits the real data at 94.3%. Based on the tests:

F-Snedecor, Shapiro-Wilk, Durbin-Watson and R^2 coefficient of determination, it should be concluded that the selection of explanatory variables for the model is correct (Table 5).

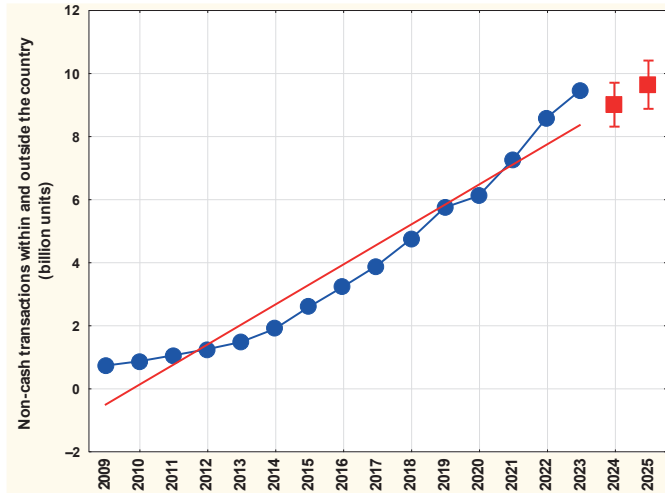


Figure 5. Number of non-cash transactions carried out from 2009 to 2023 (in million units)

Source: own compilation based on: Number of payment cards issued in 1998–2023 https://www.nbp.pl/home.aspx?f=/systemplatniczy/karty_platnicze.html.

Table 5. Forecast for 2024–2025 for the number of non-cash transactions within and outside the country (billion units)

Non-cash transactions within and outside the country (billion units)		
Linear model ($R^2 = 94.3$; $F(1.13) = 214.77$; $p_F < 0.0000$, $d_W = 0.27956$; $p_{S-W} = 0.903693$; $p_W = 0.108389$)		
Year	Forecast	Confidence interval (90%)
2024	8.98	8.28–9.68
2025	9.62	8.85–10.38

R^2 – coefficient of determination; F – test F-Snedecora, p_F – significance of the whole model (based on test F); p_{S-W} – Shapiro-Wilk normality test; p_W – significance of the whole model (based on the Shapiro-Wilk test); d_W – Durbin-Watson statistic.

Source: own study.

On the other hand, the value of non-cash transactions carried out with payment cards amounted to 688,174.89 million PLN in 2023. Compared to the end of 2022, there was an increase of 78,886.29 million PLN, or 12.95%, and compared to the end of 2021, the value of transactions increased by 195,279.85 million PLN, or 39.62% (Figure 6).

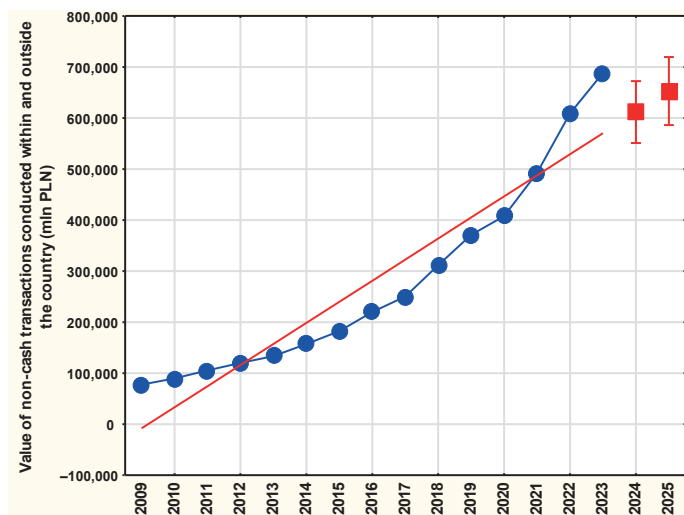


Figure 6. Value of non-cash transactions carried out in 2009–2023 (in million PLN)

Source: own compilation based on: Value of payment cards issued in 1998–2023 https://www.nbp.pl/home.aspx?f=/systemplatniczy/karty_platnicze.html.

Analyzing the value of non-cash transactions carried out, it can be seen that the linear trend passed the best verification from the classical models of development trend and thus the model's fit to real data was 90.2%. Based on the significance tests performed: F-Snedecor, Durbin-Watson statistics, Shapiro-Wilk and the coefficient of determination R^2 , as well as the analysis of residuals, it can be concluded that the selection of explanatory variables for the model is correct. Using the trend from Table 6 to extrapolate into the future, it can be expected that by the end of 2024 the value of non-cash transactions carried out will be 611,652.19 million PLN, and by the end of 2025 to 652,971.76 million PLN (see Figure 6 and Table 6).

Table 6. Forecast for 2024–2025 for the value of non-cash transactions conducted within and outside the country (mln PLN)

Value of non-cash transactions within and outside the country (mln PLN)		
Linear model ($R^2 = 90.2$; $F(1.13) = 120.04$; $p_F < 0.0000$, $d_W = 0.259357$; $p_{S-W} = 0.887355$; $p_W = 0.061166$)		
Year	Forecast	Confidence interval (90%)
2024	611,652.19	550,928.67–672,375.70
2025	652,971.76	586,296.20–719,647.32

R^2 – coefficient of determination; F – test F-Snedecora, p_F – significance of the whole model (based on test F); p_{S-W} – Shapiro-Wilk normality test; p_W – significance of the whole model (based on the Shapiro-Wilk test); d_W – Durbin-Watson statistic.

Source: own study.

The second source of information on transactions carried out with payment cards are clearing agents operating on the Polish market, who record transactions carried out at commercial and service points accepting electronic payment instruments in the country by Polish and foreign customers. These are mainly non-cash transactions carried out at POS terminals or via the Internet, as well as cash transactions in the form of store withdrawals.

NBP data obtained from clearing agents show that nearly 2,328.13 million payment card transactions were registered in 2023 (157.65 million more compared to year-end 2022 – an increase of 7.26%, and 454.39 million more transactions compared to the end of 2021 – an increase of 24.25%) (Figure 7).

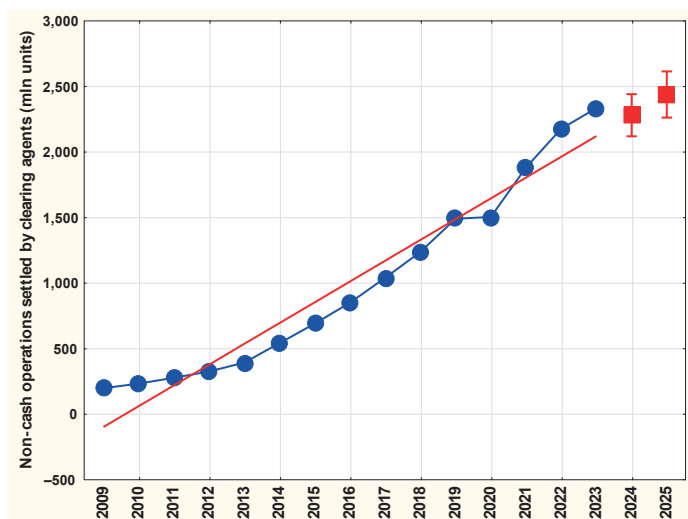


Figure 7. Number of non-cash transactions cleared by clearing agents from 2009 to 2023 (in million units)

Source: own compilation based on: Payment cards (data by clearing agents) in 1998–2023 https://www.nbp.pl/home.aspx?f=/systemplatniczy/karty_platnicze.html.

Analyzing the number of non-cash transactions cleared by clearing agents, one can see that one of the components of this time series is a linear trend (see Figure 7 and Table 7). Making a forecast based on this model, it would be expected that at the end of 2024 the number of cashless transactions will be 2,272.97 million, and at the end of 2025 it will increase to 2,431.50 million (an increase of 158.53 million – 6.97%). Using the coefficient of determination R^2 to evaluate the quality of the estimated model, we can see that the model fits the real data in 95.1%. Based on the study, we can conclude that the model has the desired characteristics.

Table 7. Forecast for 2024–2025 for number of non-cash operations settled by clearing agents (mln units)

Non-cash operations settled by clearing agents (mln)		
Linear model ($R^2 = 95.1$; $F(1,13) = 252.07$; $p_F < 0.0000$, $d_W = 0.4058$; $p_{S-W} = 0.9063$; $p_W = 0.1186$)		
Year	Forecast	Confidence interval (90%)
2024	2,272.97	2,112.19–2,433.74
2025	2,431.50	2,254.96–2,608.03

R^2 – coefficient of determination; F – test F-Snedecora, p_F – significance of the whole model (based on test F); p_{S-W} – Shapiro-Wilk normality test; p_W – significance of the whole model (based on the Shapiro-Wilk test); d_W – Durbin-Watson statistic.

Source: own study.

According to data from clearing agents, the value of non-cash transactions in 2023 amounted to 165,182.31 million PLN, an increase of 38,626.72 million PLN, or 6.9%, compared to the end of 2022, and an increase of 38,626.72 million PLN, or 30.52%, compared to the end of 2021 (Figure 8 and Table 8).

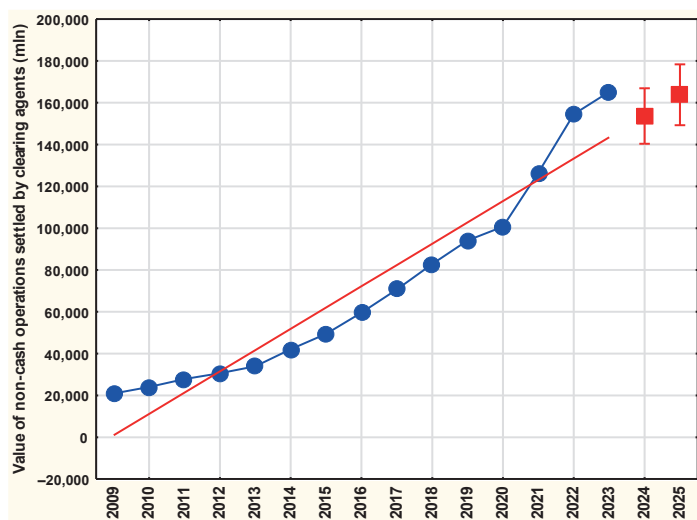


Figure 8. Value of non-cash transactions settled by clearing agents from 2009 to 2023 (in million PLN)

Source: own compilation based on: Payment cards (data by clearing agents) in 1998–2023 https://www.nbp.pl/home.aspx?f=/systemplatniczy/karty_platnicze.html.

Table 8. Forecast for 2024–2025 for the value of non-cash operations settled by clearing agents (mln)

Value of non-cash operations settled by clearing agents (mln)		
Linear model ($R^2 = 92.2$; $F(1.13) = 152.74$; $p_F < 0.0000$, $d_W = 0.3180$; $p_{S-W} = 0.8954$; $p_W = 0.081$)		
Year	Forecast	Confidence interval (90%)
2024	153,638.41	140,377.99–166,898.83
2025	163,816.36	149,256.17–178,376.55

R^2 – coefficient of determination; F – test F-Snedecora, p_F – significance of the whole model (based on test F); p_{S-W} – Shapiro-Wilk normality test; p_W – significance of the whole model (based on the Shapiro-Wilk test); d_W – Durbin-Watson statistic.

Source: own study.

Based on Figure 8 and Table 8, it can be deduced that the value of cleared non-cash transactions will increase from year to year during the study period. The trend graph is upward and can be described by a linear function. Using the linear trend to extrapolate into the future, one can expect the value of cleared transactions to increase to 153,638.41 million by the end of 2024, and to 163,816.36 million by the end of 2025 (an increase of 10,177.95 million – 6.62%). The linear model in this case fits the real data in 92.2%, and the selection of explanatory variables for the model can be considered correct.

In the domestic card acceptance market, the number of transactions carried out at POS payment terminals is also steadily increasing. According to data provided by clearing agents, in 2023, the number of transactions carried out at terminals in Poland amounted to 2,248.54 million (compared to the end of 2022, there were 137.43 million fewer transactions (6.5%), and compared to the end of 2021, there were 429.05 million more transactions (23.58%) (Figure 9).

Analyzing the number of transactions carried out at POS payment terminals, it should be noted that during the study period the number of transactions will clearly increase year by year (see Figure 9 and Table 9). The trend graph is of an increasing nature, which can be described by a linear function. Making a prediction of the increasing trend observed in 2009–2023, it would be expected that at the end of 2024 the number of transactions carried out at POS terminals will be 2,205.6 million, and at the end of 2025 it will increase to 2,358.75 million (an increase of 153.15 million transactions – 6.94%). The coefficient of determination R^2 shows us that the model fits the real data in 95.2% (Table 9). The model has a normal distribution and shows no autocorrelation.

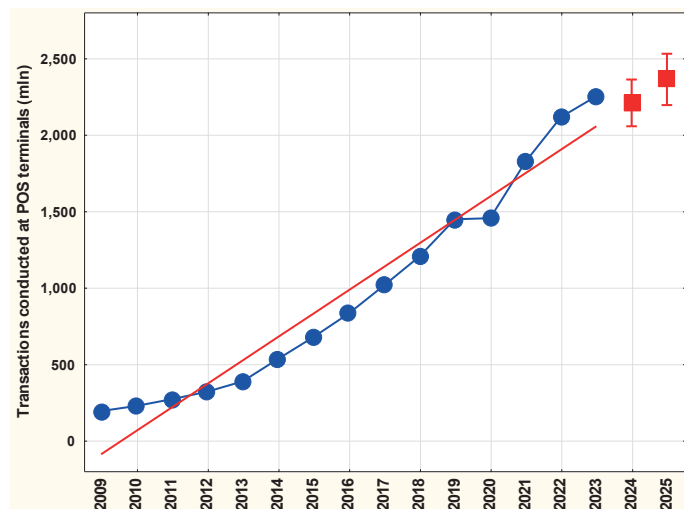


Figure 9. Number of transactions carried out at POS payment terminals from 2009 to 2023 (in million units)

Source: own compilation based on: Payment cards (data by clearing agents) in 1998–2023 https://www.nbp.pl/home.aspx?f=/systemplatniczy/karty_platnicze.html.

Table 9. Forecast for 2024–2025 for the number of transactions conducted at POS terminals (mln)

Transactions conducted at POS terminals (mln units)		
Linear model ($R^2 = 95.2$; $F(1.13) = 260.10$; $p_F < 0.0000$, $d_W = 0.4334$; $p_{S-W} = 0.9071$; $p_W = 0.1224$)		
Year	Forecast	Confidence interval (90%)
2024	2,205.60	2,052.70–2,358.50
2025	2,358.75	2,190.86–2,526.64

R^2 – coefficient of determination; F – test F-Snedecora, p_F – significance of the whole model (based on test F); p_{S-W} – Shapiro-Wilk normality test; p_W – significance of the whole model (based on the Shapiro-Wilk test); d_W – Durbin-Watson statistic.

Source: own study.

In Q1 2023, 50.3 million transactions were made with payment cards online (Figure 10), down 3.6 million from the end of 2022. The share of online transactions in the total number of non-cash payments was 2.43%.

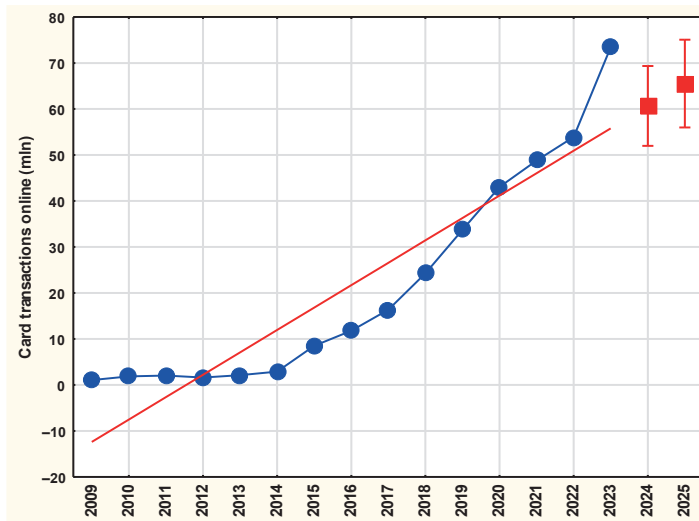


Figure 10: Number of online payment card transactions carried out from 2009 to 2023 (in million units)

Source: own compilation based on: Payment cards (data by clearing agents) in 1998–2023 https://www.nbp.pl/home.aspx?f=/systemplatniczy/karty_platnicze.html.

Table 10. Forecast for 2024–2025 for the number of card transactions online (mln)

Card transactions online (mln units)		
Linear model ($R^2 = 86.3$; $F(1.13) = 81.59$; $p_F < 0.0000$, $d_W = 0.3499$; $p_{S-W} = 0.8408$; $p_W = 0.0129$)		
Year	Forecast	Confidence interval (90%)
2024	60.66	51.98–69.35
2025	65.53	56.00–75.07

R^2 – coefficient of determination; F – test F-Snedecora, p_F – significance of the whole model (based on test F); p_{S-W} – Shapiro-Wilk normality test; p_W – significance of the whole model (based on the Shapiro-Wilk test); d_W – Durbin-Watson statistic.

Source: own study.

From an analysis of Figure 10 and Table 10, it can be concluded that the linear trend passed the best verification from the classical development trend models, and thus the model's fit to the real data was 86.3%. The rest of the model had a normal distribution and showed no autocorrelation. Using the trend from Table 10 to extrapolate into the future, it can be expected that at the end of 2024 the number of online payment card transactions carried out will increase to 60.66 million, and at the end of 2025 to 65.53 million (an increase of 4.87 million – 8%).

A payment card user, in parallel with making a non-cash transaction (of any value), can also request an additional transaction in the form of a cash withdrawal. The cash back (store withdrawal) service allows cardholders to withdraw cash when paying for purchases at a retail establishment. At the end of 2023, cash back was offered to its customers by some 274 thousand retail outlets (stores and supermarkets, gas stations, hotels, newspaper stores and other retail and service outlets). According to data from clearing agents, the number of store withdrawals in 2023 amounted to 6.17 million, 0.72 million more than from a year earlier (up 13.27%) (Figure 11).

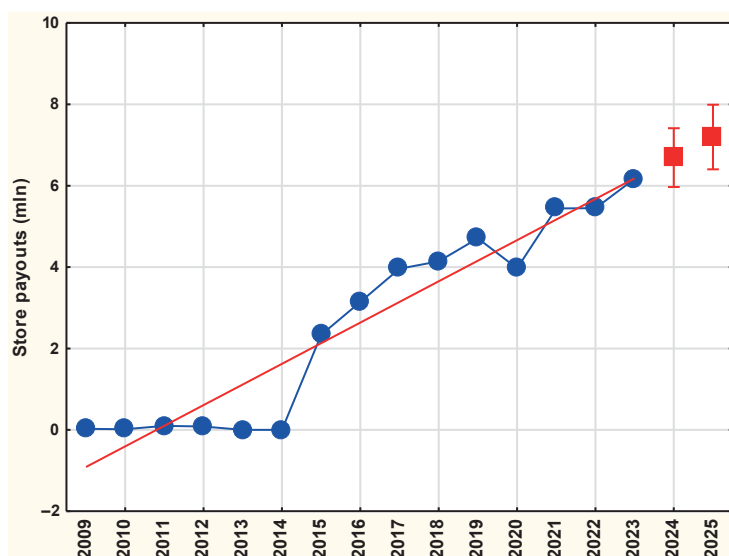


Figure 11. Number of store withdrawals from 2009 to 2023 (in million units)

Source: own compilation based on: Payment cards (data by clearing agents) in 1998–2023 https://www.nbp.pl/home.aspx?f=/systemplatniczy/karty_platnicze.html.

Table 11. Forecast for 2023–2024 for the number of store payouts (mln units)

Store payouts (mln units)		
Linear model ($R^2 = 90.7$; $F(1.13) = 127.43$; $p_F < 0.0000$, $d_W = 1.0554$; $p_{S-W} = 0.8428$; $p_W = 0.0137$)		
Year	Forecast	Confidence interval (90%)
2024	6.69	5.97–7.41
2025	7.20	6.40–7.99

R^2 – coefficient of determination; F – test F-Snedecora, p_F – significance of the whole model (based on test F); p_{S-W} – Shapiro-Wilk normality test; p_W – significance of the whole model (based on the Shapiro-Wilk test); d_W – Durbin-Watson statistic.

Source: own study.

Based on Figure 11 and Table 11, it should be concluded that the number of store disbursements will clearly increase from year to year during the study period. The graph of the increasing trend can be described by a linear function. Making a prediction of the increasing trend observed in 2009–2023, it would be expected that at the end of 2024 the number of store withdrawals will be 6.69 million, and at the end of 2024 it will increase to 7.20 million (an increase of 0.51 million – 7.62%). The coefficient of determination R^2 shows us that the model fits the real data in 90.7%. Thanks to the tests performed: F-Snedecor, Shapiro-Wilk and Durbin-Watson, we can conclude that the selection of explanatory variables for the model is correct.

Conclusions

Non-cash card payments play a very important role in both the Polish and global markets for banking services. The use of modern technologies, both IT and telecommunications, is constantly increasing from year to year. It is to be expected that banks will further develop and improve the most popular distribution channels for their services, which are undoubtedly payment cards.

Based on the analysis of payment cards in Poland, it can be concluded that the payment card is one of the better options for obtaining cash.

Over the past few years, payment cards have become one of the most popular payment instruments in Poland. The number of payment cards issued is growing dynamically. At the end of 2022 there were 44.52 million payment cards in Poland, and at the end of the 2023 their number increased to 45.24 million. According to the forecast carried out, it can be expected that the number of payment cards at the end of 2024 will increase to 46.69 million cards, and at the end of 2025 to 47.75 million. Among all payment cards issued in Poland, debit cards are the most widespread. At the end of 2023, they accounted for 85.04% of all payment cards issued – 38.47 million. Based on the research, it would be expected that the number of debit cards will increase to 39.52 million by the end of 2024, and increase to 40.67 million by the end of 2025. Between 2009 and 2023, the number of payment cards issued increased from 33.21 million to 45.24 million, i.e. by almost 36.22%. During the same period, the value of non-cash transactions increased from 0.7 billion to 9.45 billion million transactions.

Technological development facilitates the implementation of cashless transactions, but also influences increased competition among entities that operate in the payment market. Competition, on the one hand, will contribute to the faster creation of financial

innovations, especially payment innovations, and, on the other hand, will influence the transformation of payment behavior and the companies that accept them. Accordingly, competition in the market of payment service providers should be supported to a greater extent by adequate regulatory policies. A properly functioning payment system requires, among other things, development initiatives for the creation of an independent payment card system within the EU, which will promote the further development of the payment card market in Poland (*Platności gotówkowe i bezgotówkowe – analiza stanu i perspektyw*, 2022).

The development of the payment card market in Poland, seems to be an inevitable process. The displacement of cash circulation by cashless circulation is one of the symptoms of the modernity of the country's financial system. The evolution of retail payment systems is a response to IT advances and an increase in public awareness and acceptance of modern tools.

It is worth mentioning that in March 2024, one of Poland's largest banks PKO BP began the process of eliminating plastic payment cards, offering its customers the possibility of using digital credit. Soon, the bank also intends to introduce digital debit cards, and in the next stage it envisions reducing the importance of physical cards in favor of using digital payment cards, which can be added to digital wallets such as Apple Pay, Google Pay, Garmin Pay, SwatchPAY! or Xiaomi Pay without any obstacles.

Experts predict that the future of payments will primarily involve “invisible payments,” where the payment process will automate and become invisible to the user. This process will entail security challenges, where tokenization and strong authentication will be key. Likewise, the development of artificial intelligence and machine learning will have a significant impact on the way payments are made, making them more secure and convenient (<https://www.bankier.pl/smart/jak-platnosci-hce-zmienily-sposob-placenia>).

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