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Development Trends in the Global Payment Card Market

The paper examines market structure and performance of international and domestic payment systems in the context of consumer and geographic segments, and identifies their key strategic growth areas. The research explores the role of state regulators in the payment card industry development and gives a forecast for its basic parameters for the future years. The author pays special attention to the quantitative analysis of the global payment card market's payment infrastructure. The article quantifies, by means of correlation and regression analysis, influence of self-service terminal network development on the volumes of bank card payments in different regions of the world. The author suggests using the proposed regression model to predict various parameters of the payment card market.

JEL classification: G15

Keywords: payment infrastructure; non-cash payment industry; payment cards; correlation analysis; regression analysis; correlation coefficients.

Introduction

At the present stage of global economic development payment card industry is rapidly gaining traction in most countries of the world. This trend is due to the properties of a plastic card as a payment instrument that is currently the most effective and secure for making non-cash payments in the retail trade in goods and services. According to the Committee on Payments and Market Infrastructures of the Bank for International Settlements, card transactions account for an average of 47.7% of total non-cash payments[1]. Plastic cards are the most popular means of payment after cash. Therefore, the significance of payment card industry for the modern world economy cannot be overestimated, and analysis of this industry's development parameters will be highly relevant.

The objective of this study is to review the main trends in the global payment card market and to extrapolate these into the near future. This implies fullfilling the following tasks:

- to analyze the main trends in the payment card industry;
- to identify the key factors affecting the state of the payment card market;
- to study the market operators' development strategies;
- to predict changes to occur in the market in different regions of the world in the immediate future;
- to perform a quantitative analysis of the market's payment infrastructure parameters and of their correlation with the volume of bank card payments.

In the course of the study, the author consulted various sources of market-related quantitative data that can be divided into the following categories:

[1] Committee on Payments and Market Infrastructures. Statistics on payment, clearing and settlement systems in the CPMI countries. Figures for 2016 (Preliminary release). Available at: https://www.bis.org/cpmi/publ/d135.pdf.

- publicly available analytical reports of the card payment systems;
- official statistics published by central banks of different countries and by international organisations, in particular, the Committee for Payments and Market Infrastructures of the Bank for International Settlements (BIS);
- papers in professional journals (in both hard and soft copy);
- marketing research reports by specialist companies.

While conducting research the author relied on fundamental works by Russian (I. A. Aidrus [1], I. Goldovskiy [3], I. V. Kashtanov [5] and others) and foreign (M. Armstrong [12], D. Evans, R. Schmalensee [13] and others) scientists and practitioners. The results of the practical study into the evolution of the payment card industry can be found in the papers by Russian authors I. V. Kashtanov [5], S. V. Krivoruchko [7] and others. A detailed study of the methodological and technological development of the card industry can be found in the works of foreign scholars with the most significant results presented by R.-M. Gelpi [14] and L. Mandell [15].

The academic and informational novelty of the paper consists in identifying the basic trends and specific features of the global payment card market development as well as in predicting, by means of economic and statistical analysis, the major trends in the industry for the coming years.

Given the considerable dynamism of the industry and constant emergence of new factors that determine its operation (including those related to consumer, technology, economy, etc.), special attention is paid to the data for the last year.

Analysis of the current state and prediction of the main development trends in the payment card industry

As per the Nilson Report, payment cards in circulation worldwide totaled 15.8 billion at year-end 2016, up 9.9% over 2015[1]. These included:

- general purpose payment cards of International Payment Systems (IPSs): MasterCard, Visa, American Express, Diners Club, JCB, and UnionPay;
- general purpose payment cards of domestic payment systems (Elo, RuPay, Discover, BC, Interac, Star, Bancontact, BCA, BankAxept, PostFinance, girocard, Verve, CuentaRUT, etc.);
- private label prepaid, credit, and debit payment cards.

The IPSs' general purpose payment cards accounted for a 56.11% share while the general purpose payment cards issued by domestic payment systems and private label payment cards reached 4.58% and 39.31% respectively.

According to the report, as of the end of 2016 there were 8.33 billion debit, credit, and prepaid IPS cards in circulation globally (an increase of 13.3% or 975 million units year-on-year)[2]. IPSs' market shares in 2016 are shown in Fig. 1.

Chinese UnionPay became the top card issuer (680 million units, a 19.2% growth over the year) followed by MasterCard (150 million units, up 13.3%) and Visa (136.1 million units, a 5.4% increase). The next two, American Express (4.8 million, up 4.7%) and JCB (4.2 million units, up 5.2%), were far behind the market leaders with Diners Club being the only payment system to show a negative growth rate (–0.1 million units, down 1.8%).

The product-wise analysis of the IPSs' supply structure demonstrates the debit card domination on the market (73.2% in 2016 versus 71.31% in 2015). It should be noted that the cards of this type are only issued by MasterCard, Visa, and UnionPay. MasterCard debit cards comprise 42.15% of its range while those of Visa and UnionPay are reported to amount to 65.74% and 90.72% respectively. On the whole, the debit card market grew by 853.1 million units during 2015–2016, the credit card market increased by 121.9 million units by comparison.

[1] The Nilson Report, 2017, issue 1052 (Nov.).
[2] The Nilson Report, 2017, issue 1037 (Mar.).

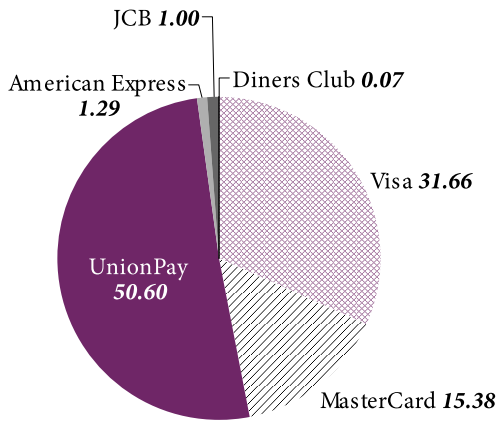

Fig. 1. IPSs' general purpose payment cards market shares in 2016, %[1]

In 2017 the payment card market was expected to experience a rise by 42.4% to 20.56 billion units (Fig. 2).

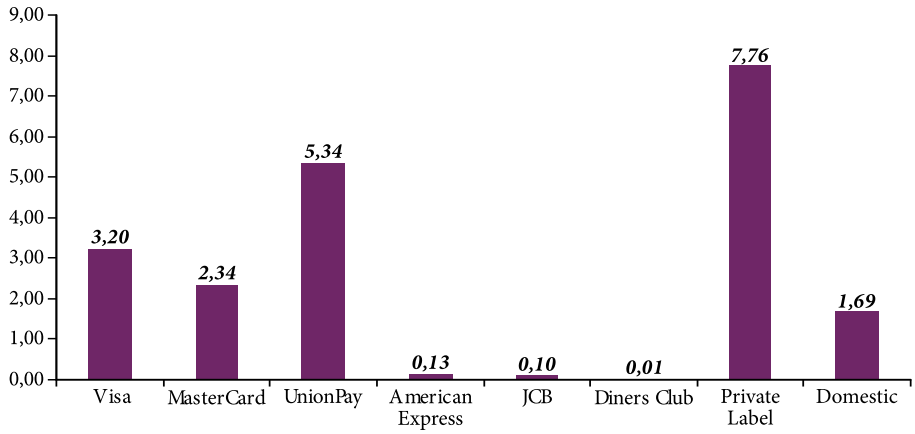

Fig. 2. Anticipated structure of the global payment card market in 2017, %[2]

The retail payment card segment was predicted to grow considerably mainly due to the increasing demand for the prepaid payment instruments among those consumers who seek to minimize their interaction with the banks. In recent past, prepaid cards were issued in relatively small quantities exclusively by merchants. Today such cards can also be put into circulation by licensed banking and non-bank financial institutions, government agencies, and associated IPS players. It is worth noting that prepaid card products often fill those market niches where the benefit and convenience of using other products are minimal.

In the US, for instance, state and local governments are actively introducing IPS prepaid cards as a benefit payment instrument. This saves considerable public funds as the costs of check handling are eliminated. The same approach was adopted in Brazil, Colombia, and the Dominican Republic. Prepaid cards have become popular among foreign workers in the Middle Eastern countries (Saudi Arabia, the United Arab Emirates, etc.) who use them to transfer

[1] The Nilson Report, 2017, issue 1037 (Mar.).
[2] The Nilson Report, 2016, issue 1029 (Nov.).

money to their families abroad[1]. Various IPSs report that the global market for prepaid cards has a significant potential for further growth.

The most popular self-service terminals include ATMs, payment terminals, imprinters, POS terminals and remote access terminals. Visa and MasterCard are the global market leaders by the number of terminals (Fig. 3). The number of operating self-service terminals per employable citizen is the highest in North America and Western Europe (these regions combined account for 67% of the world's card payments and 24% of the total amount of issued payment cards)[2].

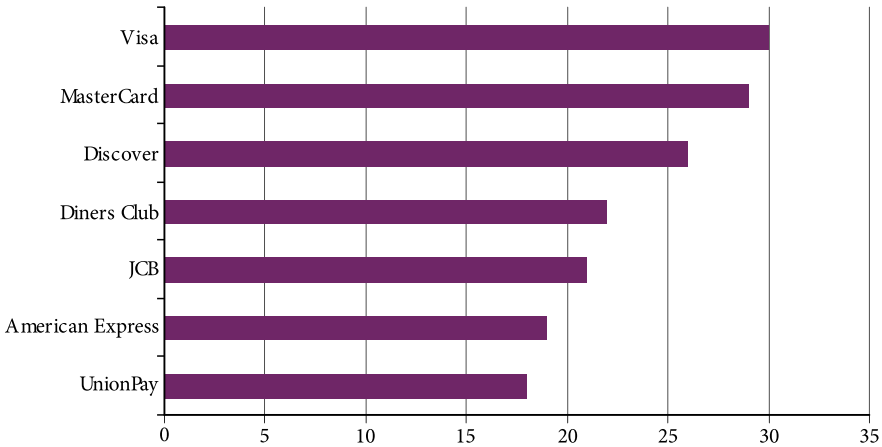

Fig. 3. Self-service terminals by payment systems in 2016, million units[3]

Agreements signed with the market-leading IPSs and a number of large acquirers allowed the Discover payment system to take the lead in the Asia-Pacific region and come third globally in terms of the size of user infrastructure. Agreements with other payment systems include, among other things, contracts with Diners Club on accepting its cards in all states where Discover cards are accepted. However, these agreements have no effect in China where contracts with the UnionPay payment system apply only to Discover cards.

Fig. 4 shows the cash withdrawal transactions conducted through ATMs globally in 2009–2016, and the author's forecast up to 2021.

The estimates on the number of cash withdrawals through ATMs are based on the linear approximation method. Forecasting and calculation of trend line equation parameters were performed in the MS Excel application environment. The trend line and the equation are given in Fig. 4. Let us put numerical values in the obtained trend equation (Table 1).

Table 1 illustrates a steady rise in the number of cash withdrawals through ATMs expected globally in the following five years (annual growth rate 5–9%). However, it is worthwhile to mention that the forecast should be treated as academic and approximate for it is difficult to predict changes in a number of factors that could affect the amount of cash withdrawals through ATMs in the nearest future. For example, adoption of legal and administrative measures limiting cash withdrawal through ATMs can have a significant impact on this indicator. In addition, there is a worldwide trend towards reducing the amount of cash payments.

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[1] UnionPay becomes the largest payment system in the world. Available at: http://www.plusworld.ru/ (in Russ.)

[2] Mirovoy rynok platezhnykh kart 2010–2016 gg. [RBR: global market of payment cards in 2010–2016]. *PLAS: informatsionno-analiticheskiy zhurnal – PLUS journal,* 2017, no. 10, p. 109. (in Russ.)

[3] Retail Banking Research. Global Payment Cards – Market Data and Forecast. *Banking Automation Bulletin*, 2017, issue 327 (August).

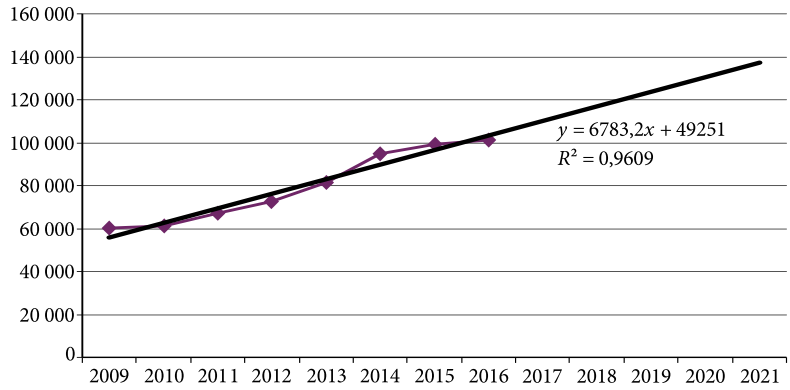

Fig. 4. Cash withdrawal transactions conducted through ATMs globally in 2009–2021, million transactions[1]

Table 1

Forecast of cash withdrawals through ATMs globally

Year	Period number	Number of transactions, million	Growth rate, %
2009	1	60,231	n/a
2010	2	61,039	1.3
2011	3	67,345	10.3
2012	4	72,551	7.7
2013	5	81,660	12.6
2014	6	94,986	16.3
2015	7	99,087	4.3
2016	8	101,305	2.2
2017	9	110,300	8.9
2018	10	117,083	6.1
2019	11	123,866	5.8
2020	12	130,649	5.5
2021	13	137,433	5.2

Differentiation of markets by the degree of saturation with self-service terminals in different countries and macroregions is expected to decrease in the process of developing the payment card infrastructure and increasing the level of awareness among the population concerning the benefits of their use. It is important to note that in most developed countries international payment cards are serviced by almost all merchants that accept card payments with the exception of several countries limiting Visa and MasterCard operations. For example, in Iran these IPS cards are accepted only by a number of specialized tourist shops due to the economic sanctions imposed by the United States. In China, as a result of the government's efforts to support the UnionPay system, the number of outlets accepting Visa and MasterCard does not exceed 30% of the total.

Quantitative analysis of the market's payment infrastructure parameters

The scientific literature review of the works on interrelation between the volume of card payments and development of the user device network (ATMs, POS-terminals, etc.) showed no recently issued papers applying econometric methods to estimate such dependency which

[1] *Note.* Compiled using the data from the Global automated teller machines report. Moscow: RBR, 2017. (In Russ.).

motivated the author to pay special attention to this subject and carry out a proper evaluation. For the assessment the author used the methods of correlation and regression analysis with Excel spreadsheets as a calculation tool. General approaches to and methods of economic calculations in Excel are described in great detail by O. N. Salmanov [10] and V. R. Baraz [2], and other scholars. Fundamental problems of correlation and regression analysis are addressed by C. R. Rao [9] who covers the period from the late 19th century to the 1970*s* to consider issues of mathematical statistics. One of the most interesting lately published books on the topic by N. R. Draper and H. Smith [4] describes the methods for forming and analysing both linear and nonlinear regression models of diverse complexity, and studies the aspects of their practical application including the use of specialized software.

To assess the influence of quantitative parameters of self-service terminal network development on the volumes of payments by bank cards issued in different regions of the world (North America, Europe, and Asia-Pacific) the author performed a number of tasks:

- estimated the degree of dependence between the indicators by conducting correlation analysis;
- identified the most significant factors of payment infrastructure and determined the nature of their impact on the volume of card payments (to provide a data set for the next stage of the study);
- built a regression model through regression analysis to formalize the dependence between the given factors and help derive a functional relationship between a specific feature and the factors affecting it.

Throughout the paper regression analysis is considered as finding and exploring the properties of a function constructed as a result of approximating the empirical values by theoretical ones [8]. Correlation analysis is treated as a set of statistics (functions of a sample) necessary to determine the dependence structure between variables [6]. Correlation-regression analysis is classified as a method for finding the parameters of a linear function when the dependence structure between variables is unknown [11].

Yearly values of variables in 2014–2016 served as raw data. The sample included data on the volume of card payments made during the three years in question as well as on the status and development of payment infrastructure in North America, Europe, and the Asia-Pacific region (retrieved from the bulletin[1]). 265 observations were carried out on four factors for each year under study.

The initial stage implied performing a correlation analysis to measure the degree of dependence between variables. A pair correlation coefficient resulting from observation data of two variables enabled measuring the degree of statistical dependence between them with the influence of other factors neutralized. The fact of correlation dependence was established by estimating probable dependence between a single measured value in a given range of its variation and other measured values.

The next step required a test of correlation existence between the studied sets of numerical data which drew on computation of correlation coefficients and their statistical verification. To determine possible regressors the author compiled a correlation matrix based on these indicators demonstrating the dependence between the factors and the number and volume of payments.

A correlation analysis revealed a linear dependence between the investigated variables which is confirmed by high values of calculated correlation coefficients (Table 2). Statistical assessment performed using the Chaddock scale criteria demonstrated a very strong dependence between the volume of card payments and the level of self-service terminal network development.

[1] Retail Banking Research. Global Payment Cards – Market Data and Forecast. *Banking Automation Bulletin*, 2017, issue 327 (August).

Table 2

Dependence between the assessed indicators and Y_{vol}

Indicator	Coefficient of pair correlation			Degree of dependence on the Chaddock scale
	01.01.2015	01.01.2016	01.01.2017	
X_1	0.947	0.973	0.994	Very strong
X_2	0.923	0.943	0.947	As above
X_3	0.955	0.966	0.991	>>
X_4	0.986	0.975	0.991	>>

The results of the correlation analysis of the variables under study enable the application of all the considered indicators of self-service terminal network development as variables in a regression model. The calculations for the regression model were done in MS Excel.

Consider the regression of the Y_{vol} multiplier. In 2014–2016 a significant linear dependence is observed between the Y_{vol} multiplier and all four parameters. Multiple regression estimation determined the dependence coefficients with significant *t*-statistics (coefficient of determination is 0.99). The value of coefficient of multiple correlation *R* indicates quite a strong dependence.

The results of the analysis are summarized in Table 3.

Table 3

Results of correlation-regression analysis of Y_{vol}

Regression statistics	
Multiple *R*	0.9969
R Square	0.9939
Number of observations	265

	Analysis of variance				Significance ***F***
	df	***SS***	***MS***	***F***	
Regression	4	*2.70593E* + 12	6.7649*E* + 12	10417.277	1.0492*E* – 285
Residual	260	1.6820*E* + 10	649382883		
Total	264	*2.72275E* + 12			

	Coefficients	Standard error	***t*-statistic**	***P*-value**
Y-intercept	–251.9092	1640.7087	–0.1536	0.8782
X_1	20.3984	0.5907	34.5379	0
X_2	–35.5622	0.8632	–41.204	0
X_3	11.1734	0.4158	26.878	0
X_4	–3.198	0.4090	–7.8188	0

Tables 2–3 employ the following indicators:

Y_{vol} – the volume of payments made by bank cards issued in a region, million US dollars;

X_1 – the number of bank cards, thousand units;

X_2 – the number of ATMs located in a region, thousand units;

X_3 – the number of electronic terminals operating in a region, thousand units;

X_4 – the number of imprinters operating in a region, thousand units;

R – the coefficient of multiple correlation;

R^2 – the coefficient of determination;

df – degrees of freedom;

SS – the sum of squares;

MS – the mean square;

F – the overall *F*-test for the null hypothesis;

t-statistic – the ratio of the departure of the estimated value of a parameter from its hypothesized value to its standard error;

P-value – the probability value.

For the abovementioned period the following regression equation (prediction equation) is derived:

$$Y_{vol} = -251.9092 + 20.3984 X_1 - 35.5622 X_2 + 11.1734 X_3 - 3.198 X_4,$$

where Y_{vol} is the volume of payments made by bank cards issued in a specific region of the world, million US dollars.

Dependence as indicated in the resulting equation (model formula) was verified by the *F*-test, *p*-value, and coefficient of determination R^2. The actual values were compared to the tabulated ones for the corresponding level of significance $\alpha = 0.01$. The verification showed a fairly sustained dependence between the tested function and the factors affecting it.

A statistical evaluation of the obtained multiple regression equation performed using the above criteria allows to declare the revealed dependence statistically significant with a 95% confidence interval, thus making the equation relevant for practical prediction.

The obtained equation can serve as a means for estimating the volume of payments made by cards issued in a specific region of the world. Comparison between the actual and predicted data allows assessing the utilization efficiency of payment infrastructure and monitor spare or insufficient capacity of self-service terminals.

Conclusion

The conclusions from the analysis of development trends in the global payment card market can be summarised as follows. The card industry plays an increasingly important role in the system of non-cash settlements. Both the population and the retailers are interested in increasing the efficiency, cost effectiveness, versatility, and security of electronic payment instruments, which is why the card market players regularly implement innovative organisational and technological solutions and develop projects aimed at different market segments. Government bodies, as a rule, try to create favorable conditions for the payment card industry development. The reason for this is the availability of powerful capabilities to control card payments, convenience of tax accounting, transparency of payment transactions, and a number of other factors.

The global payment card market has experienced positive dynamics in recent years with respect to its main parameters such as the number of issued cards, the total value of payment transactions, and infrastructure indicators. The author expects this trend to continue in the near future. The USA and Western Europe markets enjoy the most developed card industry with advanced payment infrastructure and card payments being highly popular among the general public. However, the focus of card industry is gradually shifting towards new (mostly Asian) markets. Many countries are becoming less dependent on the American IPSs due to an active promotion of their own card systems. The Chinese UnionPay payment system holds a lead in this respect and is systematically strengthening its positions both nationally and globally. The fastest growing card payment markets include those of the Asia-Pacific region, Latin America, the Middle East, Africa, and Eastern Europe. In 2017 the total share of domestic payment systems in the general structure of the global market was predicted to reach 8.26%. The active support given to the payment card industry by the state authorities and the growing popularity of payroll card programs among employers drive a shift in the world market supply towards debit and prepaid cards (and the share of credit cards is, therefore, falling).

Payment infrastructure has been developing in parallel with the payment card market. Stable growth in popularity of payment cards in retail business, tightening of state control, and other factors encourage an increasing number of merchants to accept card payments. Nevertheless, a significant proportion of cardholders prefer to pay in cash, which causes a dynamic increase in the number of ATMs and other cash withdrawal and acceptance devices.

The correlation and regression analysis of the bank card market's payment infrastructure in 2014–2016 showed sufficient quality of the obtained regression. The results presented in the paper are believed to be of benefit to both researchers of the global payment card market and the practitioners in the area of banking business development.

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Тенденции развития мирового рынка платежных карт

Г. В. Хетагуров

Исследование направлено на определение характера и динамики распределения рыночных долей международных и локальных платежных систем в разрезе различных потребительских и географических сегментов. Выявляются основные стратегические направления развития платежных систем, прогнозируются базовые параметры карточной отрасли на ближайшие годы, анализируется роль государства в развитии отрасли. Особое внимание уделяется количественному анализу состояния платежной инфраструктуры мирового рынка платежных карт. Используя метод корреляционно-регрессионного анализа, автор оценивает влияние количественных параметров развития сетей терминалов обслуживания на объемы платежей по банковским картам, выданным на территории различных регионов мира. Разработанная автором регрессионная модель может быть предложена для прогнозирования различных параметров рассматриваемого рынка.

Ключевые слова: платежная инфраструктура; индустрия безналичных расчетов; платежные карты; корреляционно-регрессионный анализ; коэффициенты корреляции.

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