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Impact of financial technologies on economic development: Theories, methods and analysis

Anel A. Kireyeva
Institute of Economics MES RK,
University of International Business,
Almaty, Kazakhstan
kireyeva.anel@ieconom.kz
ORCID 0000-0003-3412-3706

Anna Kredina
University of International Business,
Almaty, Kazakhstan
anna.kredina@uib.kz
ORCID 0000-0002-7682-2727
Corresponding Author

László Vasa
Széchenyi István University,
Győr, Hungary
E-mail: laszlo.vasa@ifat.hu
ORCID 0000-0002-3805-0244

Zaira T. Satpayeva
Institute of Economics MES RK,
Almaty, Kazakhstan
E-mail: satpayeva.zaira@ieconom.kz
ORCID 0000-0002-1644-3709

Abstract. This research focuses on an analytical review of the scientific literature to select appropriate methods and evaluate the impact of financial technologies on economic growth. Since non-cash payments can be affected by various factors, there is a great variety of studies relating to them in the scientific literature. However, existing scientific papers reflecting on the economic growth and non-cash payments do not determine the cause-effect relationship trends in different periods. Current study intends to fill this gap. Using an original method based on correlation analysis, the relationship of indicators in different periods is calculated with the use of the SPSS software. The data is collected for period of 2004-2019, during which the reviewed countries were actively developing and increasing their financial and technological capacities. Analysis results largely indicate an increase in the number of bank branches in many of the reviewed countries. Further, we

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consider the correlation between economic growth (expressed by indicators such as GDP), financial technologies (number of ATMs, user access to internet, and number of users of mobile communications) and gender indicators. The conclusions show a correlation between economic growth and financial technologies.

Keywords: GDP, ATM, bank, economic growth, financial technologies, non-cash payment.

JEL Classification: G21, L26, O16

1. INTRODUCTION

Over the past few years, the extensive impact of the COVID-19 pandemic on the economy's growth and its resulting collapse have prompted a move to a remote format of work and increased internet usage (Żak & Garcarz, 2020). This is true for many countries where purchases during pandemic were more often paid via non-cash payments, while fusion of payment service markets allowed competition between banks and non-banks to manifest in the use of various payment instruments. Transition to the dual regime of working (online and offline) has created opportunities for companies to profit fast, work long distances and cover large territories. Thus, developed and developing countries could change financial structures through technologies (Bhasin, 2016; Grzeszczyk, 2020; Vrinceanu & Horobet, 2021). Digitalization of financial services, emergence of mobile and E-banking, systems of non-cash payments, mobile systems of online payment – all this and so much more, has laid down the guidelines for further development of financial technologies.

Due to all mentioned above, the breakthrough of non-cash payment has become one of the underestimated aspects of the change in the daily life. Eventually, cash is no longer the only possibility for providing payments in many countries, and they share with other means of payment, such as payment cards. In the meantime, other payment methods are becoming obsolete. Such consumers' and entrepreneurs' choice expansion in terms of different payment methods gave rise to turnover dematerialization growth. The importance of this process is that payments made every day provide basis for society and have important economic dimension. Some scientific studies show the connection between economic growth and non-cash payments (Alvarez & Lippi, 2009; Mieseigha & Ogbodo, 2013; Bashir & Madhavaiah, 2014; Grzywińska-Rąpca & Grzybowska-Brzezińska, 2015; Aliha et al., 2020). Although other scientists focus on factors that affect non-cash payments usage, including culture, strengthening, social impact, education, employment etc. (Polasik & Wisniewski, 2009; Nisa et al., 2013; Junadi & Sferianto, 2015).

In general, emergence of electronic money and various kinds of payments has facilitated the development of non-cash digital economy and E-banking (Yousafzai et al., 2003; Rexha et al., 2003; Kumbhar, 2011). Other authors in their studies identified factors, which are crucial for successful E-banking and have obtained the results of an interpretive study of banking consumers' experiences (Wang et al., 2003; Shah & Siddiqui, 2006). Certainly, banking companies must take into account the risks of expansion switched to financial technologies that favoured living standards and sustainable development at the beginning of the transition to technological innovations (Chen, 2019; Baloch et al., 2020, Raišienė et al., 2021; Rymarczyk, 2020; Sieja & Wach, 2019). In another work mentioned the absence of pre-payment mechanisms and risk pooling combined with dominance of market-based medical operations, which exposes considerable part of population to financial vulnerability, results in catastrophic payments to cover costs (Selvaraj & Subramanian, 2012; Alao & Sorinola, 2015). Along with this risk, increase there is increase in the profitability and financial stability of banks, when the relationship between GDP and financial

technologies was mentioned earlier in other studies (Krueger, 2017; Chernis & Sekkel, 2017; Luchko et al., 2019; Shy, 2020).

At present, the payment is made in several ways – by cash, by debit and credit cards. Automated teller machines (ATMs) were considered as intermediary machines that give the opportunity to transfer money from cash to the payment card and vice versa, at the same time different denominational value in cash is given (Agarwal & Brem, 2017; Bernini & Brighi, 2018; Aliha, 2020). There were published proposals on improvement of clients' requests processing algorithms earlier that has led to a more widespread use of ATMs and security upgrade of non-cash payments (Pavković et al., 2018; Song, 2018).

The aim of this study is to conduct an analytical review of the scientific literature, select appropriate methods and evaluate the impact of financial technologies on economic growth. The interrelation between economic growth, which is presented by such indicator of GDP, financial technologies (expressed in the number of ATMs, the access of users to the world wide web, the number of mobile connection users and local landline communications) and gender indicators (active adult population) is considered in this article. Our hypothesis suggests that non-cash payments growth will have a positive influence on the GDP indicator, which measures the growth of the economy. Again, the spheres that will create more jobs will get people motivated to obtain a higher level of education and will insure new areas for investment. All these results will make it possible to evaluate current situation regarding non-cash payment considering the influence on economic growth.

The following parts include literature review, data and methodology description in the 2nd part, analysis and calculations that are given in the 3rd part, the conclusion part that includes main conclusions, summary, and limitations.

2. LITERATURE REVIEW

Nowadays the number of non-cash payments is growing rapidly. Moreover, the amount of non-cash payments during the COVID-19 pandemic showed further growth against the background of such one-time factors as purchases of necessary goods and medicines before the introduction of quarantine and self-isolation. The preference of non-cash payment is logical, as population has chosen to limit contacts with cash. As a result, bank cards rapidly drive out cash from our everyday life. At the same time non-cash payment is one of the most convenient ways for account management, as the speed of making payments is much faster.

Presentation of non-cash payments has been researched in many scientific studies, in particular its components' characteristics, its principals, forms, settlement instruments, settlement documentsand means of payment. Thus, scientific research of factors analysis and the level of their impact on the preference of payment methods are considering in the light of economic development (Bashir & Madhavaiah, 2014; Grzywińska-Rąpca & Grzybowska-Brzezińska, 2015; Premchand & Choudhry, 2015). According to the previous studies, there are factors that influence the usage of electronic payments, which can affect the ease of use, utility, satisfaction, and norms (Dehbini et al., 2015). Other studies mention factors influencing the usage of non-cash payments, including culture, productivity, duration, effort, and social influences (Junadi & Sferianto, 2015). Furthermore, usage of electronic payments is inseparable from some individual factors, as age, occupation, education, and income (Polasik & Wisniewski, 2009; Nisa et al., 2013; Itah & Emeka, 2014).

One research has focused on the field of information system analysis in the context of financial services marketing, examining the element of trust and risk in E-banking (Yousafzai et al., 2003). Other studies have concluded that trust and satisfaction have an impact on the adoption of E-banking, although satisfaction is constrained by the level of consumer's confidence (Rexha et al., 2003). Some researchers have discovered

and developed factors that are the most important for success in E-banking and reported on the key findings of an interpretive study of the banking consumer experience (Wang et al., 2003; Cheng et al., 2006; Shah & Siddiqui, 2006). The results of some studies showed that perceived value, brand perception, economic effectiveness, ease of use, convenience, efficient responsiveness are central factors for customers' satisfaction in E-banking (Kambar,2011; Bok et al, 2017; Pakhmenko et al., 2021). Other scientists, based on panel data illustrated that financial development is unfavourable to economic development, but this negative effect is stronger in the countries with high level of income (Cheng et al., 2021). In these conditions, block-chain technology and computer-based education improve cyber defence (Kjamilji et al., 2021). Such models allow digitalizing client service through creation of self-learning models too.

For inequality elimination between population and access to financial services of banks the great influence of bank branches was shown in other studies. Then there happens shift of the distribution policy towards digitalization of provided services. Whilst most of banks have calculated a positive decline in financial technologies investment and bank capital growth (Guptha & Rao, 2018; Opoku et al., 2019; Lukács & Völgyi, 2021). Notably not in every instance expansion of banking sector by opening some additional branches produces expected income, as there are great economically unjustified expenses in favour of human capital assets and technological infrastructure, major material resource (Bernini & Brighi, 2018). However, for the last few years there has been a tendency to the closure of bank branches in both cities and villages.

The work of Baloch et al. (2020) is interesting as it has proved the fact that financial technologies ameliorate environment conditions. The next work considered is directed at studying crucial meaning of financial payments for humans' wellbeing and sustainable development (Chen, 2019). In another work it is presented the absence of pre-payment mechanisms and risks pooling combined with dominance of market-based medical operations, which exposes considerable part of population to financial vulnerability, results in catastrophic payments to cover costs (Selvaraj & Subramanian, 2012; Alao & Sorinola, 2015; Sági et al., 2021). One of the types of innovation, based on limitations, economic innovations of financial sector, called solar-powered transaction systems based on solar battery Vortex (widely known as rural ATMs) and a complete analysis of embedded product development process on the ascendant and driving forces of innovation is suggested (Agarwal & Brem, 2017).

In other works, there are emphasized problems of non-cash payment development, restriction of the population access to the Internet and financial illiteracy (Braun & Netto, 2020; Fouillet et al., 2021). These issues are solved at the government level: introduction of programs that increase financial literacy among population, as this leads to a more aware choice of quality financial services and frequent usage of fintech programs for online payment. Besides, it is important to improve financial literacy not only among adult and elderly population, which studies different kinds of pension savings (Lusardi & Mitchell, 2011; Castro-González et al., 2020), but among young people as well. The utmost timespan in a lifetime among young people will generate large capitalization (Garg & Singh, 2018; Gavurová et al., 2017; Helen & Ilias, 2019). Finally, empirical data suggests that even though financial integration triggers financial instability, financial access has positive impact of financial sustainability (Neaime & Gaysset, 2017).

Existent research denotes a link between the development of non-cash payment system and economic growth (Alvarez & Lippi, 2009; Mieseigha & Ogbodo, 2013; Aliha et al., 2020). Before widespread usage of non-cash payments at the global level, many studies have indicated various hypotheses that increase in the number of transactions in the change to non-cash payments through payment cards would lead to the economy's long-term growth due to the increase in the level of supply and demand. Shy (2020) considered that usage of ATMs depends on the currency value that users have. In this respect, he pointed out that banks intentionally load ATMs in multiples of 5, 10 and 20 US dollars, which stimulates non-cash payments

usage, as a majority of the users are not likely to have a lot of small change in their pockets or carry large bills. This will affect the level of GDP increase, and the rate of its growth.

Another point of view has scientists who indicated the importance of GDP growth and retail sales during the definite period (Le & Ngô, 2015). They have found statistically significant evidence that the data of payment systems can reduce forecast error for GDP and retail sales growth as well. As the advantage of payment instruments, there must be considered such aspects as convenience and security, to a certain extent determine the choice of a payment instrument (Bernini & Brighi, 2018). Furthermore, there is given a complete analysis of the possibilities of mobile platforms for users, who are not overtaken by bank accommodations how cybersecurity is hindering the spread of financial services (Ambore et al., 2017). Moreover, there is a proposed strategy to reduce cybercrime in the complicated ecosystem of financial payments and findings of provided studies.

Fulfilment of retail non-cash payments between counterparties is among payment cards utilization methods. Where the speed of delivery and safety stand out as advantages of such method of account management. For the usage of payment cards, governments and banks set ATMs so that the user can perform a needed operation. Non-cash money cannot be counterfeited, so when withdrawing cash from an ATM we can be sure of its originality. Consequently, the higher the amount of non-cash money in a country, the lower is the level of the informal economy.

The study that compares the trends in the number of financial technologies with the course of time in the modern history in the member states of the European Union can be highlighted as the most important one. In addition, itis determined the impact of separate development indicators, which can explain the change in the number of ATMs as a dependent variable in the regression model in this stydy (Pavković et al., 2018). It is important that based on the regression modelling, when analysing the influence of the selected development indicators on the dependent variable, two evaluation models of multiple linear regression were built.

This way, the literature review of the spread of financial technologies shows that basic economic indicators can be taken apart or as a whole. Whereupon research suggests that many factors can have an impact on non-cash payments, they also can correlate with GDP growth rate. As many authors emphasize, various indicators were used to identify the reasons for the growth of non-cash payments. This way, there are no econometric studies that analyse relative impact of GDP on non-cash payments, where ATMs were taken as independent indicators for the correlation analysis. Data collection for our study was planned to be carried out for the EU and CIS member states, Kazakhstan, and countries with a transition economy. As the Central Asian region is currently understudied, all countries of this region were expected to be covered, however, data limitation did not allow to do this.

The relationship between economic growth, which is performed by such indicators as GDP, financial technologies (given in the number of ATMs, user access to the World Wide Web, the number of users of mobile and local landline communications) and gender indicators (active adult population) is studied in this article.

3. METHODOLOGY

To achieve the set goal the correlation analysis was used. The essence of the correlation analysis is in the calculation of the correlation coefficient between variables. Given coefficients can be calculated through statistical programs like R, STATA that use various software packages to calculate the correlation (Ali et al., 2020; Valente et al., 2020).

Within the framework of this research analysis and processing of statistical data was provided using the indicators, which have an impact on the dynamics of non-cash payment development considering the

GDP dynamics. The basis of the research made up secondary data obtained from the Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan, the National Bank of the Republic of Kazakhstan, and the World Bank. Gross Domestic Product (GDP) is used as a dependent variable. There were chosen several independent variables, namely: the number of ATMs as the main proxy server for non-cash banking; the population as a whole and its urban part; the number of residents using the Internet or mobile devices (Table 1).

Table 1

Variables used in the research

No.	Variable	Definition	Source
1	GDP (gross domestic product)	Gross National Income per capita	World Bank Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan
2	ATM	Automated teller machines (per 100,000 adults)	World Bank, Nation Bank of Kazakhstan
3	pop_urb	Urban population (% of the total population)	World Bank
4	part_rate_f	Labour force participation rate, female (% of female population ages 15+) (modeled ILO estimate)	World Bank
5	part_rate_m	Labour force participation rate, male (% of male population ages 15+) (modeled ILO estimate)	World Bank
6	fixed_tel_sub	Fixed telephone subscriptions (per 100 people)	World Bank, Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan
7	mob_cel_sub	Mobile cellular subscriptions (per 100 people)	World Bank
8	usi_int	Individuals using the Internet (% of population)	World Bank

Source: own compilation

The limitation of this research is restricted statistical data of some countries, so there was used only available data. Accordingly, the indicators of 15 countries were considered, of which eight countries of the European Union (Hungary, Czech Republic, the Netherlands, Italy, Romania, Lithuania, Slovakia, Austria), five CIS countries (Kazakhstan, Kyrgyzstan, Russia, Belarus, and Uzbekistan), Ukraine and Serbia as countries emerging economies. The data is considered for the period from 2004 to 2019. Nevertheless, seeing consideration of some indicators on fifteen countries for each year from the considered 16-year period resulted in obtaining three-dimensional data, there was decided to compare results for 2004, 2010, and 2019.

To identify the relationship between GDP and different variables, the Pearson coefficient is used more often (Wang et al., 2015; Song, 2018; Helen & Ilias 2019), as it is a relative indicator and does not have units of measurement. Thus, in this study, Spearman coefficient is applied (1):

$$p = 1 - 6\frac{\Sigma d^2}{n^3 - n}, \quad (1)$$

where p – correlation coefficient;

d^2 – squares of differences between ranks;

n – the number of features that participated in the ranking

To achieve the set goal there was used correlation analysis. The essence of the correlation analysis is in the calculation of the correlation coefficient between variables. Given coefficients can be calculated through statistical programs like R, STATA that use various software packages to calculate the correlation (Ali et al., 2020; Valente et al., 2020).

The current coefficient was chosen due to two reasons. Firstly, Kolmogorov-Smirnov's test for checking the hypothesis that the collected data belongs to the normal distribution showed that considered data does not belong to the normal distribution (appendix 1). Secondly, the number of observations makes up 15, the sample size is less than 30.

Spearman correlation method lets to determine the correlation coefficient, which is assigned a value from 1 to -1 (Durmuşoğlu et al., 2017). The positive value of the coefficient indicates a positive (direct) correlation between two variables, the negative – about negative (inverse) correlation, zero - about its absence. According to the Chaddock scale, if the absolute value of the correlation coefficient is less than 0.3, then the tightness (strength) of the correlation is weak, from 0.3 to 0.5 - moderate, from 0.5 to 0.7 - detectable, from 0.7 to 0.9 - high, more than 0.9 - extremely high, 1 - strict.

To evaluate the hypothesis of the research, the statistical hypothesis about the value of the Spearman correlation coefficient was tested:

H0: the correlation coefficient is equal to zero, i.e., there is no relationship between economic growth and non-cash payments.

H1: the correlation coefficient is not equal to zero, i.e., there is a relationship between economic growth and non-cash payments.

In the first case, even if we will have to accept the hypothesis that there is no significant relationship, in fact, there is an error, we will have to provide additional check studies and provide more accurate analysis based on the available statistical data. In the second case, taking into consideration that the possibility of acceptance of the main hypothesis is high, we have a high risk of unwanted consequences of accepting an incorrect hypothesis. At all rates, this will be followed by more accurate analysis, whereas the risk of unwanted circumstances may prove to be less important.

Following requirements were maintained for effective analysis:

1. The time step was the same for all data – there was taken full annual data.
2. The datum line is full for all data:

a) Data on the number of bank branches (per 100 000 adults) in Romania were absent for 2004-2007 on the website of the World Bank, due to this the average figure for the series of 30, 9916, was considered for indicated years. Data on bank branches (per 100 000 adults) in Belorussian were also absent on the website of the World Bank for the period 2018-2019, therefore an average of 3,0495 was taken since 2018 and 2019.

b) Data on personal transfer received (% GDP) in Uzbekistan and Serbia absent for the period 2004-2005 and 2004-2006 respectively. Therefore, there were taken minimum values of the following year: 5,179 for Uzbekistan and 8,719 for Serbia.

c) Data on the number of ATMs in Kazakhstan was taken from the website of the National Bank of Kazakhstan, indicators for the rest countries were taken from the website of the World Bank.

d) The data on the number of users was recorded via telephone lines in Kazakhstan, was taken from the Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan, and indicators for the rest countries were taken from the website of the World Bank.

Thereby, there will be provided the following plan of actions in the next steps:

Step 1: data collection and processing - data for 15 countries for the period 2004-2019.

Step 2: analysis of the current situation in terms of the level of GDP development for 15 countries for the period 2004-2019.

Step 3: analysis of the number of branches of banks and ATMs in Kazakhstan, in some CIS and EU countries.

Step 4: check the data for normality and perform descriptive statistics.

Step 5: analysis of the correlation between the variables under consideration through finding Spearman correlation coefficients since 2004, 2010 and 2019 and comparing obtained results.

For the analysis of the correlation between variables used statistical package, which was calculated based on the SPSS program, with everybody, that is, each variable is correlated with itself and in the matrix, numbers denote this correlation.

4. ANALYSIS AND RESULTS

4.1. Current state analysis by the level of GDP development in Kazakhstan, in some cis and EU countries

Provision of retail non-cash payments between counterparties is one way of payment cards usage. Along with this, speed and safety are the advantages of such ways of account management. For the usage of payment cards, the government and banks set ATMs so that the user can perform the needed operations. Non-cash money cannot be counterfeited, when withdrawing cash from an ATM can be sure in it. Consequently, the higher the amount of non-cash money in a country, the lower is the level of an informal economy.

GDP is the microeconomic indicator, which reflects the market value of all goods and services, produced a year in all areas of the economy. Comparing countries by GDP could be identified countries which are the most or the least developed. GDP is used with other indicators as characteristics for various aspects of economic growth. In this scientific study, we have tried to follow the GDP dynamics compared with some EU countries and CIS countries. It should be mentioned that the current state of the market of non-cash payments in Kazakhstan has different trends compared with the rest of the world. Overall, we provided a list of countries GDP levels from the World Bank database. The sample list includes fifteen countries, which were ranked in accordance with GDP in US dollars for the period from 2004 to 2019.

To provide a comparison of Kazakhstan GDP and other CIS countries were taken five other CIS member-states with the highest GDP indicators. These included Belarus, Russia, Uzbekistan, Kyrgyzstan and Ukraine. So, the data of the CIS countries for 2004-2019 are shown in Figure 1.

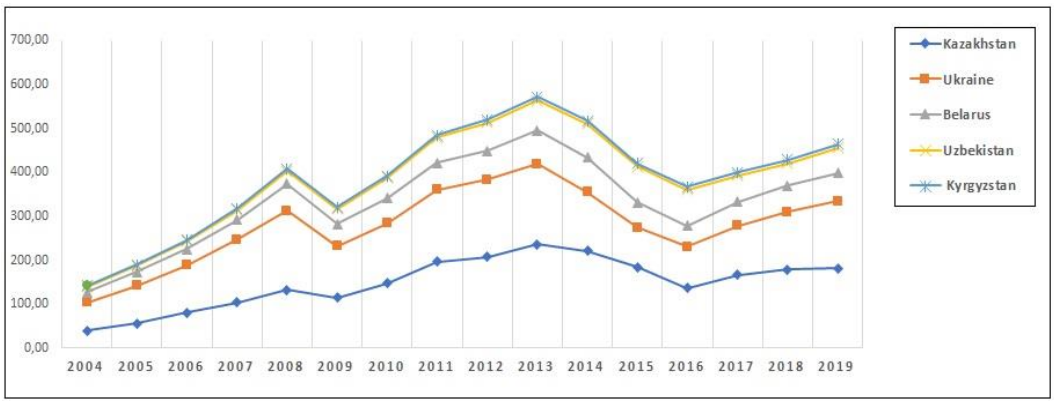

Figure 1. Dynamics of the level of GDP in the CIS countries

Source: compiled by authors based on data of the World Bank

The reviewed period from 2004-2019 showed that the economic policy of many CIS countries is in large part determined by the goal of increasing the level of GDP. In particular, in accordance with provided data, Russia, Kazakhstan and Ukraine have shown considerable GDP growth in comparison with other CIS countries. In 2019, the GDP level growth rate in these three countries increased by almost 3-4 times in comparison with 2004, Kazakhstan (181.67 billion US dollars), Russia (1700 billion US dollars) and Ukraine (153.79 billion US dollars), respectively. At the same time, it is a noteworthy fact that Belarus, Uzbekistan, and Kyrgyzstan also demonstrate growth in terms of GDP, yet lower economic growth rate and weaker indicators. It should highlight that the economy of Kazakhstan has shown higher indicators driven by oil and gas and mining industries.

This way, the economy of Kazakhstan throughout the reviewed period showed extremely high growth dynamics compared with other CIS countries. EU countries from May 15, 2019, have declared about series of cooperation programs focused on contributing to sustainable development and partnership with Central Asian countries, including Kazakhstan. Further, we suggest studying the dynamics of GDP growth in Kazakhstan in comparison with EU countries (figure 2).

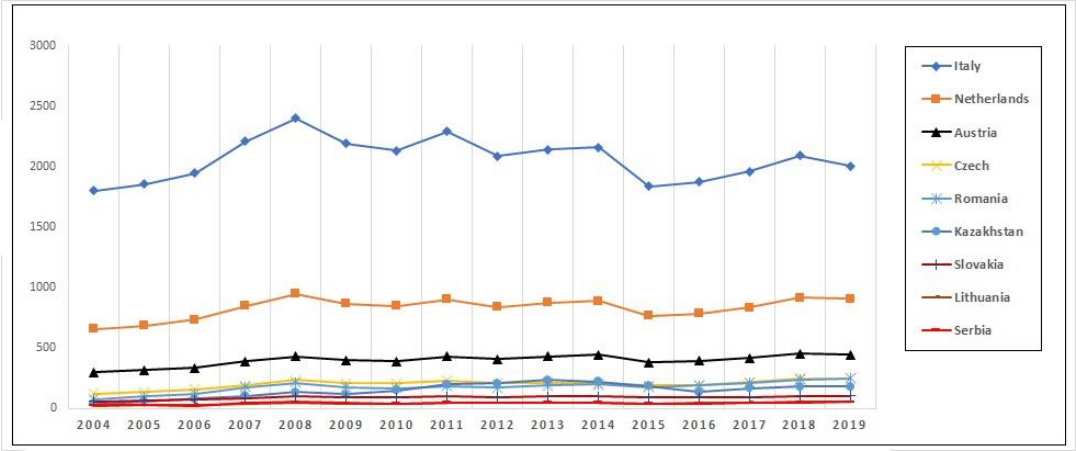

Figure 2. Dynamics of the level of GDP in the EU countries

Source: compiled by authors based on data of the World Bank

In figure 2 it is apparent that during the period under consideration 2004-2019 many EU countries demonstrate steady economic growth. In its turn, Kazakhstan unlike other EU countries also demonstrated development trends. In 2019 against 2004 the GDP in Italy made up 2004 billion US dollars, in the Netherlands - 907 billion US dollars, in Austria - 445 billion US dollars, in Kazakhstan - 182 billion US dollars (increase by 4-5 times). In general, Italy in different years demonstrated high GDP growth indicators, as it is the third-largest economy in the EU and the eighth largest in the world in terms of nominal GDP. Despite some difficulties, the economy in Italy is the second-largest centre of production with a prominent role for medium and small companies producing high-quality consumer goods for export. There is a set of EU countries with low growth of GDP level dynamics. According to the provided data, these are Slovakia, Lithuania, and Serbia.

Slovakia and Lithuania became EU members in 2004 and to this date, they are countries with moderate innovations. Serbia is not officially a member of the EU but actively strives to become one (has had the status of the candidate since 2012). Real-estate price-cutting and the USA financial markets unrest, credit interest rate increase, limited access to financial resources in 2008 led to the global financial crisis, which unfolded in 2009-2010. These countries depend on foreign investments, which stopped flowing during post-

crisis years - the graph shows a strong drop in the level of GDP. Unemployment and external debt also reached high levels during these years.

Firstly, the majority of countries under review by the level of GDP dynamics show stable growth during 2004-2019. It stands to mention that GDP upward trend from 2004 to 2008 and slowdown in growth rates in 2009 and 2010, because of government use of "safety cushion" and reduction of government support for business in 2009-2010 in the CIS countries. Next, GDP growth is detained foremost due to stock depletion for after crisis recovery. In CIS countries, in addition, the flow of foreign investment has decreased since 2012. However, the economic lag of CIS countries from the EU relates to considerable differences in the economic and social development of countries and regions, internal differences between member states and their reluctance to limit the borders of their sovereignty, acute issues of migration policy and several others. Accordingly, the results of the analysis of economic and financial development of selecting for the study countries are quite useful for understanding the trends of non-cash payments development in the European Union and CIS.

Secondly, the level of GDP in Kazakhstan illustrated in both graphs mostly has an upward trend. In 2009 has gone down GDP as a consequence of the impact of the 2008 global financial crisis. Further, GDP is growing up from 2010 until 2013, which is associated with the flow of attracted foreign investment. Kazakhstan is an oil-producing country, therefore the decrees in GDP level in 2014-2016 relates to the oil price downturn. For instance, the price of Brent crude oil has cut in half. Further, GDP growth in 2017-2019 demonstrates growth while in 2019 the GDP in Kazakhstan slightly exceeds the level of 2010 and amounts to 181.67 billion US dollars.

4.2. Development of bank branches and ATMs in Kazakhstan, in some CIS and EU countries

A generous number of banks in any country because of competition in the banking sector leads to the accessibility and reduction of banking operations prices for the public. Despite current advantages, governments regulate the quality of banks performance and close those banks that do not fulfil their obligations to customers by revoking licenses, consolidating several banks into one. The number of bank branches regarding the adult population is shown in Table 2.

Table 2

Commercial bank branches (per 100,000 adults) for 2004-2019

Country	Adult population (ages 15+) (modeled ILO estimate), 2004	Adult population (ages 15+) (modeled ILO estimate), 2019	The ratio for 2019/ 2004, %	2004	2010	2019	The ratio for 2010/ 2004, %	The ratio for 2019/ 2004, %
Ukraine	26267270	24106160	91,77	3,7	2,3	0,4	62,16	10,81
Kazakhstan	10411766	12758096	122,54	3,7	3,3	2,5	89,19	67,57
Belarus	5891272	6083828	103,27	6,1	3,2	3,0	52,46	49,18
Kyrgyzstan	3257248	3879776	119,11	5,1	6,1	8,0	119,61	156,86
Netherlands	10474836	11032646	105,33	33,6	23,0	9,2	68,45	27,38
Lithuania	1933813	1720027	88,94	23,8	29,1	10,1	122,27	42,44
Austria	4649198	5390896	115,95	13,9	11,3	11,9	81,29	85,61
Czech Republic	6038027	6468070	107,12	21,0	22,6	20,6	107,62	98,10
Hungary	5000252	5527277	110,54	13,8	16,8	23,4	121,74	169,57
Romania	11829176	10599786	89,61	31,0	35,4	23,7	114,19	76,45
Slovak Republic	3239612	3251210	100,36	25,2	26,3	24,8	104,37	98,41
Russian	87404155	89469744	102,36	26,8	35,1	25,6	130,97	95,52

Serbia	4110696	3816459	92,84	22,3	41,2	27,6	184,75	123,77
Uzbekistan	16191985	21899187	135,25	39,2	39,2	34,2	100,00	87,24
Italy	28630020	29927296	104,53	56,2	58,4	38,8	103,91	69,04

Source: compiled by authors based on data of the World Bank

According to estimated data in 2019, the largest number of bank branches relative to the population has risen in Hungary by 169,57%, Kyrgyzstan by 156,86% and Serbia by 123,77%. The smallest ratio of the number of bank branches has decreased in Ukraine, the Netherlands and Lithuania (10,81%, 27,38% and 42,44%, respectively). Over 16 years, the largest number of bank branches, opened in Hungary is growing up by 169,57%, in Kyrgyzstan is growing up by 156,86% and in Serbia is growing up by 123,77%.

Thus, the wise banking sector is crucial for social and economic development of reviewed countries. Development of safe and sustainable banking system with a wide range of provided services in developing and developed countries can favour overcoming wealth disparity and improvement of the quality of life. Provided analysis has shown that in developing countries banks act as primary financial intermediaries. In 2019, Kazakhstan in terms of bank density has occupied 4th place from the end among reviewed countries with an adult population of 10,411,766 people. The government policy is directed against uncompetitive banks and focused on the development of non-cash payment systems. For this reason, the Internet access (5G) in remote cities, regions are being developed, the number of ATMs is increasing. Next, there will be considered given technical means.

This study shows a comparison of the number of ATMs in three periods: 2004-2009, 2010-2014 and 2015-2019, presented in table 3.

Table 3

The growth of ATMs number (per 100,000 adults) for 2004-2019

Country	**2004**	**2009**	**The ratio for 2009/2004, in times**	**2010**	**2014**	**The ratio for 2014/ 2010, in times**	**2015**	**2019**	**The ratio for 2019/ 2015, in times**
Kyrgyzstan	1	8	8,0	7	25	3,6	30	39	1,3
Serbia	1	45	45,0	47	44	0,9	45	50	1,1
Uzbekistan	1	2	2,0	4	8	2,0	10	38	3,8
Russian	16	72	4,5	96	185	1,9	173	165	1,0
Kazakhstan	10	57	5,7	61	72	1,2	71	86	1,2
Belarus	11	33	3,0	38	55	1,4	56	55	1,0
Ukraine	20	73	3,7	77	95	1,2	87	96	1,1
Romania	18	57	3,2	59	65	1,1	69	64	0,9
Czech	32	40	1,3	42	50	1,2	51	58	1,1
Slovakia	38	50	1,3	51	59	1,2	60	62	1,0
Hungary	39	56	1,4	57	58	1,0	57	61	1,1
Austria	116	112	1,0	113	186	1,6	183	172	0,9
Italy	74	107	1,4	100	93	0,9	97	91	0,9
Lithuania	36	57	1,6	60	51	0,9	49	39	0,8
Netherlands	59	63	1,1	58	54	0,9	50	41	0,8

For the period 2004-2009, it is visible that the number of ATMs has increased almost in all countries, except Austria. In particular, the increase in ATMs in Serbia has gone up by 45 times, in Kyrgyzstan by 8 times, in Kazakhstan by 5,7 times. The lowest growth rates in the number of ATMs were indicated in two countries: Austria and the Netherlands. Next, the greatest growth in the number of ATMs has gone up in Kyrgyzstan (3,6 times), Uzbekistan (2 times) and Russia (1,9 times). Interestingly, the decrease in the number of ATMs has declined in only four countries: Lithuania, the Netherlands, Italy and Serbia. In turn, for the period 2015-2019, the number of ATMs has gone down by five countries: Romania, Lithuania, Netherlands,

Italy and Austria. In conclusion, the number of ATMs has increased in Uzbekistan by 3,8 times, Kyrgyzstan and Kazakhstan by 1,3 times and 1,2 times, respectively.

At the same time, the load demand on the ATM sector has a trend up to now, considering the impact of the COVID-19 pandemic on civilian displacements, financial expenses and the national economy of the countries. As the number of countries emerging from quarantine increases, businesses and consumers will find themselves in a new world, nevertheless, many of the long-term trends will remain broadly like those that existed before the pandemic. The application of this equipment keeps developing the independence of users on cash, as modern ATMs are expanding their service. The results of data analysis show that many countries will increase the number of ATMs.

4.3 Relationship between GDP and indicators of non-cash payments development

Following step 4, we checked the data for normality and performed descriptive statistics; following step 5, we found Spearman correlation coefficients since 2004, 2010, 2019 and compared the results.

We used the Kolmogorov-Smirnov test as the hypothesis that the collected data belong to the normal distribution. At the same time, if the data check shows their normal distribution (the main indicator of statistical significance (2-sided) should be greater than 0,05), then Pearson correlation coefficients will be calculated, and if the data are not distributed normally, the Spearman correlation coefficient will be applied. The results of the comparison of the three periods are presented in table 4.

Table 4

One-Sample Kolmogorov-Smirnov Test

			GDP	**ATM**	**pop_urb**	**part_rate_m**	**part_rate_f**	**fixed_tel_sub**	**mob_cel_sub**	**us_int**
N			15	15	15	15	15	15	15	15
Normal Parametersa,b	Mean		$426,429.20	8505,20	18253944,98	8609597,13	7119100,07	5842456,32	36880592,05	20010424,41
	Std. Deviation		$622,899.617	18544,577	27200891,783	11680671,402	10429338,067	8498370,677	59320659,812	29575287,608
Most Extreme Differences	Absolute		,344	,365	,319	,295	,277	,376	,319	,333
	Positive		,344	,365	,319	,295	,277	,376	,319	,333
	Negative		-,251	-,330	-,274	-,254	-,274	-,257	-,294	-,274
Test Statistic			,344	,365	,319	,295	,277	,376	,319	,333
Asymp. Sig. (2-tailed) c			**,000**	**,000**	**,000**	**,001**	**,003**	**,000**	**,000**	**,000**
Monte Carlo Sig. (2-tailed)d	Sig.		,000	,000	,000	,001	,003	,000	,000	,000
	99% Confidence Interval	Lower Bound	,000	,000	,000	,000	,002	,000	,000	,000
		Upper Bound	,000	,000	,000	,001	,004	,000	,000	,000

a. Test distribution is Normal

b. Calculated from data.

c. Lilliefors Significance Correction.

Source: Authors' results

The analysis showed a statistical significance value (2-sided) of less than 0,05. It means that the data distribution is not normal. This confirms the correctness of the choice for the calculations - Spearman coefficient. Next, using the SPSS program, we showed a scattering diagram of the GDP variable (figure 3).

Based on the constructed system of rectangular coordinates and the regression line on the plane, we can see the dependence of GDP on the selected independent variables. The scatter plot shows a clear

positive correlation. It should be emphasized that the distribution of the graphical representation of the data shows that although most of the data is "within the range", but some indicators are different from the normal one. There is another criterion for choosing between Pearson or Spearman rank correlation coefficients – the sample size. So, if n<30, then the Spearman coefficient is used to calculate the correlation coefficients, if n=30, then the Pearson correlation coefficient is used. In our case, n=15, which further confirms the correctness of Spearman coefficient application for the correlation analysis.

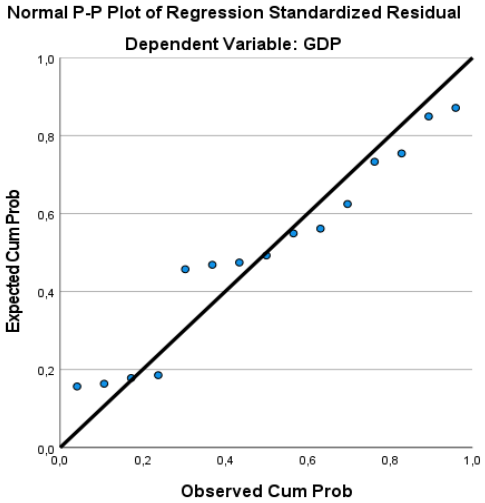

Figure 3. Variable scatter plot

Source: own compilation

Detection of correlation coefficients and comparison of the results was provided via the SPSS program. The coefficients were found separately for each year. Below there is a comparison of the results of correlation analysis for 3 years: 2004, 2010, 2019 (table 5).

Table 5

Spearman's rho correlation matrix

		GDP	ATM	pop_urb	part_rate_m	part_rate_f	fixed_tel_sub	mob_cel_sub	us_int
GDP	2004								
	2010								
	2019								
ATM	2004	,936**							
	2010	,846**							
	2019	,750**							
pop_urb	2004	,596*	,686**						
	2010	,700**	,757**						
	2019	,657**	,893**						
part_rate_m	2004	1	,604*	,979**					
	2010	,654**	,750**	,979**					
	2019	,600*	,889**	,975**					
part_rate_f	2004	0,450	,571*	,968**	,986**				
	2010	,614*	,743**	,971**	,982**				
	2019	,604*	,893**	,989**	,986**				
fixed_tel_sub	2004	,854**	,900**	,832**	,789**	,768**			
	2010	,779**	,925**	,825**	,800**	,811**			
	2019	,686**	,782**	,829**	,761**	,829**			
	2004	,911**	,911**	,679**	,593*	,546*	,882**		

mob_cel_sub	2010	,743**	,814**	,964**	,979**	,946**	,818**		
	2019	,639*	,921**	,971**	,989**	,979**	,775**		
us_int	2004	,911**	,839**	0,454	0,371	0,296	,729**	,871**	
	2010	,911**	,871**	,854**	,807**	,771**	,843**	,868**	
	2019	,668**	,896**	,996**	,971**	,982**	,807**	,964**	

The current matrix demonstrated that all determinants correlate not only with GDP but with each other as well. According to the results of the study, it is clear that there is a strong positive character. Between other indicators and GDP there is the tightness of the connection, but in the last reviewed period the tightness of the connection is decreased (in 2019).

With the development of financial technologies, transfers of P2P (from person to person), B2C (from business to consumer) and G2C (from the government to consumer) with non-cash money have become cheaper and faster than cash. It is important to consider that cardholders usually use E-banking for non-cash payments, consequently, use Internet access. For this reason, mobile and local telephony users, and Internet users were taken as technology factors.

Notable, service receivers of fixed-line telephony and mobile telecommunications per 100 people were normalized to the indicator of one person; individuals using the Internet in % of the population were indicated in the number of people. This allowed providing a more realistic analysis. In addition, gender was taken as an indicator: economically active women and men, at the age of 15+ (modelled ILO assessment). According to the results it is clear, that women use ATMs more often than men do. Users of mobile service, as before, are more often men, but women are more active in using landline phones and active Internet users.

Earlier provided studies assessing the relationship between economic growth and non-cash payments are not instructive as they did not identify the trends of cause-effect relationship in different periods of the system (Krueger, 2017; Chernis & Sekkel, 2017; Shy, 2020). Moreover, the indicator as the population was considered in the form of interpreting the results of a survey of residents of specific settlements, the country, or users of a particular bank. In this research as indicators, there were taken urban population (measured in % of the total population). The level of women economic activity (% of the female population aged 15+) and the level of male labour force participation (% of the male population aged 15+) will allow us to analyse the results of the investigation in terms of gender.

The urban population (measured in % of the total population) currently uses ATMs more often compared to 2004. However, ATMs are not the only method of non-cash payment. To pay online for goods is possible through mobile applications and through personal computers as well, which have internet access. At the same time, it should be considered that the World Wide Web almost completely covers the population. The urban population has a direct correlation with the number of service receivers of fixed landline communication (per 100 people). This may be the consequence of the fact that a modem and Internet access for stationary personal computers can be connected via a local telephone connection.

Accordingly, the null hypothesis is rejected. There is a correlation between economic growth and non-cash payments. This correlation has a positive character, and the correlation ratio is strong (strong static dependence).

5. CONCLUSION

This study attempts to analyze the impact of financial technologies on economic growth, as well as to determine the trend of causation in different periods. The main method of the study was correlation analysis based on Spearman's coefficient, carried out using SPSS software to calculate the relationship of indicators in dynamics (2004, 2010, 2019). Current research considered EU countries (Hungary, Czech

Republic, the Netherlands, Italy, Romania, Lithuania, Slovakia, Austria). Serbia and Ukraine were considered as countries with economies in transition. Among CIS countries Kazakhstan, Kyrgyzstan, Russia, Belarus, and Uzbekistan were selected for the research.

The literature review of scientific research allowed identifying the direct impact of an increase of the share of non-cash payments on general economic growth by means the increase of the number of non-cash payments and ATMs as well. Additionally, the evaluation of quantity effects in this area overall depends on the level of GDP impact. During the study, the following conclusions were obtained.

Firstly, in the period 2004-2019 many EU countries have demonstrated stable economic growth, except Slovakia, Lithuania, and Serbia with low growth in the level of GDP dynamics. Among CIS countries Russia, Kazakhstan, as well as Ukraine, demonstrate significant GDP growth in comparison with other CIS countries. Belarus, Uzbekistan and Kyrgyzstan showed a lower trend in economic growth and weaker indicators despite GDP growth. In the selected economies, there were marked following periods: the global financial crisis of 2008, economic recovery, the crisis in the oil and gas industry and a period of recovery.

Secondly, during the period 2004-2019, the reviewed countries demonstrated rapid development and increased their financial and technological capacities. The tendencies of the last 16 years have evidenced a significant growth rate in the volume of transactions using non-cash payments. Financial innovations were introduced into the banking sphere: widespread ATMs (in some countries their number per 100 000 citizens for the last 16 years have doubled). The increase of importance of banking in the sector of social and economic development is evidenced by the increase in the number of bank branches in most of the studied countries. It is noteworthy that the number of bank branches throughout the reviewed period has decreased. It should be noted that in Ukraine, the Netherlands and Lithuania, the number of bank branches decreased during the period under review.

Thirdly, the provided study has proved the influence of ATMs number on GDP, taken as the main proxy server for non-cash banking. Interestingly that comparison with a step of several years showed that previously strong relationships between GDP and urban population, labour force participation rate, fixed telephone subscriptions, mobile cellular subscriptions, individuals using the Internet became weaker. Again, used by us technological and gender factors: urban population, the level of economic activity of women and labour force participation rate of men, the amount of fixed and mobile telephone subscribers and the number of individuals using the Internet have a strong correlation with ATMs. This demonstrates that present-day developments differ from previous ones. They highlight the importance of financial technologies transformation.

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