

Digitization of the Financial System in the World Economy

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Summary

This article is devoted to the study of digital finance development in the global economy. The study aims to show the digital finance development level in different states and its impact on their economic development. In the course of the study, three hypotheses are put forward: 1) increased spending on innovation contributes to the competitiveness of financial services; 2) digital technology makes the financial systems of states more developed; 3) the development of digital finance contributes to the competitiveness at the level of states. Correlation and regression analysis are applied for building the empirical study. The results of the study helped to understand the digital finance concept. It also shows the main stages of digital finance development, the digitalization rank of the countries, the impact of digitalization on the financial and economic sphere. According to the results of empirical analysis, it is confirmed that the countries that invest more in innovative technologies are more developed. Therefore, digitalization has a significant value for the financial system and has a synergistic effect on all areas of the economy.

Key words:

Innovation, Digital Finance, Globalization, Competitiveness, R&D Spending

1. Introduction

The digitalization of the financial sector is an inherent feature of today's global economy. In order to be successful and competitive, financial market participants need to keep pace with global trends in the adoption of advanced technologies and be digital. The fulfillment of this task determines the transformation of traditional financial business models to meet the challenges of the modern world. Credit institutions, insurance companies, and investors are making significant changes to improve their operations under the influence of digital technologies. By investing in new technologies, they are becoming more competitive. The confirmation of this fact at the practical level allows us to highlight one of the study's relevance, which is based on the assumption that the higher investments in innovation are, the more competitive financial institutions become.

During analyzing digitalization as an evolutionary stage in the development of modern society, it is necessary to consider the main stages of its formation in the segment of finance. It should be emphasized that the digitalization of civilization is more noticeable in the financial sector than in the economic one since financial services accompany all types of traditional and digital business. Thus, we can summarize another side of the study's relevance, which is based on the fact that states' financial systems would become more developed with the development of digital technology.

Digitalization is evolving rapidly, disrupting the usual order of things in the traditional value chain. As a result, companies in the financial segment and companies that use digital financial technology have a more significant advantage over other traditional financial technology companies. The difference is felt at the level of micro-entrepreneurship or the financial market and in developing the country's economies. Practice shows that the better developed financial technology, namely digital finance, the more developed financial markets, and states' financial and economic conditions are considered.

Today, many researchers believe that digital finance allows bringing almost the entire range of financial services to the global level, making finance available for different activities for different countries, regardless of their development level. Moreover, according to the World Bank [1], digital finance through free global distribution can become a tool to fight poverty. Digital technology also contributes to higher rates of economic growth and reduces income inequality faster. This fact forms the study's main hypothesis, which suggests that the greater the implementation of digital finance in a country's economy is, the more developed it will be against countries that do not develop digital finance.

The study aims to show the level of development of digital finance in different countries and its impact on their economic development.

2. Literature Review

The issue of digital finance in general terms is sufficiently studied in the scientific literature and covered in the regulatory documents. At the same time, the concept of digital finance is quite controversial, and each researcher puts different components in the essence of this concept [2]. For example, some authors study digital finance in terms of financial services, which financial and non-financial organizations provide via the Internet, cell phones, and cards connected to payment systems [3-5]. In other words, the authors believe that the concept can be applied both in creating a digital product and using a traditional product sold over the Internet. The same opinion is held by Shofawati [4], who highlights digital finance through technologies that make it easier to use financial products.

In the same turn, McKee et al. [5], in their study, believe that the field of review of digital finance includes the activities of financial institutions that provide digital products through their online resources. Digital products include loans, money transfers, insurance services arranged through the Internet, cell phones, POS, biometric devices, and ATMs.

When it comes to international organizations, the Asian Development Bank puts service technology in the concept of digital finance [6]. The Organization for Economic Cooperation and Development applies the concept to the entire range of financial services provided by financial institutions [7]. Furthermore, Bank for International Settlements and the World Bank Group use digital finance in the context of the application of digital payment systems in the economy, the use of cloud technology in the establishment of commercial relationships, particularly the use of electronic contracts. Also, the field of research includes government financial transactions for the sale of government securities, business financing, etc. [8].

As a result of the different approaches to understanding the concept of digital finance, it makes sense to combine them. The same opinion is held by Pertseva, who believes that the ecosystem of the financial sphere includes such elements as startups, technology companies, financial institutions, and infrastructure players [9]. Thus, the sphere of digital finance contains:

- automated operation of the banking sector;
- electronic payments in e-commerce;
- electronic money transfers;
- electronic trading, including public procurement;
- electronic management of the securities market;
- automated operation of private investors and investment funds;
- digital allocation of the state budget;
- public social assistance requests;
- automated digital insurance services [10].

The introduction of digital technologies requires a significant financial outlay and a radical change in the business strategies of all sectors of the economy. In turn, the high efficiency of applying innovative solutions forces the financial sector to transform both to strengthen its position in the market and increase the level of interaction with customers and market participants. That is why digital finance in this study will be studied not only in financial institutions but also in financial transactions in general, which accompany all economic processes in the states.

3. Research Methods

The development of digital finance can be observed and analyzed through statistical information, in particular surveys of international organizations, such as the World Economic Forum. Quite valuable are also studies by Tufts University in the field of digitalization of economies and estimates of the level of confidence in digital technology by people around the world [11].

The empirical research uses statistical data, particularly the results of surveys conducted by international organizations and universities. The results of these surveys made it possible to form a rating of the digitalization of economies based on an analysis of the rate of development of the digital economy in different countries of the world. Digital finance was evaluated according to more than one hundred indicators. The Digital Evolution Index assessed the survey as answering the following questions:

which countries own more competitive digital economies?

which organizations are considered key drivers of the economy, and are they privately or publicly owned?

how do countries drive the pace of their digital economies?

There is also information on the impact of digital technology on the economy from the World Economic Forum's annual World Competitiveness Rankings [12]. This ranking shows the information on the development of the financial system of each state. Therefore, the work will study the impact of digitalization of the economy on the innovation level, the IT-technology development, the financial system, and the country in general.

The work also applies the grouping, sorting, the study of the largest and smallest values, the average indicators. To conduct empirical research, a sample of 25 states, which form the rating of digitalization of the economy, was made. It considers the states of different continents and different levels of development to show the complete picture of the generalized world. The method of correlation analysis, particularly the Pearson coefficient, is used to find relationships between different indicators. According to the

research results, it will be considered that the dependence is present if the Pearson coefficient is higher than 0.9.

The study also applies general scientific methods of knowledge, which help to find patterns, generalize information, highlight ideas and hypotheses and conduct their research. In addition, graphical methods of presenting information are used to display the results of the study.

4. Research results

Let's summarize the history of the development of digital finance in the global economy studied in the literature. In that case, it is possible to identify seven major stages, which are vital in financial technology development. Consider them in Table 1.

Table 1: Evolution of global finance development

Period	Stage	Characteristics
1950s	Appearance and active spreading of bank cards	Development and promotion of banking products and services for a wide range of clients in the retail segment. Credit cards were a universal product developed by banks for mass consumer
1960s	Use of ATMs	Automated Teller Machine (ATM) ATMs were invented and began to be actively used for the convenience of customers and the ease of conducting cash transactions, which made it possible to use banking services outside bank offices
1970s	Creation of electronic trading platforms (the first one was NASDAQ)	Systematization and automation of operations on the securities market significantly simplified financial transactions
1980s	The first banking computers and information technology solutions	The creation of special electronic tools for processing banking information on the basis of specialized microcomputers allowed credit institutions to reduce costs. It became possible to equip the workplace of a bank employee with a computer
1990s	The emergence of the "financial technology" industry	The emergence of a special ecosystem that combines innovative solutions and technologies in the field of financial products and services
2000s	Robotization, visualization, and the advent of the Internet of Things, as well as the creation of ecosystems that link people and digital agents	Mass spread of Internet communications. The merging of traditional operational and information technologies, the spread of "smart" machines. Information becomes a tool for value creation and an independent product (predictive and prescriptive analytics, remote monitoring and management).
2010s	Application of smart contracts in the financial industry, use of blockchain technologies	Blockchain technology goes beyond cryptocurrencies and is used in various spheres of commercial activity and the organization of mutual financial settlements. The use of smart contracts reduces the cost of intermediary services, accelerates business processes in all spheres, and makes them more secure

Source: compiled by the author

Let's conduct an empirical study to determine the impact of digital finance on the global economy. Firstly, let's rank 25 countries on the level of digitalization of economies, which will form the sampling field for the study.

These countries have both the highest digital evolution index scores and the lowest to make the maximum coverage of the different types of impact of digitalization on financial processes.

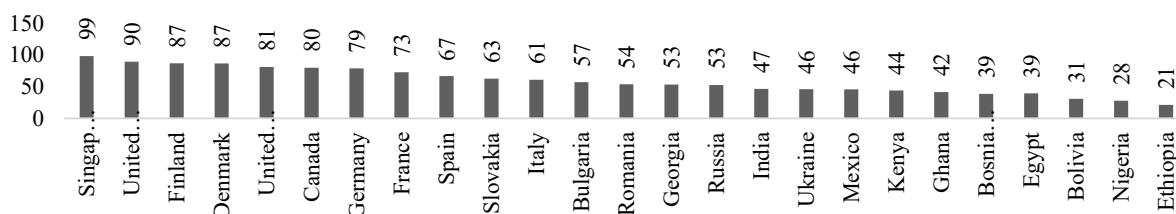
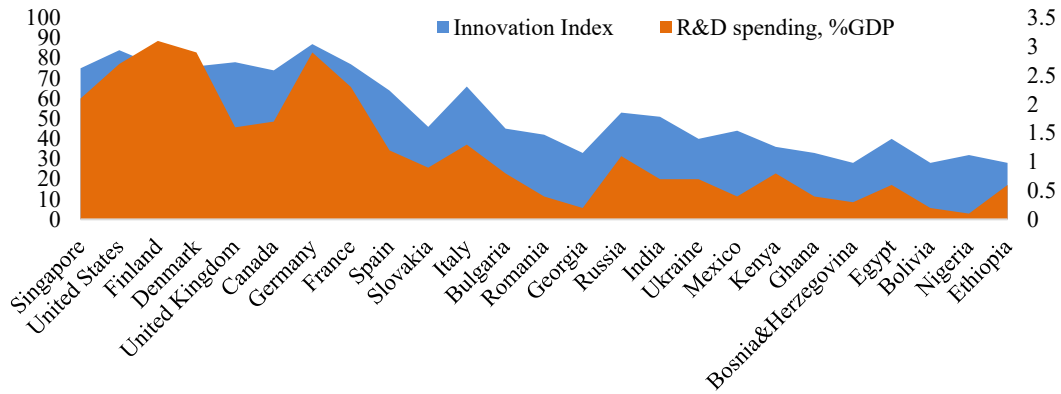


Fig.1. Ranking of countries by the level of digitalization of economies

Source: compiled by the authors based on [11]

According to the ranking results, it can be concluded that the absolute leader in the digitalization of the economy today is Singapore. Being one of the most developed countries today, the USA occupies second place in the ranking with a gap of 9 positions from the leader. Today, we can safely say that digital development depends directly on innovation, development, and research investments. Of

course, the development of digital and innovative technologies requires significant funding, so countries with sufficiently developed economies can mostly afford such costs. For example, the U.S. allocates 2.7% of the country's GDP for research and development, and Finland - 3.1% (see fig.2).



x - R&D spending, % GDP	2,1	2,7	3,1	2,9	1,6	1,7	2,9	2,3	1,2	0,9	1,3	0,8	0,4	0,2	1,1	0,7	0,7	0,4	0,8	0,4	0,3	0,6	0,2	0,1	0,6
y- Innovation Index	75	84	76	76	78	74	87	77	64	46	66	45	42	33	53	51	40	44	36	33	28	40	28	32	28
$(x - \bar{x})$	0,9	1,5	1,9	1,7	0,4	0,5	1,7	1,1	0,0	-0,3	0,1	-0,4	-0,8	-1,0	-0,1	-0,5	-0,5	-0,8	-0,4	-0,8	-0,9	-0,6	-1,0	-1,1	-0,6
$(y - \bar{y})$	21,6	30,6	22,6	22,6	24,6	20,6	33,6	23,6	10,6	-7,4	12,6	-8,4	-11,4	-20,4	-0,4	-2,4	-13,4	-9,4	-17,4	-20,4	25,4	-13,4	25,4	-21,4	-25,4
$(x - \bar{x})(y - \bar{y})$	19,4	45,8	42,9	38,4	9,8	10,3	57,1	25,9	0,0	2,2	1,3	3,4	9,2	20,4	0,0	1,2	6,7	7,6	7,0	16,4	22,9	8,1	25,4	23,6	15,3
$(x - \bar{x})^2$	0,8	2,3	3,6	2,9	0,2	0,3	2,9	1,2	0,0	0,1	0,0	0,2	0,6	1,0	0,0	0,3	0,3	0,6	0,2	0,6	0,8	0,4	1,0	1,2	0,4
$(y - \bar{y})^2$	465	934	509	509	603	423	1126	555	112	55	158	71	131	418	0	6	181	89	304	418	647	181	647	460	647
\bar{x}	1,2																								
\bar{y}	53,44																								
$\sum(x - \bar{x})(y - \bar{y})$	420,10																								
$\sum(x - \bar{x})^2$	21,66																								
$\sum(y - \bar{y})^2$	9648,16																								
R	0,92																								

Fig. 2. Comparison of the innovative development country's level and investment in new technologies
Source: compiled by the author based on [12; 13]

To prove the influence of investments in the development of innovative technologies on the level of innovations in the country, let us compare investments into innovative products and the level of countries' innovative development.

The results of the analysis show a correlation between the indicators at the level of 0.92, which allows us to prove that the more the state allocates funds for the development of innovation, the higher will be the level of innovative development and, consequently, the level of digitalization of the economy.

Having measured the current state of development of the digital economy and the pace of its development, let's make the map of the "digital planet" [14]. It divides countries into four groups: leaders, slow-growth countries, promising countries, and problematic countries. Of course, some countries are present on the borders of these areas. Two of the world's largest economies, the U.S. and Germany, are present between the leading and the slowing countries. The world's third-largest economy, Japan, is also close to them. They must recognize the risk of a digital dead end and explore what policies can improve a country's

competitiveness using the example of smaller, more dynamic emerging economies.

More and more systemic changes are needed to accelerate digital development in such an environment [15].

Table 2: Comparison of the dynamics of digital finance in the world

Group of countries	Characteristics	Examples of countries
Leading countries	They have a highly developed digital economy and strong development dynamics. They drive innovation by leveraging their advantageous position. However, it is very difficult to maintain high growth rates over time, and innovation is often unreliable for expanding economic influence. In order not to lose their position, these countries must create new demand, and the development of innovative solutions must be in full swing. Otherwise, they run the risk of becoming a slow economy.	Singapore, USA, Finland, Denmark, United Kingdom, United Arab Emirates, New Zealand
Slow-growth countries	They have a well-developed digital economy, but they are losing momentum. The top five countries in our ranking (Norway, Sweden, Switzerland, Denmark, and Finland) are in this category, which shows how difficult it is to maintain growth. To overcome the digital plateau, these countries will have to make a conscious effort to rethink their economic model, put everything on the digital technologies and technological areas in which they lead, and remove any obstacles to innovation. What they can learn from leading countries is how to support innovative development. Using their experience, scale, and network effect, slowing countries can transform themselves and start growing again.	Denmark, Sweden, Ireland, South Korea, Belgium, Canada, Netherlands
Emerging countries	They are currently at a low level of digitalization, but they are overgrowing. Significant momentum and potential can make them very attractive to investors. However, they are held back by underdeveloped infrastructure and a poor institutional environment. The best solution for them is to create new high-quality institutions that would help stimulate innovation. Prospective countries have the potential to become the leaders of the future.	China, Malaysia, Kenya, Russia, India, Cameroon, Ukraine, Nigeria, South Africa
Troubled countries	They are at a low level of digitalization and have low momentum, which creates a big challenge for them. In some of them, the pace of digital development is declining altogether. On the other hand, some of the challenged countries are creative in the face of significant infrastructure shortages, institutional constraints, and a lack of consumer sophistication. The surest way for them to increase their momentum would be to improve people's access to the Internet by narrowing the gap in mobile Internet use, the difference between the number of cell phones and cell phones connected to the network.	Egypt, Hungary, Peru, Pakistan, Greece

Source: [15]

It should be noted that by 2030, the rate of development of the global digital economy will more than double. This is due not only to the future population increase but also to the increase in income and life quality. As a result, the Chinese and Indian middle classes will become the largest consumers in the world, which means that the market will be largely focused on them.

Many financial companies will have to move to new business models that incorporate a new level of information technology that supports a sufficient level of security, speed, and transparency.

Changing old business models by financial institutions involves.

1. Developing a digital strategy based on the need to make constant adjustments (high speed of digital innovations, changes in legislation, etc.). The bank's digital strategy development is based on defining key segments of sustainable development: creating a digital product, including personalized banking services; ensuring end-to-end interaction with clients, regulators, and partners; developing a financial ecosystem of partners; creating business incubators, etc.

2. Creation of IT system architecture or IT landscape. This stage implies developing sets of software, computing,

and telecommunication means arranged in a specific configuration and providing operational processes for business units; creating a road map for implementing the digital strategy with the help of the IT landscape involves singling out separate business areas: multichannel distribution and marketing, integration of services and processes, operations processing, maintenance, data factory, strategy, and management. Banks need to implement a single multichannel digital platform to develop these business domains to manage multichannel services effectively.

3. Development of IT solutions and their commissioning. In order to ensure effective integration of services and processes, mobile technologies should be used to provide open data to the participants of the lined partnership scheme. Furthermore, in the area of transaction processing, including cross-product functions, it is advisable to strengthen the automation of processes and procedures.

Already existing technologies make financial transactions faster, safer, and more transparent. They involve multichannel procedure support and the ability to accompany any business processes with automated financial settlements. Blockchain technologies are actively

promoted in the financial sector, which can save banking costs and take service to another level [16].

Speaking about the financial sector, it should be noted that in 2020, the turnover of the cryptocurrency market consisted of \$0.84 billion. Already in 2021, the indicator will be \$1.46 billion [17], and then the dynamics will develop rapidly, increasing last year's figures almost twofold (see Fig. 3.).

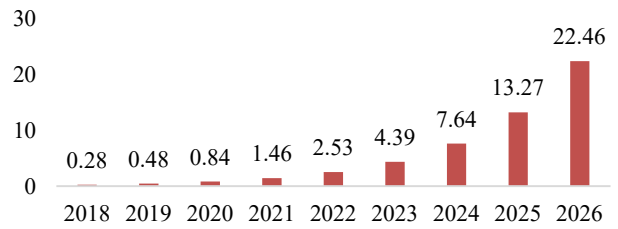
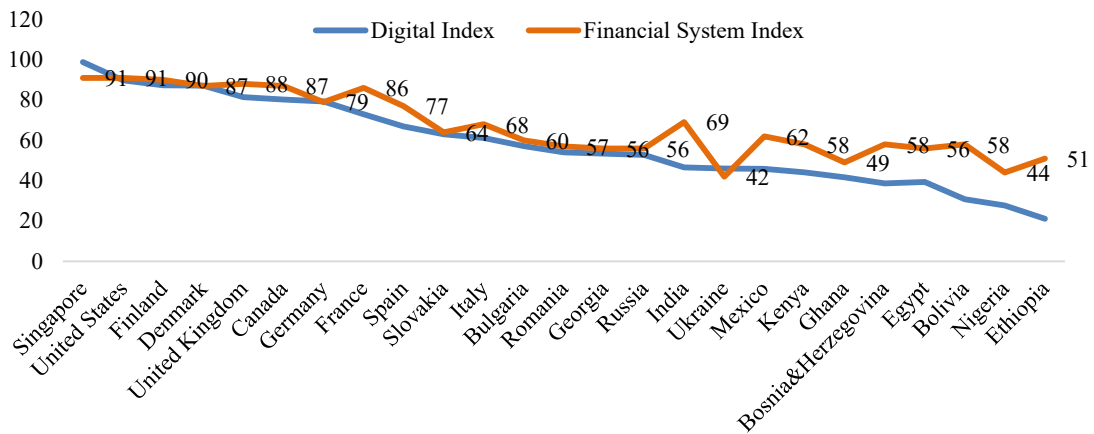


Fig. 3. Forecast for blockchain technology in the financial industry, \$ billion. Source: [17]

If we talk about the impact of digitalization of the economy on the financial sector, these indicators are also interrelated, as shown in Fig. 4.

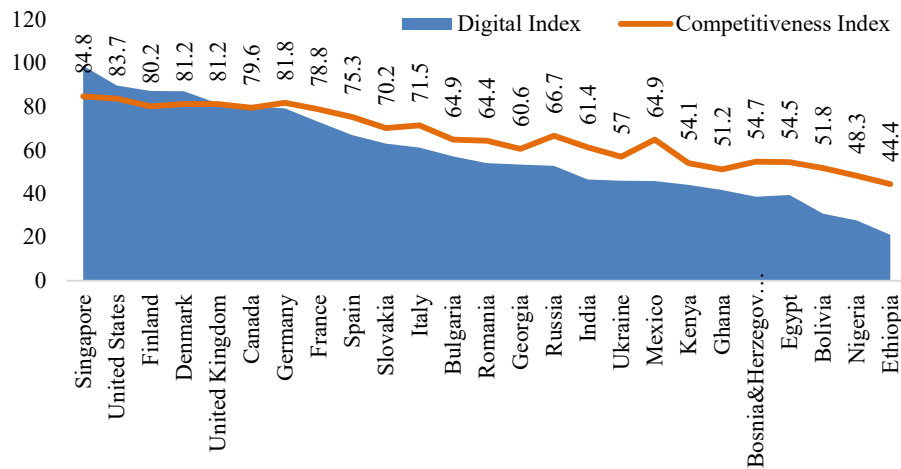


$x - \bar{x}$	99	90	87	87	81	80	79	73	67	63	61	57	54	53	53	47	46	46	44	42	39	39	31	28	21
$y - \bar{y}$	91	91	90	87	88	87	79	86	77	64	68	60	57	56	56	69	42	62	58	49	58	56	58	44	51
$(x - \bar{x})(y - \bar{y})$	40	31	29	28	23	22	21	14	8	4	3	-2	-5	-5	-6	-12	-13	-13	-15	-17	-20	-19	-28	-31	-38
$(x - \bar{x})^2$	160	968	817	810	519	464	423	204	68	18	7	2	22	28	35	147	161	165	214	290	402	372	778	958	141
$(y - \bar{y})^2$	559	559	513	386	426	386	135	347	93	11	0	54	107	129	129	3	643	29	88	337	88	129	88	546	268
\bar{x}	58,71																								
\bar{y}	67,36																								
$\sum(x - \bar{x})(y - \bar{y})$	7367,93																								
$\sum(x - \bar{x})^2$	10894,43																								
$\sum(y - \bar{y})^2$	6051,76																								
R	0,91																								

Fig. 4. Comparison of the state of digitalization of economies and the financial system of states Source: [11; 12]

Pearson index between the level of digitalization of economies and the financial system is $R=0.91$, which in general leads to the conclusion that the overall indicator of digitalization of the economy has a significant impact on the financial sphere. At the same time, the financial sphere is improving more noticeably than the economic processes. For example, a few years ago, it was impossible to imagine that it was possible to monitor bank accounts without visiting a financial institution [18]. Still, today it is possible to scan all financial processes with a cell phone, and household settlements can be performed even without using mobile devices using biometric data.

Despite the differentiation of countries, we can say that all states are aware that improving the quality of digital resources is a priority. The economy will function more effectively if the state has reached the full potential of infrastructure development in time and its entirety. All spheres of public life are aimed at digitalization, which leads to transparency, flexibility, and rhythm of functioning. The digitalization of the economy has a more significant impact on economic development in general than on specific sectors of the economy, as can be seen in Fig. 5.



$x - \bar{x}$	99	90	87	87	81	80	79	73	67	63	61	57	54	53	53	47	46	46	44	42	39	39	31	28	21	
$y - \bar{y}$	84.8	83.7	80.2	81.2	81.2	79.6	81.8	78.8	75.3	70.2	71.5	64.9	64.4	60.6	66.7	61.4	57	64.9	54.1	51.2	54.7	54.5	51.8	48.3	44.4	
$(x - \bar{x})^2$	1609	968	817	810	519	464	423	204	68	18	7	2	22	28	35	147	161	165	214	290	402	372	778	958	1414	
$(y - \bar{y})^2$	328	289	183	211	211	167	228	147	74	12	23	3	5	37	0	28	94	3	158	240	144	149	222	338	497	
$\sum(x - \bar{x})(y - \bar{y})$	6246,89																									
$\sum(x - \bar{x})^2$	10894,43																									
$\sum(y - \bar{y})^2$	3790,31																									
R	0,97																									

Fig.5. Comparison of the level of digitalization of economies and their competitiveness
Source: [11; 12]

The correlation between the digitalization of economies and state competitive level is the highest, as the Pearson coefficient is $R=0.97$. This supports the hypothesis that as economies' overall level of digitalization increases, they become more competitive. Therefore, digital investments are attracting more and more attention. Of particular importance in this matter is the financial policy of the countries, which is directed to the development of financial markets. More and more countries around the world are aware of the need to digitalize the economy's financial sector. Developed and developing countries are actively pursuing policies to increase money turnover in the digital economy, and digital finance also remains a significant challenge.

Discussion

The issue of the importance of innovation in the financial sector is a well-studied one in the academic literature. The theory of financial innovation was proposed in 1983 by Silber, who already suggested that increased speed, automation of work, and reduced office costs contribute to the rapid development of the economy through increased liquidity of companies [19]. Ketterer in his study, showed that the development of digital finance after the end of the great crisis of 2007-2010 contributed to the development of new business models of activity [20]. Financial institutions that have organized e-accounts and the ability to settle, finance, and inform through mobile devices build significant competition to older financial services business models. Shofawati examines empirical research across different countries and concludes that digital finance is vital for small businesses and people of all nations who are starting businesses and increasing business activity using digital financial technology [4]. Empirical research in the industry was conducted by Beck [21] and Michelle [19], who confirmed that financial institutions with old business models could not effectively manage financial resources.

The researchers also note that closing the gap between cash and digital payments is helping businesses grow more rapidly and creating new opportunities for their organizations. Unsurprisingly, digital finance is also being explored on the crowdfunding side of startup financing. The work of world-renowned platforms Kickstarter, Crowdcube, Crowdfunder, Kisskissbank, Ulule promote business activity in all countries [22].

If we talk about the future directions of the development of digital finance, the main driving force for the development of digital finance are cloud computing, BigData technologies, DLT blockchain technologies, application of artificial intelligence, Internet of things, electronic and cryptocurrencies [23]. These technologies are the primary tools for building modern business models,

expected by society, which is accustomed to the available technologies of business creation on Google, Amazon, Facebook, Apple, Alibaba. Today, society is ready for platforms that are ready to finance purchases and investments using a lender's business model on a trading platform. At the same time, the service should be as simple and accessible as the management of businesses on the marketplaces mentioned above [20].

Conclusion

The study of statistical information and theoretical framework allows us to draw the following conclusions:

- digital finance is the basis for supporting all economic processes in the state. It allows organizing business financing, improving financial flows, and making them more accessible to developing countries;
- developed countries have more advanced digital technologies, which allow, through innovation, to develop the economy more efficiently compared to less developed countries;
- it is essential for developing countries to allocate sufficient funds for the digitalization of all business processes, which will improve their competitiveness in the global market.

The empirical study has been shown to form the study's novelty and the field for further scientific research. According to the statistical analysis, the following hypotheses and assumptions can be confirmed:

- the higher the level of spending on innovative development and technology is, the higher is the level of the innovation economy, i.e., automation of all business processes, including financial ones;
- digital technologies have a significant impact on the financial system, i.e., with the development of digital technologies, the financial systems of states become more developed;
- digital technologies have a more significant impact on all spheres of activity than on a separate one. It indicates the synergistic effect of the digitalization of finance on the development of states.

Thus, by developing digital technologies in the financial sphere or acquiring them, states can significantly grow the financial system, which will become the foundation for economic development.

The practical value of the research allows justifying the use of financial flows for the innovative development of the financial sphere as the main driver of economic growth. The main prospects for the development of this topic are mobile express technologies for financing business development, which will accompany the conduct of digital and traditional business.

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