THE INFLUENCE OF INDUSTRY 4.0 ON FINANCIAL SERVICES: DETERMINANTS OF ALTERNATIVE FINANCE DEVELOPMENT

Bilan Yu., Rubanov P., Vasylieva T., Lyeonov S. [*]

Abstract: Digitalization and virtualization in the era of the Industry 4.0 adjust the nature of finance and interaction between market participants. Many financial services are transferred to the virtual plane allowing the development of alternative finance – raising funds and carrying out borrowings through online platforms. Based on the analysis of the influence of factors on the alternative finance development, the paper formulates five hypotheses on the dependence of the amount of financial resources attracted through online platforms on the quantitative characteristics of the relevant factors. The goal is to study the factors of online financing service as an alternative to traditional financial intermediaries (including banks) using the method of correlation analysis. As the quantitative parameters of each factor, the use of commonly accepted indices and individual relative indicators is proposed. The results of the study showed 1) the significant impact of the country's economic development on the degree of the alternative finance development; 2) the strong direct influence of financial inclusion and the level of innovation of the country on the volume of alternative finance; 3) the lack of direct influence of information technology and the absence of the regulatory influence of the state on the development of the alternative finance market.

Key words: financial services, Industry 4.0, financial innovations, alternative finance, online financing

Introduction

The modern industrial revolution is a natural result of all previous technological developments, embedded in social and economic systems. The concept of Industry 4.0 is based on the creation of value through the close interaction of all economic agents through digitalization. Each physical asset involved in the process of creating value is digitized and embedded into a single ecosystem of Industry 4.0 (Schwab, 2015). The main characteristics of Industry 4.0 include: digitization and

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[*] Dr. **Yuriy Bilan**, Tomas Bata University in Zlin, Faculty of Management and Economics, Centre of Applied Economic Research, Zlin, Czech Republic; Assoc. Prof. **Pavlo Rubanov,** PhD.; Prof. Dr. **Tetiana Vasylieva,** Sumy State University, O. Balatskyi Academic and Research Institute of Finance, Economics and Management, Department of Finance and Entrepreneurship, Sumy, Ukraine; Prof. Dr. **Serhiy Lyeonov,** Sumy State University, Education and Research Institute for Business Technologies, Department of Economic Cybernetics, Sumy, Ukraine

✉Corresponding author: yuriy_bilan@yahoo.co.uk

✉p.rubanov@finance.sumdu.edu.ua; tavasilyeva@fem.sumdu.edu.ua;

s.lieonov@uabs.sumdu.edu.ua

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vertical integration along the value chain, digitization and horizontal integration of several cost-creating chains, digitization of products and services, digital business models and customer access, developed technological platform.

Virtualization and decentralization, characteristics of the Fourth Industrial Revolution, have spread to the sphere of production, promotion and sales, as well as to the sphere of services and information exchange. But although the changes from the introduction of digital technologies affect all spheres of life, the pace of changes in various sectors of the economy depends on many influencing factors, and what business model the actors follow (Ślusarczyk, 2018). Industry 4.0 has positive effects on the economy; in particular, it leads to improvements in the processing of information, its distribution among the participants and accessibility. New intellectual capabilities provide the opportunity to receive actual and reliable information in real time, reduce the time to process data, sorting and classifying information, increasing its quality and relevance for quick and up-to-date decisions (Min et al., 2018).

The development of digital technologies further contributes to the producer's understanding of the needs and expectations of consumers at the stage of using goods and services. This allows businesses to use both cost-based and results-based approaches to assess the competitiveness of products (Fedulova, 2018). In contrast to the traditional focus mainly on minimizing the costs of goods and services to consumers, businesses also need to monitor, measure and analyze the economic results from the use of the product on the side of its customers. Such consideration of consumer needs allows enterprises to compete more effectively in the market. At the same time, Industry 4.0 could yield greater inequality, particularly in its potential to disrupt labor markets. In addition, there are a variety of challenges, such as cybersecurity, hacking, risk assessment, and others (Lambert, 2017).

The financial sphere as a significant element of the economic system should be directly involved in the formation and implementation of the concept of Industry 4.0. Financial services generated by financial and credit relations should be integrated into the process of functioning Industry 4.0 ecosystem.

Virtualization and decentralization of processes in production and services are among the principles of Industry 4.0 (Hermann et al., 2016). The use of digital technologies has triggered large-scale transformations in the financial sector. In particular, significant changes have occurred in the technology of financial services, in circulation and trade of financial instruments that led to the rethinking of the role of financial intermediation.

The continuous digitization of financial services ensures their compatibility with used gadgets, adapts them to CPS (cyberphysical systems), and data analytics platforms, provides an opportunity for invariant and complex consumer solutions. All revisions to the standards of financial services are made taking into account the expanding requirements of end-users. Leading financial institutions are constantly increasing the list of innovative financial services. Consumers are often offered innovative standards. For example, technologies of augmented reality, improved

interfaces "human - computer". Personalized customer service is becoming commonplace in order to improve the access of clients of availability of banking, insurance and investment services.

Some innovative financial technologies have rooted in the functioning of the financial sector; have become commonly used as the only possible way of performing technological operations and processes. At the same time, innovative financial technologies are a new means of competitive struggle in the markets of traditional financial products (Paskevicius and Keliuotyte-Staniuleniene, 2018).

Further technological development and digitalization of financial services are associated with the use of innovative financing methods and the development of FinTech start-ups, which ensure the provision of a number of online financial services directly to the key market participants, excluding the participation of financial intermediaries.

Thus, the purpose of the article is studying the factors of online financing service as an alternative to traditional financial intermediaries (including banks) using the method of correlation analysis.

The present study consists of several parts. First of all, we considered and grouped the factors that influence the volumes of alternative finance. In the next step, we proposed five hypotheses regarding the direction and the strength of linkage of each of the factors and volumes of alternative financing. We also identified a list of indices and indicators for the quantitative display of the influence of each factor. The next part of the study is devoted to testing hypotheses and goes through several stages. At the first stage, the correlation analysis method determines the presence and the strength of the link between the selected indicators for each factor and the indicator of the volume of alternative finance. The last part of the study includes testing and discussion of the formed hypotheses.

Literature Review

The thesis on the leading role of banks in the functioning of the financial system still remains valid for today's economies. However, digitalization and virtualization in the era of the Industry 4.0 adjust the nature of finance and interaction between the main market participants. Many business processes and services are transferred to the virtual plane. Nowadays consumers prefer mobile or Internet banking, online consultations and virtual operations with their accounts. There are online platforms that allow loans directly from the creditor to the borrower (peer-to-peer platforms) or to raise funds for investment or other needs under different conditions – on a charitable basis, with financial or non-financial remuneration (crowdfunding platforms). There is a widespread view of the availability and price advantage of peer-to-peer loans compared to bank lending, since transaction costs are significantly reduced and there is no interest margin of the bank. However, research shows that there are many factors that influence the formation of the cost of loans on the peer-to-peer market and on the choice of borrowers by creditors (Gavurova et al., 2018).

On the other hand, peer-to-peer and crowdfunding platforms are often able to provide funding for those groups of borrowers, for which bank credit products are unavailable or too expensive. This applies to small- and medium-sized businesses receiving bank loans, which face with a number of obstacles, even in developed countries because of the high cost of a loan, the need for collateral, the lack of available loans, etc. (Rahman et al., 2016). Another reason for choosing crowdfunding platforms instead of bank lending is the need to finance innovative projects that are reasonably associated with an increased risk, and therefore, banks are very limited or do not lend at all (Cichy and Gradoń, 2016). Thus, crowdfunding platforms are an alternative source of additional financial resources for the implementation of green projects (Pimonenko et al., 2017). The exception is only specialized investment banks focused on lending innovative investment projects (Kozmenko and Vasylieva, 2008).

In the broad sense, alternative financing includes all channels of getting financial resources by individuals and legal entities in addition to traditional lending from banks and non-bank financial institutions; getting funds on the stock market. In this approach, alternative finance particularly includes funds raised by enterprises from internal sources, as well as external alternative financing - loans from friends and relatives, commercial and leasing loans. Another approach to considering the nature of alternative finance interprets it as funds raised by individuals and legal entities through specialized online platforms.

In this study, we will consider alternative financing as attracting financial resources to individuals and legal entities exclusively through specialized peer-to-peer and crowdfunding online platforms that create access to financial resources bypassing the banking system or traditional non-bank financial intermediaries and provide direct linking between borrowers and creditors (providers and recipients of financial resources). The types of alternative financing considered in the article include peer-to-peer consumer lending, peer-to-peer business lending, balance sheet business lending, equity-based crowdfunding, reward-based crowdfunding, real estate crowdfunding, profit sharing crowdfunding, donation-based crowdfunding, invoice trading (Zhang et al., 2016a).

In 2015, the total global market for alternative finance was about $ 150 billion. Among European countries, the mechanism for attracting financial resources has developed most in the UK, France, Germany, the Netherlands (Wardrop et al., 2015); among countries of the Americas region - in the USA and Canada (Wardrop et al., 2016). In Asia–Pacific region, the leaders in terms of alternative financing are China, Japan, Australia, New Zealand (Zhang et al., 2016a). A significant amount of alternative financing among the countries of Africa and the Middle East is concentrated in Israel and the UAE (Ziegler et al., 2018). Significant volumes of financial resources attracted through the online platforms are characteristic of countries such as Mexico, India, Chile, Argentina, Estonia, Poland, Brazil, OAU. In contrast, in many countries characterized by a much higher level of economic development and the development of the financial system (Norway, Iceland,

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Luxembourg), the mechanism of alternative financing has not become widespread. Thus, a powerful alternative to traditional bank loans exists in many countries around the world in the form of online peer-to-peer and crowdfunding platforms.

The development of alternative finance in each country depends on many factors, among which economic factors play an important but not exclusive role (Zakharkin et al., 2017). Investigating these factors and formalizing the impact of each of them on the dynamics of the alternative finance market will make it possible to better understand the functioning of the alternative finance mechanism and identify the relationship between their development and the state of the banking system in the country. The article proposes the solution of the problem of formalizing the influence of factors on the dynamics of the alternative financing market using the methodology of correlation analysis. As the quantitative parameters of each factor, the use of commonly accepted indices and individual relative indicators is proposed.

Identification of the Factors

Alternative online financing is used to attract borrowed funds for consumer and investment needs of households, as well as to realize the investment objectives of individuals-entrepreneurs, small- and medium-sized businesses, and even large enterprises. As a rule, the cost of borrowing financial resources through the online platform is lower than in the case of bank lending (Barnes, 2015). At the same time, high inflation, unfavorable investment climate, reduced household savings, unfavorable business conditions and other threats to the macroeconomic environment have the same negative effect on the dynamics of development of all segments of the financial market (Bhowmik, 2018), including both the banking sector and alternative financing market. The study (Leonov et al., 2014) also confirms the dependence of stock market development on the dynamics of economic indicators such as GDP, inflation, gross savings, the level of interest rates on deposits and others.

Even in favorable periods of the business cycle, despite the available opportunities to increase capital and liquidity reserves, the financial sector accumulates financial imbalances within itself, which later becomes the cause of the financial crisis (Vasilyeva et al., 2013). However, a study by Djalilov et al. (2015) specifies that banks with a high level of concentration and technical efficiency demonstrate a different attitude towards risks in early and late transition countries. In particular, such banks in countries with the early transition countries reduce risks more during periods of economic stability and even more during times of turbulence. On the contrary, similar banks assume more risks in the late transition countries in stable conditions.

When analyzing the state of the economy, one should pay particular attention to such components as investment climate and business development. Particularly important is the favorable business environment and the availability of funding

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sources for small- and medium-sized businesses (Civelek et al., 2016), as the main users of crowdfunding and peer-to-peer business lending.

In addition to the general state of the economy, the factors of the state and development of financial intermediation system have a direct influence on the development of alternative financing. Due to the branch network, the services of banking institutions are physically accessible to the majority of the population. In addition, bank savings instruments are perceived by the public as less risky, and therefore, in a crisis, bank liabilities will be less vulnerable than liabilities of non-bank financial intermediaries, in particular, joint investment institutions (Leonov et al., 2012).

At the same time, the problem of modern society is the level of financial inclusion in the country, that is, the ability to obtain the necessary financial services for all categories of the population regardless of their age, income level, credit history, place of residence, etc. (Morsher et al., 2017). Persons with low income, lack of permanent employment and / or credit history are a group of borrowers with a high credit risk, therefore, such categories of persons are either not loaned at all or they are subject to a high cost of credit resources. Limited access to banks' loan resources is often observed for people living in rural areas, geographically remote regions, and so on. It can be assumed that if it is impossible to obtain a bank loan, citizens and enterprises will look for alternative sources of funding and will use peer-to-peer and crowdfunding platforms.

One of the key factors of changes in modern society that is characteristic of any sphere of human activity, without exception, is digitalization (Beyi, 2018; Balaraman, 2018). Alternative financing is an example of the use of digital technologies in the financial sector. For the market as a whole, crowdfunding and peer-to-peer online platforms are innovations. To date, such platforms can be considered one of the most successful types of Fintech startups (Deutsche Bank, 2015). Considering the alternative finance as a financial innovation, one can assume that the dynamics of its development in each country will depend on the level of its innovation, on the creation of favorable conditions for the introduction of innovations, the attitude to innovations and their perception in society, the willingness of people to use innovative technologies in various spheres of their activities (Akhmetova, 2017).

Alternative finance is not only financial but also technical innovation. The emergence and development of this mechanism would be impossible without the current level of development of information and communication technologies (Segal, 2016). The implementation of the alternative financing mechanism involves conducting Internet transactions using peer-to-peer and peer-to-peer online platforms that allow establishing direct links between creditors and borrowers (providers and recipients of financial resources) bypassing the banking system and other traditional non-bank financial intermediaries. Persons, who want to attract financial resources, after registering on the platform, publish information on the site about the purposes and desirable amounts of the loans or receiving funding

under other conditions. In turn, investors are able to choose their investment directions independently by reviewing their requests. Thus, the use of the alternative online financing mechanism requires the availability of special technical means, Internet connection, and computer skills. Therefore, it is fair to assume that the level of technological development of the country affects the number of Internet users and, accordingly, the number of potential participants in the alternative financing mechanism. On the other hand, there is the influence of the level of development of the alternative financing system on the development of the social sphere and human capital, which in turn form the country's long-term competitive advantages (Vasilyeva et al., 2018).

In our opinion, an important factor in the development of alternative financing is the nature of the regulatory influence of the state in this area. For the implementation of the online funding mechanism, special legal regulation may be created or the effect of existing regulatory documents in the financial sector can be extended. In the absence of special regulation, existing legal rules may restrict the use of certain models of alternative finance or the participation of individual groups of entities (for example, in the presence of requirements for possible sources of formation of the authorized capital of enterprises).

The introduction of special regulation of alternative finance can have both a stimulating and limiting effect on their development. For example, in China restrictive regulatory action against peer-to-peer platforms has been applied in connection with the lack of a procedure for evaluating borrowers' creditworthiness and massive non-repayment of loans raised through such platforms. In the United Kingdom, by contrast, peer-to-peer platforms are used to support small- and medium-sized businesses, by applying special tax incentives introduced in this country (Zhang et al., 2016b). In the United States and Mexico, special regulation of alternative finance involves simplifying the access to online platforms of certain types of investors (Wardrop et al., 2016).

There are definitely other factors that can affect the development of alternative finance, such as social structure, cultural characteristics of the country, the level of corruption, etc. (Nguedie, 2018; Prince, 2017; Yerznkyan et al., 2017), but the manifestation of their influence is mostly indirect and not so essential.

In general, the main factors that have the most significant impact on financial service industry are considered in the following groups: general economic condition, technology, legal regulation factor and demand for services (Office of Technology Assessment, 1984). We support this approach in the current study, but it needs to be clarified regarding alternative finance (Fig. 1).

Each of the identified factors is complex and in order to assess its impact on the development of the alternative financing market in the country, it is necessary to use complex, aggregate indicators. In view of this, it is suggested that indexes and generic indicators be used to show the appropriate state of economic, financial, regulatory, technological and innovation factors, and to provide comparability of data around the world. This approach allows us to accurately reflect the nature and

impact of each factor mark on a productive variable during inter-regional and interstate analysis (Mikalauskiene et al., 2016).

Statement of Hypotheses and Input Data

As a result of the preliminary analysis of the influence of factors on the development of alternative financing, five hypotheses were formulated regarding the dependence of the amount of financial resources involved through the online platforms on the quantitative and qualitative characteristics of the relevant factors:

Hypothesis 1: The volume of alternative finance in the country directly depends on the level of its economic development.

Hypothesis 2: The volume of alternative finance has a reverse dependence on the level of financial inclusion in the country.

Hypothesis 3: The volume of alternative finance directly depends on the level of innovativeness of the country.

Hypothesis 4: The volume of alternative finance has a direct dependence on the level of information technology development in the country.

Hypothesis 5: The volume of alternative finance directly depends on the nature of the regulatory influence of the state on the economy.
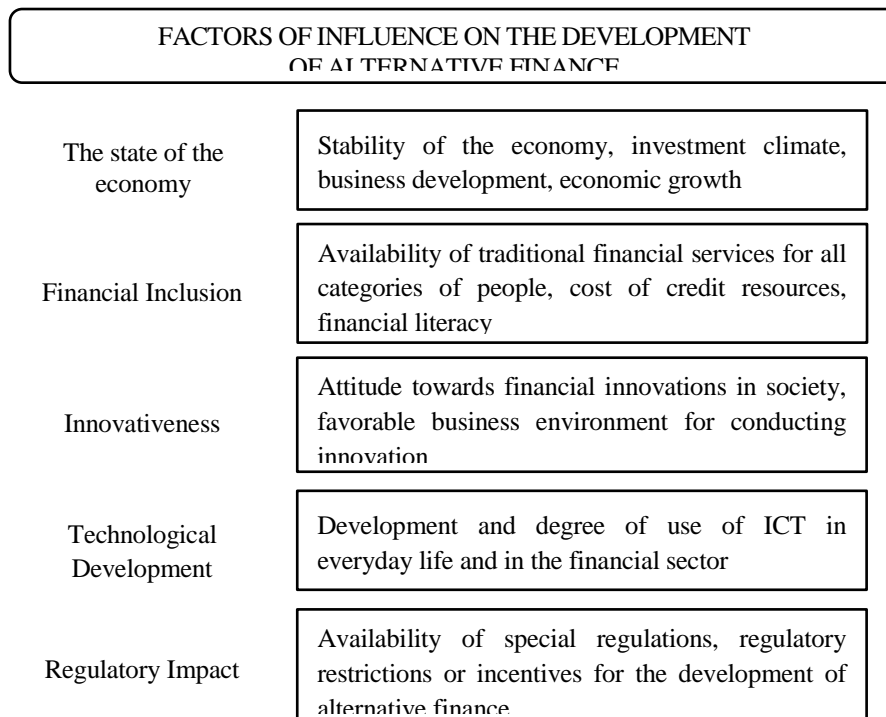

Figure 1. Factors of the development of alternative finance

Hypothesis testing is carried out for the countries of the world, which according to statistics from the Cambridge Center for Alternative Finance are leaders in the global alternative financing market.

For the adequacy of the interstate analysis, the selection of quantitative parameters for each of the factors of influence must meet the requirements of comparability, relevance, the display of the influence of the factor, the availability of statistical indicators for all countries under consideration. These requirements are met by indices and individual indicators, calculated and accumulated by international institutions and organizations such as the World Bank, OECD, specialized UN agencies (in particular, the World Intellectual Property Organization and the International Telecommunication Union), The World Economic Forum, and research institutes (in particular The Heritage Foundation).

The list of indices and indicators chosen for the quantitative display of the influence factors identified in this work is presented in Table 1.

Table 1. Indices and indicators for quantifying the influence factors

Factors influencing the volumes of alternative financing		Indices and indicators for impact assessment	Data source
The state of the economy	Economic development, financing need	GDP	The World Bank, 2014
	Financial market development	Global Competitiveness Index (GCI) - 8th component of "Financial Market Development"	The World Economic Forum, 2016
Financial Inclusion	Availability of traditional funding	The share of population (aged 15+) using loans from traditional financial intermediaries	The World Bank, 2014
	The share of the population not covered by the services of traditional financial intermediaries	The share of the population (aged 15+) not having a bank account	The World Bank, 2014
Innovations	The perception and support of innovation	Global Innovation Index (GII)	Cornell University et al., 2016
Technological development	Accessibility, prevalence and use of ICT	ICT Development Index (IDI)	International Telecommunication Union, 2016
Regulatory Impact	Public Policy Openness and Adaptability	Regulatory Impact Assessment (RIA) by the OECD methodology	OECD, 2015
	Regulatory barriers or incentives	Index of Economic Freedom	OECD, 2015

To test the first hypothesis regarding the direct dependence of the amount of alternative financing in the country on the level of its economic development, it is proposed to use two indicators − GDP and the component of the Global

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Competitiveness Index "Financial Market Development". The Global Competitiveness Index (GCI) is calculated annually by the International Economic Forum. It summarizes the ranking of countries in 12 components: the quality of institutions; infrastructure; macroeconomic stability; health and elementary education; higher education and vocational training; efficiency of the market of goods and services; labor market efficiency; financial market development; level of technological development; the size of the domestic market; competitiveness of companies and innovation potential. The use of the GCI aggregate indicator to test the impact of factors on the development of an alternative finance market is not feasible, since it does not allow to distinguish the effect of a particular parameter on the resulting indicator. Therefore, for the purposes of this study, only the 8th component index is used, which generalizes only the parameters of financial market development, namely: availability of financial services; affordability of financial services; financing on the domestic equity market; ease of access to loans; the availability of venture capital, and the reliability and credibility of financial intermediaries (The World Economic Forum, 2016). Indicators for assessing the impact of the level of financial inclusion on the development of alternative finance is the proportion of people aged 15 and over who borrowed money from traditional financial intermediaries, and the proportion of people aged 15 or older who have an account with a bank. The first indicator is calculated as the percentage of respondents who received any loan in a bank or other financial institution in the past 12 months. The second indicator reflects the percentage of respondents with an open account in the bank (both individual and joint) or another financial institution, considering the use of a mobile phone as a financial account. Both of these indicators are components of the World Bank's Financial Inclusion Index - Global Findex Database (The World Bank, 2014). They directly relate to the researched factor of financial inclusion and allow to objectively assess its impact on the level of development of alternative finance.

The Global Innovation Index (GII) can be considered as an accepted indicator for assessing the level of innovation in the country. When calculating the index, two groups of the components determining the input parameters of the development of innovations in the country (institutions, human capital and research, infrastructure, market sophistication and business sophistication) and the output parameters of innovation development (knowledge and technology outputs, creative innovation outputs). The organizations that collect information and calculate this index are Cornell University, INSEAD and the World Intellectual Property Organization (WIPO) (Cornell University et al., 2016).

The factors of innovation in the economy and technological development of the country are often considered in their mutual connection with each other (for example, in the study Balcerzak (2016)), since indeed most of the modern innovation is associated with the use of information technology. In this study, when assessing the impact of the technological factor, attention is focused exclusively on the level of information technology use. To test the hypothesis of a direct effect

of technological development on the volume of alternative finance, it is proposed to use ICT Development Index (IDI). Data on this index are published by the specialized agency ITU (International Telecommunication Union). The indicated index allows to fully take into account all factors related to the influence of information technologies on the development of the market of alternative finance, because in its calculation included 11 indicators for the three key components that respectively characterize the accessibility of ICT (the number of users of fixed and mobile telephony, international Internet bandwidth, the share of households with a computer and Internet access), the degree of use of the Internet (the share of Internet users, fixed (wired) broadband subscribers, and mobile-broadband (wireless) subscribers) and level of education as an indicator of the availability of necessary skills for working with ICT (International Telecommunication Union, 2016).

The use of the two indicators, such as Regulatory Impact Assessments (RIA) and the Economic Freedom Index, allows testing the latest hypothesis regarding the direct dependence of the development of alternative financing on the nature of the state regulatory policy. The OECD calculates RIA for the members of this organization and the acceding countries on the basis of its own methodology in order to assess the degree of participation of stakeholders in the development of regulatory documents, the introduction of new regulatory practices based on the principles of openness, transparency and feedback (OECD, 2015).

The Index of Economic Freedom is a generalized indicator of the openness of the economy. It is equal to the average of the following ten groups of quantitative and qualitative indicators for each country: freedom of entrepreneurship, freedom of trade, monetary freedom, tax freedom, and the level of public expenditures, the protection of property rights, investment freedom, financial freedom, and freedom from corruption, freedom of labor relations. The Heritage Foundation calculated this indicator based on official statistics from the World Bank, the International Monetary Fund, and the Economist Intelligence Unit research center (Miller and Kim 2016). The authors of the paper (Yevdokimov et al., 2018) emphasize that the expansion of the sphere of economic freedom has become the main source of fluctuations in the economic development of the EU countries. In general, the Index takes into account the existence of registration, tax, tariff barriers, and the level of state intervention in the economy. Therefore, this is the basis for its reasonable application also for a general assessment of the possibility of the alternative finance development in the country.

To verify the significance of these factors, it is proposed to apply the method of correlation analysis. This method allows to reveal the existence of interconnection between parameters and to establish the significance of such a connection. The correlation analysis does not require the determining of a dependent and independent variables of the model. The probabilistic relationship between the range of quantitative values of one parameter $x=\{x_1,x_2,\ldots,x_n\}$ and the corresponding range of quantitative values of another parameter $y=\{y_1,y_2,\ldots,y_n\}$

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determine the existence of the correlation dependence. The significance of the correlation, as a rule, characterizes the Pearson criterion. Calculation of Pearson correlation coefficients (linear correlation coefficient) reflects only the linear dependence between the model variables. Another approach to the correlation analysis is the use of the Spearman's rank coefficient (the rank coefficient of correlation). Spearman's rank correlation is a nonparametric measure of statistical dependence between two variables, ranked in increasing or decreasing order. Spearman's correlation coefficient determines the strength and direction of the monotonic relationship between two ranked variables, rather than the strength and direction of the linear relationship, which is what Pearson's correlation determines. The Spearman correlation can be used when the assumptions of the Pearson correlation are markedly violated (Tan et al., 2006; Zizlavsky, 2016).

Statistical data for 33 countries of the world for 2015 form an input data array for modeling. The availability of statistical data for recent years on all studied countries determined the choice of this particular study period. The input data for the analysis are given in the summary Table 2.

Table 2. Input data of correlation analysis of factors influence on volumes of alternative finance

Country	The volume of alternative finance, million dollars	GDP, billion dollars	Financial market development (8th component of GCI)	The share of population (15+) using loans from traditional financial intermediaries	The share of population (15+) not having a bank account	Global Innovation Index (GII)	ICT Development Index (IDI)	Regulatory Impact Assessment (RIA) by the OECP methodology	Index of Economic Freedom
	y	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8
China	101690	11064.7	4.1	9.5	21.1	50.57	5.19	n/a	52.0
USA	36170	18120.7	5.5	23.3	6.4	61.40	8.17	2.73	75.4
UK	4796	2885.6	4.8	21.1	1.1	61.93	8.57	3.40	76.4
Japan	360	4383.1	4.7	7.9	3.4	54.52	8.37	1.38	73.1
Australia	348	1345.4	5.4	23.4	1.1	53.07	8.19	2.85	80.3
France	347	2433.6	4.5	15.1	3.4	54.04	8.11	1.96	62.3
Germany	271	3375.6	4.7	18.6	1.2	57.94	8.31	2.59	74.4
New Zealand	268	175.6	5.7	32.5	0.5	54.23	8.29	2.70	81.6
Canada	207	1552.8	5.5	27.0	0.9	54.71	7.62	2.96	78.0
Israel	124	299.1	4.6	40.5	10.0	52.28	7.40	0.93	70.7
Netherlands	121	758.0	4.4	12.6	0.7	58.29	8.43	1.30	74.6
Finland	70	232.4	5.4	21.6	0.0	59.90	8.08	1.46	72.6
Spain	54	1197.8	3.8	18.0	2.4	49.19	7.62	1.88	68.5
Chile	48	242.5	4.6	15.6	36.8	38.41	6.35	0.49	77.7
South Korea	41	1382.8	3.6	18.2	5.6	57.15	8.84	2.45	71.7

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Belgium	40	455.2	4.4	15.8	1.9	51.97	7.83	2.31	68.4
India	40	2089.9	4.1	6.4	47.2	33.61	2.69	n/a	56.2
Singapore	40	296.8	5.6	14.2	3.6	59.16	7.95	n/a	87.8
Italy	35	1832.3	3.2	13.5	12.7	47.17	7.11	1.57	61.2
Estonia	35	22.6	4.6	14.3	2.3	51.73	8.07	2.90	77.2
Denmark	26	301.3	4.6	21.6	0.0	58.45	8.74	1.15	75.3
Brazil	24	1803.6	4	11.9	31.9	33.19	5.99	n/a	56.5
UAE	17	358.0	4.7	15.4	16.8	39.35	7.11	n/a	72.6
Switzerland	17	679.3	5.1	8.4	2.0	66.28	8.68	2.91	81.0
Latvia	16	27.0	4.4	16.8	9.8	44.33	7.08	n/a	70.4
Taiwan	14	525.2	4.8	13.9	8.6	n/a	n/a	n/a	74.7
Sweden	14	497.9	5	27.7	0.3	63.57	8.45	2.03	72.0
Mexico	13	1152.3	4.2	10.4	61.3	34.56	4.87	3.32	65.2
Austria	13	382.1	4.2	13.3	3.3	52.65	7.69	2.45	71.7
Poland	11	477.3	4.3	18.9	22.1	40.22	6.65	1.80	69.3
Czech Republic	10	186.8	4.6	13.0	17.8	49.40	7.25	2.48	73.2
Argentina	9	584.7	2.8	8.3	49.8	30.04	6.52	n/a	43.8
Hong Kong	9	309.4	5.5	8.2	3.9	55.69	8.46	n/a	88.6

Note that there are no statistics available for individual countries concerning the indicators of Global Innovation Index (GII), ICI Development Index (IDI) and Regulatory Impact Assessment Indicators, so the corresponding sampling for correlation analysis has been reduced to 32 countries (excluding Taiwan) while analyzing the dependence of the volume of alternative finance on the level of innovation and dependence of the volume of alternative finance on the level of ICT development, and 24 countries (excluding China, India, Singapore, Brazil, UAE, Latvia, Taiwan, Argentina, Hong Kong) while analyzing the dependence the volume of alternative finance on RIA.

The majority of indicators selected for quantitative characteristics of the influence factors are indices or relative indicators (except for GDP), and the dependent variable (volume of alternative finance) is an absolute indicator. Therefore, in order to ensure the adequacy of modeling results and the comparability of the parameters of different countries during the correlation analysis we used relative indicators of the volume of alternative finance per capita and GDP per capita. In determining the pair correlation of GDP indicators and the volume of alternative finance, it is permissible to use the absolute values of the parameters.

Results

The verification of the influence of the selected factors on the alternative finance development in countries worldwide goes through several stages. At the first stage, the Pearson's correlation analysis determines the presence and the strength of the linear relationship between the selected indicators for each factor and the indicator of the volume of alternative finance. The second part of correlation analysis includes the calculation of Spearman's correlation coefficient to determine

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the strength and direction of the monotonic relationships between ranked variables for each pair of factor and the indicator of the volume of alternative finance.

The Pearson's correlation analysis allows to establish the relationship between the volume of alternative financing (y_1) and GDP (x_1) on the basis of data arrays of the absolute values of these indicators. The correlation relationship with other indicators (x_2… x_8) was investigated using the relative indicator of the volume of alternative finance per capita (y_2). Table 3 presents the summary results of Pearson's correlation analysis.

From the list of investigated indicators, only GDP shows a strong tightness of the relationship with the volume of alternative finance in the country. The value of the correlation coefficient is 0.7237, which for the level of significance $\alpha = 0.05$ and the number of observations equal to 33 significantly exceeds the critical value of the Pearson correlation coefficient (0.34). Fulfilment of condition $|r_{obs}<r_{crit}|$ for the remaining indicators points to the lack of a significant linear relationship between the investigated parameters.

Table 3. Pearson's correlation analysis results

Indicator		Correlation coefficient	Number of observations	Value of r-critical	Tightness of the relationship	Nature of the relationship
The volume of alternative finance	y_1	1	-	-	-	-
GDP	x_1	0.7237	33	0.34	Strong	Direct
The volume of alternative finance per capita	y_2	1	-	-	-	-
Financial market development (GCI component)	x_2	0.2615	33	0.34	Weak	Direct
The share of population (15+) using loans from traditional financial intermediaries	x_3	0.2829	33	0.34	Weak	Direct
The share of population (15+) not having a bank account	x_4	-0.1711	33	0.34	Weak	Converse
Global Innovation Index	x_5	0.3155	32	0.34	Moderate	Direct
ICT Development Index	x_6	0.0932	32	0.34	Almost absent	Direct
Regulatory Impact Assessment	x_7	0.3567	24	0.39	Moderate	Direct
Index of Economic Freedom	x_8	0.0599	33	0.34	Absent	Direct

The calculation of the Spearman correlation coefficients showed a close correlation between the development of alternative finance and the majority of investigated

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factors. Weak tightness of the relationship was detected between the amount of alternative financing and the level of innovativeness of the country. Besides, according to the Pearson criterion, there is no dependence between alternative finance and the indicator of Regulatory Impact Assessment.

Table 4. Spearman's correlation analysis

Indicator		Spearman's rho	Number of observations	Critical value	Tightness of the relationship	Nature of the relationship
The volume of alternative finance	y_1	1	-	-	-	-
GDP	x_1	0.5010	33	0.29	Strong	Direct
The volume of alternative finance per capita	y_2	1	-		-	-
Financial market development (GCI component)	x_2	0.4890	33	0.29	Strong	Direct
The share of population (15+) using loans from traditional financial intermediaries	x_3	0.4995	33	0.29	Strong	Direct
The share of population (15+) not having a bank account	x_4	-0.5283	33	0.29	Strong	Converse
Global Innovation Index	x_5	0.5099	32	0.30	Strong	Direct
ICT Development Index	x_6	0.3412	32	0.30	Weak	Direct
Regulatory Impact Assessment	x_7	0.1557	24	0.34	Absent	Direct
Index of Economic Freedom	x_8	0.4415	33	0.29	Moderate	Direct

To summarize the results of the study, the results of testing the hypotheses for establishing the relationships are presented in Table 5.

Table 5. The results of a statistical testing the hypotheses concerning the influence of the factors on the alternative finance development

Hypothesis 1. Dependence of the volume of alternative finance on the level of economic development of the country [1]			
Variables	Hypothesis H_0	Prob > |t|	Conclusion on the hypothesis H_0
1.1. The volume of alternative finance (y_1) – GDP (x_1)	y_1 and x_1 are independent	0.0030	False
1.2 The volume of alternative finance per capita (y_2) – Financial market development (x_2)	y_2 and x_2 are independent	0.0039	False
Hypothesis 2. Dependence of the volume of alternative finance on the level of financial inclusion			

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Variables	Hypothesis H_0	Prob > |t|	Conclusion on the hypothesis H_0
2.1. The volume of alternative finance per capita (y_2) – The share of population (age 15+) using loans from traditional financial intermediaries (x_3)	y_2 and x_3 are independent	0.0031	False
2.2 The volume of alternative finance per capita (y_2) – The share of population (age 15+) not having a bank account (x_4)	y_2 and x_4 are independent	0.0016	False
Hypothesis 3. Dependence of the volume of alternative finance on the level of innovation of the country			
Variables	Hypothesis H_0	Prob > |t|	Conclusion on the hypothesis H_0
3.1. The volume of alternative finance per capita (y_2) – Global Innovation Index (x_5)	y_2 and x_5 are independent	0.0029	False
Hypothesis 4. Dependence of the volume of alternative finance on the level of ICT development			
Variables	Hypothesis H_0	Prob > |t|	Conclusion on the hypothesis H_0
4.1. The volume of alternative finance per capita (y_2) – ICT Development Index (x_6)	y_2 and x_6 are independent	0.0560	False
Hypothesis 5. Dependence of the volume of alternative finance on the nature of regulatory influence			
Variables	Hypothesis H_0	Prob > |t|	Conclusion on the hypothesis H_0
5.1. The volume of alternative finance per capita (y_2) – Regulatory Impact Assessment (x_7)	y_2 and x_7 are independent	0.4676	True
5.2 The volume of alternative finance per capita (y_2) – Index of Economic Freedom (x_8)	y_2 and x_8 are independent	0.0101	False

Discussion

The obtained results of the correlation analysis made it possible to make the following conclusions regarding the implementation of hypotheses presented in the work.

Hypothesis 1: The volume of alternative finance in the country directly depends on the level of its economic development. As already mentioned, according to the results of the correlation analysis, a strong tightness of the relationship between GDP and the volume of alternative finance in the country has been revealed.

A number of studies confirm the fairness of establishing another direction of relationship between the studied variables, that is, the impact of the volume of alternative finance on GDP. For example, Zhang et al. (2016a) say that alternative online finance is a source of GDP growth and a stimulus for economic growth in the country.

The second indicator used to test the hypothesis about the impact of the economy on the alternative finance market development – the component of GCI "Financial market development" – confirms the presence of strong influence on the result. Consequently, the hypothesis about the direct dependence of the volume

of alternative finance on the level of economic development of the country was confirmed.

Hypothesis 2: The volume of alternative finance has a reverse dependence on the level of financial inclusion in the country. Proceeding from this hypothesis, the indicator of the share of population using loans from traditional financial intermediaries, which directly reflects the level of financial inclusion, should have a reverse influence on the volume of alternative finance. In turn, the indicator of the share of population not having a bank account, characterizes the financial exclusion, that is, it should have a direct impact on the market of alternative finance. The calculations made within the correlation analysis showed the opposite results – the direct influence of the first factor and the reverse influence of the second factor.

Taking into account the results of calculations according to the share of population using loans from traditional financial intermediaries, the bank lending and the alternative online finance are not mutually exclusive sources of financial resources. Alternative finances do not replace, but complement traditional sources of borrowing. Therefore, in countries with a developed banking system, the development of alternative finance is also active.

The reverse relationship between the share of population not having a bank account and the volume of alternative finance indicates that individuals who do not have access to traditional financial services most likely will not use alternative online finance. This statement is quite fair, for example, in case of low financial literacy of the population, lack of access to the Internet and the inability to use both online banking services and online platforms.

Consequently, the higher the level of financial inclusion in the country and the more the share of population which uses the services of banks and other financial intermediaries, the greater is the demand for alternative finance. The hypothesis presented in the work is false, because according to the results of the study, the volume of alternative finance showed the direct dependence on the level of financial inclusion in the country.

Hypothesis 3: The volume of alternative finance directly depends on the level of innovation of the country. Summarizing the results of the correlation analysis, one can conclude that the level of innovation of the country has a moderate impact on the development of alternative finance according to the results of Pearson's correlation analysis, and a strong impact according to the Spearman's rank coefficient. Consequently, the hypothesis regarding the availability of dependence of the volume of alternative finance on the level of innovation of the country can be considered as confirmed.

Hypothesis 4: The volume of alternative finance has a direct dependence on the level of information technology development in the country. A computerization and a development of information technologies are a prerequisite for the development of alternative online finance. In all of the countries under study, the level of ICT development is high, which is confirmed by the IDI index to be above

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the average for all countries under consideration, with the exception of India and Mexico. At the same time, among the investigated leading countries, the volume of financial resources involved through the online platform does not have a significant correlation with the level of ICT development. Consequently, the hypothesis concerning the direct influence of the information technology on the alternative finance market can be considered as not confirmed, because the revealed relationship between the factors is weak, but for the development of alternative finance it is necessary to achieve at least an average level of ICT development.

Similar to the simultaneous causality for the indicators of the level of alternative financing and GDP, it is fair to assert that the availability of alternative financing instruments in countries with limited access to other sources of financial resources will encourage more individuals and legal entities to use alternative online financing for satisfaction their investment demand and supply. For financial intermediaries, the use of innovative financial technologies is a way to attract more customers. Thus, alternative finance is potentially a trigger for information technology development and an increase in the level of financial innovativeness in developing countries.

Hypothesis 5: The volume of alternative finance directly depends on the nature of the regulatory influence of the state on the economy. The verification of the last hypothesis was based on the use of two parameters as factor indicators – the Regulatory Impact Assessment (RIA) and the Index of Economic Freedom. The results of the Spearman's correlation analysis showed a moderate relationship of the volume of alternative finance with the Index of Economic Freedom and the absence of such a relationship with the Regulatory Impact Assessment. Consequently, the nature of the regulatory influence does not have a significant impact on the alternative finance market development. So, the hypothesis is refuted. However, it should be noted that during the modeling the direct prohibitions or privileges for online platforms in individual countries were not taken into account, but the overall liberalism and adaptability of state policy and the degree of economic freedom were assessed.

The proposed approach to assessing the impact of factors on the development of the alternative finance market has several limitations and drawbacks that need to be taken into account when analyzing the results of the correlation analysis, namely:

− the indices used may not accurately reflect the nature of the factors under study and cause an error in the assessment of the factor significance;

− the indicators general to all countries establish the correlation dependencies, while the applied method does not allow to take into account factors specific for each country, which in some cases can have a decisive influence on the development of the alternative finance market;

− only one generalization parameter, such as the volume of alternative financing, characterize the development of the alternative financial market (crowdfunding and peer-to-peer lending). The predominance of a particular type of platform and type of funding in a country can greatly affect the total volume of financial

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resources involved through such platforms. In a number of studies (Zhang et al., 2016a; Zhang et al., 2016b), their authors notes that the volume of loans borrowed through peer-to-peer platforms significantly exceeds the corresponding volumes of financial resources accumulated on the crowdfunding platforms.

The proposed list of indicators and investigated factors is not exhaustive. In particular, this study does not analyze the impact on the development of the alternative finance market of such parameters as social structure, cultural characteristics of the country, the level of corruption, etc., which in a number of studies show the presence of influence on relevant economic indicators (Nguedie, 2018; Prince, 2017; Yerznkyan et al., 2017). According to the authors, these factors are not a priority in terms of the alternative finance market development, but the presence of their influence cannot be ruled out.

Summary

Digitization and computerization leads to tremendous changes in the face of the financial services market. Along with the functioning of traditional financial intermediaries, there is a tendency towards the development of direct relations between providers and recipients of financial resources. This became possible only within the fourth industrial revolution, informatization of all spheres of society and industries, and functioning of online platforms. Therefore, the modern approach to understanding the alternative funding used in this study relates to the specialized online platforms that create access to financial resources bypassing the banking system and non-bank financial intermediaries. Innovativeness of alternative financing models is not only in new sources and methods of attracting financial resources but is also in the use of special technical tools and online platforms.

In the article we analyzed the factors of online financing service as an alternative to traditional financial intermediaries (including banks) using the method of correlation analysis. Based on hypothesis testing for the 33 countries of the world that are leaders in terms of alternative finance in 2015, it is established that the country's economic development has a significant impact on the degree of the alternative finance development, as evidenced by strong correlation between the indicators of the volume of alternative finance and GDP, and also by the strong dependencies of the volume of alternative finance on GDP and the volume of alternative finance per capita on the 8th component of the Global Competitiveness Index "Financial Market Development".

The Spearman's correlation analysis made it possible to confirm the hypothesis that there was a dependence of the volume of alternative finance on the level of innovation of the country. Instead, the falsehood of the second hypothesis was determined and the moderate direct influence of financial inclusion on the alternative finance development was revealed. It is established that the alternative finance does not replace, but supplement bank lending; therefore, in countries with a developed banking system, the alternative finance development is also active.

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The hypotheses regarding the direct influence of information technology and the nature of the regulatory influence of the state on the development of the alternative finance market can be considered as not confirmed due to the absence of a statistically significant relationship between the investigated factors.

Alternative online financing is often considered solely as a substitute for bank lending. Online loans can be seen as a threat to the competitiveness of banks and such traditional non-bank intermediaries as pawnshops, credit unions and leasing companies. However, as the study has shown, bank lending and alternative online funding may co-exist and develop in parallel. The task of traditional financial intermediaries is to take advantage of the high level of informatization and digitalization, work with Big data solutions, automation of operational processes and other opportunities created by Industry 4.0, in order to maintain and strengthen their competitive positions.

Options for adapting to the development of innovative financial technologies and turning them into the advantages of banking sector are as follows:

− to adopt the new principles of alternative platforms in traditional banking (convenience, flexibility, low cost and technology);
− to develop a partnership between banks and Fintech-segment players.

Peer-to-peer and crowdfunding platforms lack effective risk management. It is difficult to estimate the cost of a loan and the level of risk, based only on answers to a few simple questions or data from social networks. On the other hand, banks have a powerful risk management system that is not comparable to Internet companies. We believe that convergence of "traditional" and "alternative" types of financing will minimize the disadvantages and weaknesses of each of them and will bring additional benefits to all participants in the financial market.

Interaction of banks and peer-to-peer platforms is possible in several formats. Such interaction can take quite different forms, from separation to merging.

There are two main options for incumbent banks: 1) the mediation between the platform and the depositors, when the bank acts as an institutional investor, 2) a platform participant, when the bank performs the role of guarantor in cooperation with peer-to-peer platforms.

Thus, the further field of research is, firstly, the search for an optimal model of interaction between banks and online platforms, identifying opportunities and methods for banks' participation in alternative finance models.

On the other hand, the banking sector is exposed to significant regulatory influence aimed at ensuring the stability of the entire financial system. The regulation of alternative online finance is fragmented and uncertain in many countries across the world. The annual growth in the use of alternative financing may create macroeconomic threats to financial stability. Therefore, this aspect of the functioning of alternative finances should also be the subject of in-depth scientific research.

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WPŁYW PRZEMYSŁU 4.0 NA USŁUGI FINANSOWE: DETERMINANTY ROZWOJU ALTERNATYWNYCH FINANSÓW

Streszczenie: Digitalizacja i wirtualizacja w dobie Przemysłu 4.0 dostosowują charakter finansów i interakcji między uczestnikami rynku. Wiele usług finansowych jest przenoszonych na płaszczyznę wirtualną umożliwiając rozwój alternatywnych źródeł finansowania - pozyskiwanie funduszy i prowadzenie pożyczek za pośrednictwem platform internetowych. Na podstawie analizy wpływu czynników na alternatywny rozwój finansów w artykule sformułowano pięć hipotez dotyczących zależności ilości środków finansowych przyciąganych przez platformy internetowe od cech ilościowych istotnych czynników. Celem artykułu jest zbadanie czynników usług finansowania online jako alternatywy dla tradycyjnych pośredników finansowych (w tym banków) przy użyciu metody analizy korelacji. Jako parametry ilościowe każdego czynnika proponuje się stosowanie powszechnie akceptowanych wskaźników i indywidualnych wskaźników względnych. Wyniki badania wykazały 1) znaczący wpływ rozwoju gospodarczego kraju na stopień rozwoju alternatywnego finansowania; 2) silny bezpośredni wpływ dostępności finansowania i poziomu innowacyjności kraju na wielkość alternatywnego finansowania; 3) brak bezpośredniego wpływu technologii informatycznych i brak regulacyjnego wpływu państwa na rozwój alternatywnego rynku finansowego.

Słowa kluczowe: usługi finansowe, przemysł 4.0, innowacje finansowe, alternatywne finansowanie, finansowanie online.

工业4.0对金融服务的影响：替代性金融发展的决定因素

摘要： 行业时代的数字化与虚拟化。许多金融服务都转移到在线平台。我对以下因素感兴趣：使用相关分析方法分析财务分析（包括银行）的方法。作为每个可接受因素的定量参数。研究结果显示2）经济对替代金融量的强烈直接影响；
3）缺乏直接融资和发展替代金融市场。

关键词： 金融服务，工业4.0，金融创新，替代金融，在线融资。