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INFLUENCE OF DIGITALISATION AND TECHNOLOGICAL INNOVATIONS IN THE FINANCIAL MARKET ON THE DEVELOPMENT OF THE FINANCIAL MARKET

Uticaj digitalizacije i tehnoloških inovacija na finansijskom tržištu na razvijenost finansijskog tržišta

Abstract

The aim of the paper is to establish a connection between the credit rating of the country and the development of the financial market on one hand, and the level of technology and innovation development across countries, on the other. The first research question is: "What is the connection, if any, between the credit rating of a country and its level of technology and innovation development?" The second research question is: "What is the connection, if any, between financial market development and the level of technology and innovation development?". The methods used in the paper are analysis and synthesis of previous research and theoretical findings, regression analysis, whereas the conclusions were made by applying the induction method. The answers to the research questions may indicate the direction of change in regulation that would have a stimulating or disincentivising effect on the development of innovations and technologies in the financial markets in developing countries. The contribution of the paper is reflected in the opportunities for developing and improving the financial market in developing countries. The research findings reveal a connection between credit rating and technology and innovation levels across countries, and a connection between financial market development and technology and innovation levels across countries. We have offered an answer to the question of whether it is rational for financial intermediaries in developing countries to change their business models and adapt them to the accelerated market changes. In addition, we have highlighted the need to adjust the regulation and reduce operational costs of financial intermediaries in developing countries.

Given that we have demonstrated a cause-and-effect relationship between innovation and technological development of financial intermediaries and market development, we also emphasise the need to eliminate the constraints and other limiting factors that affect further digitalisation in the financial sector in the region.

Keywords: *digitalisation, innovation, market development, 4th Industrial Revolution.*

Sažetak

Cilj rada je da se dovedu u vezu kreditni rejting zemlje i razvijenost finansijskog tržišta sa jedne strane i nivo tehnologije i inovacija po zemljama, sa druge. Prvo istraživačko pitanje glasi: „Da li su i u kakvoj vezi kreditni rejting zemlje i nivo tehnologije i inovacija?“ Drugo istraživačko pitanje glasi: „Da li su i u kakvoj vezi razvijenost finansijskog tržišta i nivo tehnologije i inovacija?“. Metode korištene u radu su analiza i sinteza prethodnih istraživanja i teoretskih nalaza, regresiona analiza, a zaključci su izvučeni metodom indukcije. Dobijeni odgovori na istraživačka pitanja mogu ukazati na pravac promjene regulative koja bi stimulatивно ili destimulatивно djelovala na razvoj inovacija i tehnologija na finansijskim tržištima u zemljama u razvoju. Doprinos rada ogleda se u tome što su objašnjene mogućnosti za razvoj i unapređenje finansijskog tržišta u zemljama u razvoju. Rezultati istraživanja pokazuju vezu između kreditnog rejtinga i nivoa tehnologije i inovacija po zemljama te vezu između razvijenosti finansijskog tržišta i nivoa tehnologije i inovacija po zemljama. Ukazali smo i na to da li je racionalno da finansijski posrednici u zemljama u razvoju mijenjaju svoje poslovne modele i prilagođavaju ih ubrzanim promjenama na tržištu. Osim toga, ukazali smo na potrebu za prilagođavanjem regulative i smanjivanjem operativnih troškova finansijskih posrednika u zemljama u razvoju.

S obzirom na to da smo pokazali uzročno-posljedičnu vezu između inovacija i tehnološkog razvoja finansijskih posrednika i razvijenosti tržišta, ističemo i činjenicu da je potrebno eliminisati ograničenja i druge otežavajuće faktore koji utiču na dalji proces digitalizacije u finansijskom sektoru u regiji.

Cljučne reči: *digitalizacija, inovacije, razvoj tržišta, Industrija 4.0.*

Introduction

In the past three centuries, civilisation has gone through three industrial revolutions, while according to the opinion of the world's leading economists, the Fourth Industrial Revolution or Industry 4.0, as it is popularly called, is in progress. Each of these industrial revolutions was characterised by technological innovations that had a key impact on the development of the entire mankind. What is characteristic of Industry 4.0 is that in different ways it already affects all business activities, while simultaneously developing digital and other technologies, but also affecting lifestyle in the entire world. After the process of globalisation and connecting the world into one global market, which resulted in an unobstructed expansion of business, a new era began which can be called the age of digital transformation. The basic characteristic of the new, digital age is that it takes new dimensions and new forms, from one day to the next. Although, in terms of their structure, form of business and other characteristics, banks are less likely to accept changes, they have largely adjusted their businesses to the changes in the business environment and, consequently, adopted and applied certain processes imposed by digitalisation. The continuous process of creating new banking products and services which are directly linked to the digitalisation process is a clear sign that the banking sector has taken the upcoming changes very seriously, which certainly result in the creation of competitive advantage and a better position in the market. Of course, intense competition in the market and the emergence of various services offered in connection with banking services, demonstrate market overload, and this is certainly the biggest challenge for banks in the upcoming period. It should be especially borne in mind that in this situation, banks are not just competing with each other, but also with high-tech companies providing similar services that have emerged in the last few years and started offering this kind of service. These companies have their own payment systems and customer databases, which results in a deduction of a portion of the banks' profit. All this clearly means that banks have to work intensively on innovations in

the banking field and develop new business strategies and models that will be adapted to new demands in the market. Certainly, in addition to the activities related to the introduction of new services, as well as their adjustment to the market, the focus must still be on the clients of the bank, i.e., banks must pay attention to the optimum quality of services that will satisfy the needs of the existing clients and also attract new ones. It is very important that the process of transforming banking services is accompanied by the continuous monitoring of the market and clients' needs, since it should not be forgotten that all banks have and will have traditional customers in the future, who will certainly use the standard banking services, as well as clients who most likely will not use digital banking services in a certain period of time. Therefore, the banks will have to seek an optimal measure in transforming their business units and introducing digital bank branches that would completely replace human resources. Essentially, the process of digitalisation in the banking sector is, besides the great advantages for banks and their clients, also bringing certain challenges that banks need to handle. The research titled "A Brave New World for Global Banking" says that banks in Europe are at risk of loss which could account for almost a third of their profit. The following, even more rigorous, stage of digital transformation will further reduce the banks' profit in the upcoming years, which will be a consequence of even greater competition and the continuation of the decline in banks' margins. In such circumstances, banks are trying to compete by introducing innovative services, available through mobile devices. However, in this process, much of their revenues are taken by small digital marketing companies that are increasingly involved in work that was until recently reserved only for commercial banks. If banks plan to position themselves in the market in an adequate way and adapt to the new changes, it will be necessary to quickly change their business models by transforming themselves from exclusively financial institutions into institutions whose platform will be based on data analysis and offer of appropriate products and services with which they will compete in the market, as well as by opening up greater opportunities for cooperation with fintech companies.

Previous research

A large body of literature for the respective literature surveys has been accumulated to assess the impact of financial development on economic growth, inequality, and economic stability [15], [8], [7]. Financial development involves improvements in functions provided by the financial systems such as: (i) pooling of savings; (ii) allocating capital to productive investments; (iii) monitoring those investments; (iv) risk diversification; and (v) exchange of goods and services [15]. Each of these financial functions can influence savings and investment decisions and the efficiency of allocating funds. As a result, finance affects the accumulation of physical and human capital and total factor productivity – the three factors that determine economic growth. Given that financial development reduces informational asymmetries and financial constraints and promotes risk sharing, it can enhance the ability of financial systems to absorb shocks and reduce the amplification of cycles through the financial reduction of macroeconomic volatility and inequality.

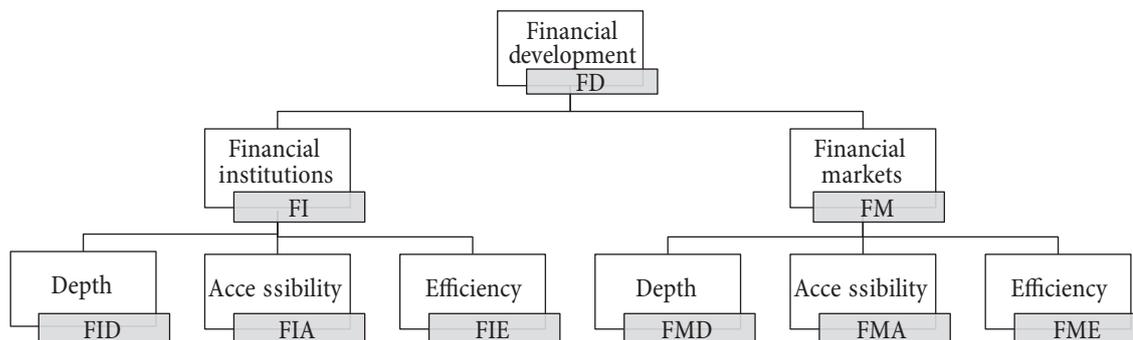
Most of the empirical literature since the 1970s observes financial development through two measures of financial depth – the ratio of private credit to GDP and, to a lesser extent, through stock market capitalisation, also as a ratio to GDP. For example, in an influential industry-level study, Rajan & Zingales [20] use both measures to show that more financial development facilitates economic growth. On the macroeconomic volatility side, as measured by private credit from banks and other financial institutions to GDP, it plays a significant role in dampening the volatility of output, consumption, and investment growth, but only up to a certain point [7]. Most researchers in this field use variations of these two measures to examine the role of the financial system in economic development.

And yet, financial development is a multidimensional process. With the passage of time, financial sectors have evolved across the globe, and modern financial systems have become multifaceted. For example, while banks are typically the largest and most important players, investment banks, insurance companies, mutual funds, pension funds, venture capital firms, and many other types of non-bank financial institutions now play notable roles.

Similarly, financial markets have developed in ways that allow individuals and firms to diversify their savings, and firms can now raise money through stocks, bonds, and wholesale money markets, bypassing the traditional bank lending. The constellation of such financial institutions and markets facilitates the provision of financial services. Furthermore, an important feature of financial systems is their accessibility and efficiency. Large financial systems are of limited use if they are not accessible to a sufficiently large portion of the population and firms. Even if the financial systems are sizeable and have a broad reach, their contribution to economic development will be limited if they are uneconomical and inefficient. This point is made also, for example, in Čihák, Demirgüç-Kunt, Feyen & Levine [6] and Aizenman, Jinjark & Park [1]. The diversity of financial systems across countries implies that one needs to look at multiple indicators to measure financial development.

To overcome the shortcomings of single indicators as proxies for financial development, a large number of indices has been created, and these indices summarise how developed financial institutions and financial markets are in terms of their depth, accessibility, and efficiency, culminating in the final index of financial development (Figure 1). These indices were originally developed in the context of the IMF Staff Discussion Note “Rethinking Financial Deepening: Stability and Growth in Emerging Markets” [21]. This paper presents and explains the methodology that underpins the said indices. The subindices and the final overall index are constructed for 183 countries on an annual frequency between 1980 and 2013. Financial institutions include banks, insurance companies, mutual funds, and pension funds. Financial markets include stock and bond markets. Financial development is defined as a combination of depth (size and liquidity of markets), accessibility (ability of individuals and companies to access financial services), and efficiency (ability of institutions to provide financial services at low costs and with sustainable revenues, and the level of activity of capital markets). This broad multidimensional approach to defining financial development follows the matrix of financial system characteristics developed by Čihák et al. [6].

Figure 1: Financial development index pyramid



Source: [6].

The contribution of this paper is quite distinct. Firstly, we have supplemented the World Bank's FinStats, a more updated version of the Global Financial Development Database (GFDD) introduced by Čihák et al., with additional data from the Bank of International Settlements' (BIS) debt securities database, Dealogic's corporate debt database, and the IMF's Financial Access Survey. Secondly, we have summarised this diverse information in several easy-to-use indices. Given the wealth of information on financial system properties – there are 105 distinct indicators in GFDD and 46 indicators in FinStats – it is not feasible to track all of these different indicators individually, especially in empirical research. And even if it was possible, not one single indicator, when observed in isolation, would offer a comprehensive understanding of the level of financial development [12]. The subindices and the final index pull together these various indicators and allow a comprehensive assessment of particular features of financial systems and the overall level of financial development. As a result, the indices allow to pin down exactly where the deficiencies in financial development lie or which aspects of financial development affect macroeconomic performance, which could then be investigated in greater detail by using the disaggregated data from FinStats or GFDD.

The methodology described below was used to construct the index, including data sources, treatment of the missing values, functional form, and weights used in aggregation. It shows how new indices compare to the traditional measures and key stylised facts about financial development around the world. The discussion will look at some of the limitations and shortcomings of the index in order to show the extent to which the

structure and size of pension funds affect the outcome of the index. The goal is to determine whether “copying” a particular country by structure and size of the index can further develop the financial market. In this regard, the term “emerging market” refers to countries that are characterised by institutional turbulence, low level of corporate governance and economic development in relation to the developed countries. Hoskisson, Eden, Lau & Wright mark all the countries of the Western Balkans as countries in transition [13, pp. 249-267]. For the sake of illustration, the institutional legacy of communism is reflected in a large, undisciplined and ineffective administration, a bureaucratic approach of the institutions and corruption.

“A bureaucratized and restrictive authority has opened the door to corruption and bribery of public services because most citizens seem to believe that it is the only way to get things done” [9, p. 206]. Even a glance at statistical offices in Western Balkan countries confirms the prolongation of such practice, i.e., the increase in number of employees in the budget-funded sectors of administration, public authorities, education, and art. On the other hand, there is an obvious decrease in the number of employees in the processing industry. Besides, relevant research also shows a high level of corruption in the new EU Member States as opposed to the old ones, as a consequence of the communist doctrine [24]. Also, when observing the trust in institutions, transition countries are always at the bottom of such lists [4]. Also, in small and open economies, such as the countries in the Western Balkans, monetary policy capabilities are limited by many constraints [3, p. 1039]. Therefore, in parallel with the weak development of the financial market, the criticism of the transition is based

on the significant increase of poverty and degradation, mostly of the middle class [5].

By comparing the developing markets, we notice that non-economic factors in the region play the most important role in determining the value of trade between countries [25, p. 57]. Economic instability results in “frequent reforms, where the economic growth and the social impact of changes were completely ignored, low rates of domestic and foreign investment, foreign trade deficit and low rates of GDP” [10, p. 198]. For example, there is a series of social and economic issues which remain undealt with and whose solution requires complicated and demanding solutions [2, p. 57].

Industry 4.0 and digital economy

Industry 4.0 or the so-called Fourth Industrial Revolution, i.e., the digitalisation of industry, has been a key topic for several years, where people are trying to find the answers to how the economies can be more competitive in the global markets [16, p. 9]. Klaus Schwab, the founder and chairman of the World Economic Forum, deals with this issue in his book “The Fourth Industrial Revolution”, in which he analyses the consequences of development that is different from everything that has ever happened to mankind. However, one should think well about the consequences of the Fourth Industrial Revolution because, according to the conducted surveys, the use of digitalisation in the industry of the modern countries could result in the loss of a significant number of jobs in the upcoming period [16, p. 9]. The essence of Industry 4.0 is in the new approach, i.e., networking of smart digital devices with products, tools, robots, and people, while its primary goal is smart factories that are flexible and that efficiently integrate clients and business partners into a unique process. This would increase productivity and efficiency, and thereby ensure competitiveness in the global market. One of the interesting features of this revolution is that it is scheduled in advance, i.e., out of necessity due to the crisis, the recession and the slowdown in economic activity that made the leading European Union states look for answers on how their economies can strengthen the global competitiveness. Action Plan

for the Fourth Industrial Revolution is composed of four courses of action [16, pp. 9-10].

- to enable all industrial companies, especially small and medium-sized companies, to have easier access to digital infrastructure and to adopt innovation;
- to enable the automotive and aviation industry to assume leadership over the digital industry;
- training the labour force, with the promotion of digital skills, education, and training;
- adoption of adequate regulatory solutions that will arrange security and accountability as a basis for further digitalisation.

The digitalisation process itself essentially involves the conversion of analogue to digital form, without losing information in this transformation, and thus facilitates faster flow, information exchange and better information of all participants [16, p. 9]. The first association when it comes to the digital economy is the economy of internet businesses, e-commerce, e-banking and other services offered on a daily basis. However, the digital economy is a much wider concept than that. The digital economy is an economy based on digital technologies, primarily through the use of information technologies in all fields of the economy, including internal and external activities between business entities and individuals [16, p. 9].

It is also possible to find definitions that treat the digital economy as a new, post-industrial, global economy based on internet transactions and advanced technology, i.e., as a global network of economic activities based on information and communication technology, or more simply, as an economy based on digital technology. Essentially, the digital economy is an economy based on information, knowledge, ideas, and innovations. According to certain information, it is estimated that the digital economy is growing seven times faster than other economies, and that in the developed countries it makes up for 10% of gross domestic product, which means that digital economy is constantly growing and it is certain that modules of classical economic business will increasingly move towards the digital form.

According to research conducted by the European Banking Federation (EBF) in 2018, a digital single market is expected to boost the development of companies operating

Table 1: Technological and economic changes that marked the industrial revolutions so far

The First Industrial Revolution (second half of the 18 th and the first half of the 19 th century)	
Technological changes	Invention of the steam engine, development of rail traffic
Economic changes	Transfer from manual to mechanical and industrial production, development of textile industry and abandoning villages and agriculture and population moving to urban centres
The Second Industrial Revolution (Second half of the 19 th and early 20 th century)	
Technological changes	Invention of electrical energy and machines based on electrical drives
Economic changes	Mass production and production lines
The Third Industrial Revolution (from 1960 to 1995)	
Technological changes	Computer revolution, mainframe computers (1960), microprocessors and personal computers (1970-1980)
Economic changes	Computerised production and mass use of computers in all processes and private life
The Fourth Industrial Revolution (1995 – the first decades of the 21 st century) – smart digital revolution	
Technological changes	Expansion of internet, smart devices, social networks, artificial intelligence, IoT, neurotechnology, 3D printers
Economic changes	Network – digital economy, virtual products and similar, information as a key economic recourse and source of growth, economy of platforms and free staff

Source: [14, p. 27].

in this system and to serve for the well-being of all clients, further economic growth and further employment.

As seen in the review, the previous industrial revolutions, in addition to technological changes, caused changes in the economy and in the entire society. However, economics, although it developed like any other science, did not change its postulates based on industrial production, i.e., economy, with technological revolutions. The Fourth Industrial Revolution brought about fundamental and essential changes and resulted in a completely new economy – the digital economy [14, p. 27].

The essential question is what constitutes the digital economy in structural terms and in terms of statistical and economic coverage. In this respect, it is useful to start from the definition given by Thomas Mesenbourg, as well as from the understanding of the digital economy, as defined by the OECD in 2012. Mesenbourg recognizes three main components of the digital economy [14, p. 27] as follows:

- e-business infrastructure (hardware, software, telecoms, networks, human capital, etc.);
- e-business (the focus is on how business is done/ conducted, that is, any process that an organisation conducts over computer-mediated networks);
- e-commerce (transfer of goods, for example when a book is sold online).

Under the term digital economy, the OECD implies “an umbrella term used to describe markets that focus on digital technologies. It involves the trade of information goods or services through electronic commerce. It operates on a layered basis, with separate segments for data transportation and applications” [16, p. 11]. The role of banks in this transformation is that they are not only innovative partners who invest in innovative financial technologies, but also contribute to economic growth and development in the overall financial market.

Table 2 shows that a certain number of countries has achieved high levels of technology and innovation. This primarily includes countries that are technological leaders in the world, as well as drivers of new ideas and innovative solutions. Although it is evident that a large number of countries has made great progress in the field of technology and innovation, on the other hand, however, there are those countries that are still stagnating and do not show any progress in the development of technology and innovative solutions. In general, these are the countries that are burdened with a number of problems, such as low standard of living, insufficiently developed infrastructure, poverty, and so forth.

Methodology

In the paper, we have observed the data provided by the National Bureau of Economic Research [17], the Organisation for Economic Co-operation and Development [18], World Economic Forum (2018), as well as credit ratings of countries published by the three most famous rating agencies in the world.

For each observed country, we have taken into account the amount of GDP for each country and the amount of the FD index, but we have also reported on the credit rating for each country in accordance with the

ratings obtained by the agencies: Moody's, S&P, and Fitch. Finally, we have presented an investment rating for each individual rating (Prime – first-class rating; High grade – high credit rating; Upper medium grade – upper-middle

class; Lower medium grade – lower middle class; Non-investment grade – non-investment class; Speculative – speculative bonds; and Highly speculative – highly speculative bonds).

Table 2: Overview of structure and size of pension funds, indicators of market development and GDP per country

Country	GDP	Rank in technology and innovations	FD index	Moody's ratings	S&P ratings	Fitch ratings	Description
Australia	1,427,767	4.26	0.85	Aaa	AAA	AAA	Prime
Austria	459,401	7.46	0.64	Aa1	AA+	AA+	High grade
Belgium	536,055	6.51	0.58	Aa3	AA	AA-	High grade
Canada	1,733,706	5.81	0.86	Aaa	AAA	AAA	Prime
Chile	299,887	4.18	0.47	A1	A+	A	Upper medium grade
Czech Republic	244,540	7.94	0.37	A1	AA-	AA-	Upper medium grade
Denmark	354,683	6.29	0.64	Aaa	AAA	AAA	Prime
Estonia	29,527	5.75	0.33	A1	AA-	AA-	Upper medium grade
Finland	276,553	7	0.66	Aa1	AA+	AA+	High grade
France	2,794,696	6.87	0.76	Aa2	AA	AA	High grade
Germany	4,029,140	8.68	0.7	Aaa	AAA	AAA	Prime
Greece	218,057	4.44	0.54	B1	B+	BB-	Highly speculative
Hungary	156,393	6.96	0.44	Baa3	BBB	BBB	Lower medium grade
Ireland	366,448	7.34	0.69	A2	A+	A+	Upper medium grade
Israel	365,599	6.43	0.57	A1	AA-	A+	Upper medium grade
Italy	2,086,911	6.99	0.8	Baa3	BBB	BBB	Lower medium grade
Japan	5,070,626	8.99	0.87	A1	A+	A	Upper medium grade
Latvia	34,286	4.91	0.29	A3	A	A-	Upper medium grade
Lithuania	52,468	5.92	0.26	A3	A	A-	Upper medium grade
Mexico	1,199,264	6.74	0.41	A3	BBB+	BBB+	Upper medium grade
Netherlands	909,887	6.32	0.71	Aaa	AAA	AAA	Prime
New Zealand	205,997	4.79	0.61	Aaa	AA	AA	Prime
Norway	441,439	5.65	0.69	Aaa	AAA	AAA	Prime
Poland	549,478	6.83	0.47	A2	A-	A-	Upper medium grade
Portugal	237,962	5.36	0.69	Baa3	BBB	BBB	Lower medium grade
Slovakia	106,940	6.98	-	A2	A+	A+	Upper medium grade
Slovenia	54,969	6.8	0.39	Baa1	A+	A-	Lower medium grade
Spain	1,437,047	6.05	0.88	Baa1	A-	A-	Lower medium grade
Sweden	554,659	7.46	0.72	Aaa	AAA	AAA	Prime
Switzerland	709,118	8.39	0.94	Aaa	AAA	AAA	Prime
Turkey	713,513	5.87	0.83	Ba3	B+	BB	speculative
United Kingdom	2,808,899	7.05	0.82	Aa2	AA	AA	High grade
United States	20,513,000	7.78	0.87	Aaa	AA+	AAA	Prime
Mauritius	14,033	3.84	0.43	Baa1	0	0	Lower medium grade
Pakistan	306,987	3.82	0.23	B3	B-	B-	Highly speculative
Peru	228,944	3.67	0.38	A3	BBB+	BBB+	Upper medium grade
Colombia	336,940	4.61	0.44	Baa2	BBB-	BBB	Lower medium grade
Armenia	12,533	4.1	0.25	B1	0	B+	Highly speculative
Romania	239,440	6.61	0.31	Baa3	BBB-	BBB-	Lower medium grade
Zambia	25,778	2.39	0.12	0	B-	B-	Highly speculative
Croatia	59,971	5.5	0.41	Ba2	BBB-	BB+	speculative
Kenya	89,591	2.97	0.19	0	B+	B+	Highly speculative
South Africa	376,679	5.03	0.62	Baa3	BB	BB+	Lower medium grade
Thailand	490,120	7.13	0.73	Baa1	BBB+	BBB+	Lower medium grade
Bulgaria	63,651	5.23	0.38	Baa2	BBB-	BBB	Lower medium grade
Indonesia	1,005,268	5.41	0.36	Baa2	BBB-	BBB	Lower medium grade
Uganda	27,855	2.25	0.12	0	B	B+	Highly speculative

Country	GDP	Rank in technology and innovations	FD index	Moody's ratings	S&P ratings	Fitch ratings	Description
Russia	1,576,488	5.71	0.51	Baa3	BBB-	BBB-	Lower medium grade
India	2,689,992	5.99	0.41	Baa2	BBB-	BBB-	Lower medium grade
Nigeria	397,472	1.66	0.24	0	B	B+	Highly speculative
Malaysia	347,290	6.81	0.66	A3	A-	A-	Upper medium grade
Brazil	1,909,386	5.22	0.57	Ba2	BB-	BB-	speculative
Serbia	47,564	5.18	0.27	0	BB	BB	speculative
Egypt	249,471	4.99	0.31	B3	B	B+	Highly speculative
Costa Rica	60,816	4.97	0.27	B1	B+	B+	Highly speculative
Ghana	51,815	1.96	0.15	0	B	B	Highly speculative
Panama	66,031	3.82	0.35	Baa1	BBB	BBB	Lower medium grade
Singapore	346,621	7.28	0.71	Aaa	AAA	AAA	Prime
Uruguay	60,933	4.52	0.25	Baa2	BBB	BBB-	Lower medium grade
Dominican Republic	81,103	3.99	0.18	Ba3	BB-	BB-	speculative
Albania	15,121	2.73	0.21	B1	B+	0	Highly speculative

Source: Authors' calculations.

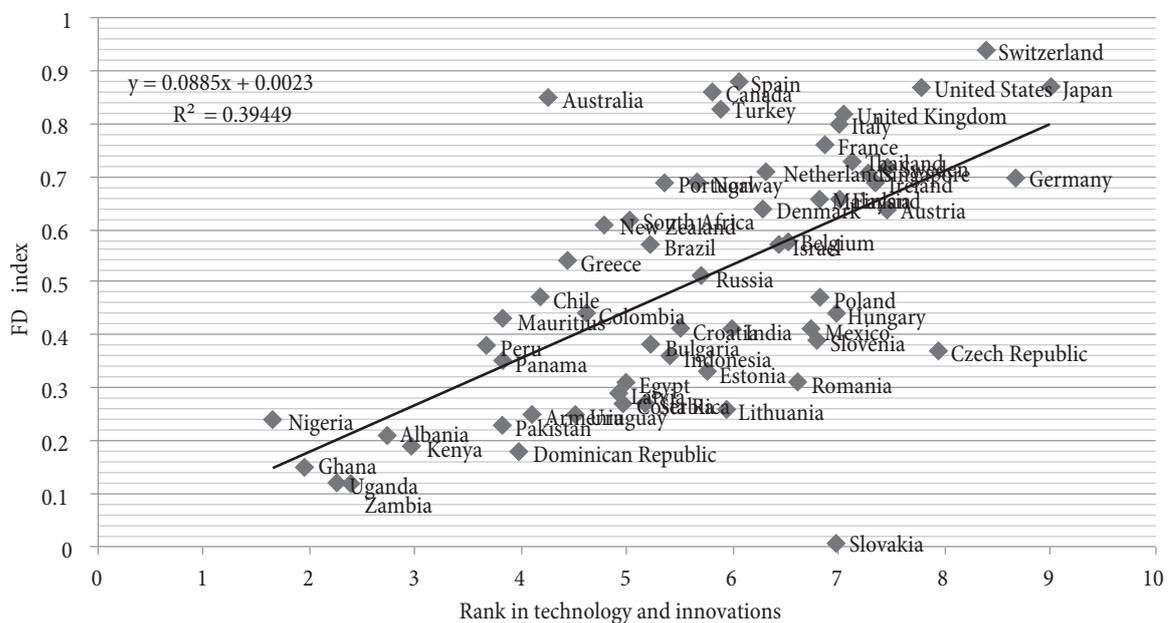
By using the Microsoft Excel programme, we have calculated the correlation coefficients and determinations for the following variables: X-axis – country rating in technology and innovation and Y-axis – financial market development (FD index), and X-axis – country rating in technology and innovation and Y-axis – country credit rating.

Results and discussion

We can note that both functions are growing. The first function is $y = 1,8859x + 5,3919$, where the coefficient of

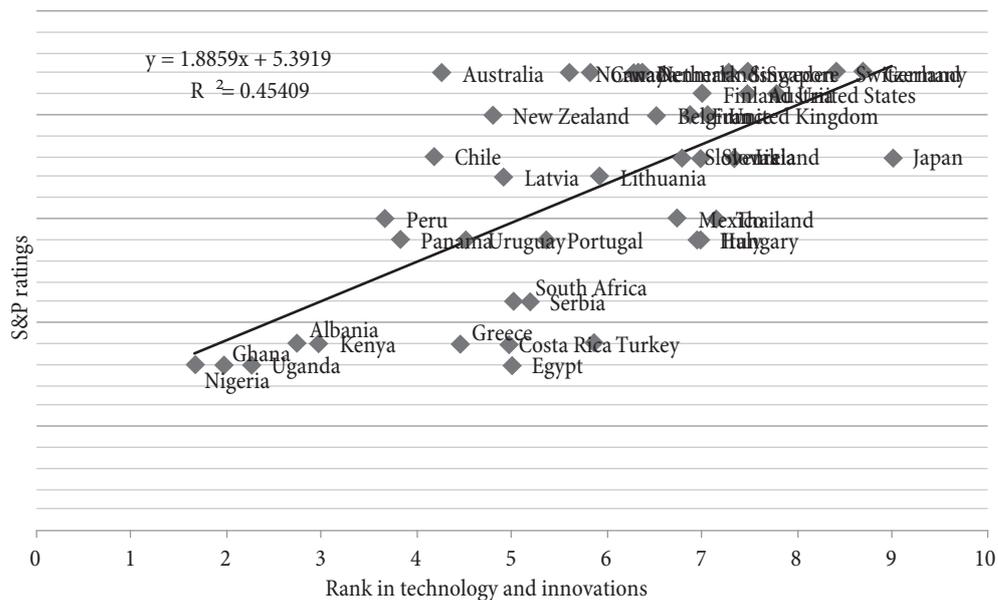
determination $R^2 = 0.3945$ is in correlation with the two observed phenomena for 68.57% of the sample, whereas the second one is $y = 1,9907x + 3,1292$, where the coefficient of determination $R^2=0.4541$ is in correlation with the two observed phenomena for 45.41% of the sample. This means that 39.45% of the variance of the FD index is explained by the ranking in technology and innovations. Correlation (R) equals 0.6281. This means that there is a strong direct relationship between the two observed elements (Figure 2). In addition to this, there is strong relationship between technology and innovations and the credit rating of the country.

Figure 2: Overview of the relationship between development of technology and innovations and market development of a country



Source: Authors' calculations.

Figure 3: Overview of the relationship between market development and credit rating of a country



Source: Authors' calculations.

The research results indicate that there is a strong determination between the rating of a country in terms of technology and innovations and the development of financial market, i.e., that we could connect 39.45% of market development with the level of development of technology and innovation in the respective country.

Therefore, without a doubt, digitalisation and innovation have a major impact both on the development of the financial market and the credit rating of the country.

Conclusion

Our research has shown that there is a strong direct relationship between ranking in technology and innovations and the FD index. Correlation is 62.81%, and determination is 39.45%. In addition to this, our research has shown that there is an even stronger direct relationship between ranking in technology and innovations and the credit rating. Here, the correlation is 67.39%, and determination is 45.41%. Therefore, without a doubt, digitalisation and innovation have a major impact both on the development of the financial market and the credit rating of the country.

The Fourth Industrial Revolution requires the involvement of all market participants, as well as the mobilisation of all the people who have exhibited talent and knowledge for the future, with maximum support from the government to maximise their potential. The

support must be both institutional, through investment in education, science, research and digitisation, and financial. If we look at the market of Bosnia and Herzegovina, we could talk about an insufficient level of technological innovation and digitalisation. We have proven in the paper that we can rightfully claim that there is a weak positive relationship between the development of technology and innovations in a country and the development of its financial market. On the other hand, we have demonstrated that there is virtually connection between the country's technology and innovation development and the country's credit rating. Therefore, we emphasise the need to introduce innovations and new technologies in the domestic financial market.

By analysing the current trends and indicators of the level of development of digitalisation of financial services, it is evident that financial intermediaries in the developing countries will be forced to change their business models and either adapt them to the accelerated market changes, or to form alliances with large technology companies, as well as with smaller companies that offer solutions complementary to the ones offered by the banks. In addition, they will have to act proactively towards regulatory authorities and reduce their operating costs so that they can compete in the market. From an organisational point of view, all future changes will be based on technologies and capabilities of financial intermediaries to quickly overcome new methods

of processing by constantly increasing amounts of data. Therefore, many financial intermediaries will partner up with fintech companies and make joint investments in technological projects.

In conjunction with the digitalisation process, it is also necessary to adequately regulate the financial framework in order to eliminate or mitigate systemic risks. First of all, it is necessary to protect clients and their data in the digital economy, to align the operations of companies that deal with similar transactions and to apply the same rules to all market participants. This implies that it is necessary to find the appropriate balance between competition, innovation, security, and client protection. It is strategically important that the impact of Industry 4.0 on the transformation of the financial sector must not jeopardise security at the expense of competition and innovation. From everything that was mentioned above, it is clear that Industry 4.0 has a major influence on the transformation of the financial sector, with clear understanding that certain constraints and the legal framework that might hinder further digitalisation of the financial sector must promptly be eliminated.

Financial markets of the future will certainly be marked by further digitalisation of banking products and services, which means that financial intermediaries that wish to be competitive in the market must invest in new technologies, which would certainly imply additional revenues they can count on, but also the costs of additional investments at this stage of transformation. The financial sector will develop towards open financial services, which will further affect all financial intermediaries and other participants in the financial industry, pushing them to further customise their businesses and services.

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