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Digitization of the Ukrainian Economy: Strategic Challenges and Implementation Technologies

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Abstract. **The paper deals with main directions, challenges and threats of digitalization of the national economy of Ukraine.**

The attention is focused on the identified weaknesses and the imperfection of the strategy and the state policy of digitization of the Ukrainian economy. The authors prove an existence of potential and new possibilities of public finance management problems solving with the usage of blockchain technology. They ground that activation of transformation processes in the real economy sector due to the introduction of Industry 4.0 concept is important for Ukraine. The paper reveals basic principles and technologies, the experience of the European Union and characterizes Industry 4.0 landscape in Ukraine. The driver of digital financial services transformation is the development of the latest financial technologies - FinTech. The authors describe the types of FinTech-innovations, the features of increasing competition between FinTech-companies and traditional financial intermediaries, the tendencies of FinTech development in Ukraine.

Keywords—digital divide; digital gap; digital economy; digital transformations; Industry 4.0; BigData; Artificial intelligence, AI; Internet of Things, IoT; innovation; financial innovation; FinTech

I. INTRODUCTION

Globalization, integration and digitalisation of economic relations and social development are interconnected processes that require well-balanced policy and effective mechanisms of implementation. However, the constraining factors of the development of the national economy of Ukraine, along with the chronic lack of financial resources, are accompanied by strategic failures and poor performance of state support mechanisms, the imperfection of the legislative framework and the high risks associated with political and financial instability. Under these circumstances, it is necessary to search and activate drivers of economic growth, which, in our opinion, definitely include a digital economy based on dominant application of digital technologies, principles of openness and transparency.

At the same time, digital transformations of the national economy, taking into account challenges and threats, should not be projections or extrapolations of modern trends of Western society. They should become a new principle of social and technological organization of the national economy, as well as a new way of life of Ukrainian society.

II. STATE POLICY OF UKRAINE IN THE SPHERE OF DIGITALIZATION OF THE NATIONAL ECONOMY

A. Strategic Aspects of State Policy in the Sphere of Digitalization of the Economy of Ukraine

The processes of digitalization, as well as market relations in general, are characterized by market faults and failures, which require state regulation. The main one is digital inequality or digital divide (digital gap) [1]. The capabilities of modern digital technologies are enormous, but not all can use them to achieve social and economic goals. For example, in Ukraine, with a high mean value and even distribution, the penetration of Internet broadband access has a pronounced gap between a city and a village - about 30%. Moreover, a significant part of rural population (up to 35%) does not have Internet broadband access at all. Digital inequality can be also demonstrated in sectoral terms. In particular, only 1% of health care institutions and 47% of secondary schools in Ukraine have broadband access [2].

Digital gap is a problem not only for individuals, but also for entire countries and regions. It is globally high. Thus, according to the Internet penetration rate, Ukraine is among outsiders, because its rating is lower than world average (it ranks 112th out of 201 countries of the world and 44.1% against 54.4% on average) [3]. Although Ukraine has well-developed fast fixed broadband Internet and ranks 47th out of 130 countries according to Speedtest Global Index, it has problems with mobile Internet access.

The country is among the top 10 outsiders countries (it ranks 117th) by this indicator [4]. Such a situation threatens the competitiveness of the country, becomes a severe challenge for its social and economic development in the context of digitalization processes development at the stage of transition to a post-industrial society.

To solve this problem is the top priority task of the state policy in the field of digitalization. All market participants should cooperate actively to overcome digital divide and to ensure active deployment of high-speed networks. It is important for the state to create incentives for attracting private capital and mobilize all national resources to accelerate technological changes [5]. At the same time, key incentives are initiatives to create sustainable digital skills among citizens through such areas as education, medicine, tourism, transport, e-government, etc. The ultimate goal is not just giving the infrastructure of broadband access to the Internet to citizens, but also creating their needs in it, especially those aimed at improving life, comfort, education, business, development, etc.

Unfortunately, it is worth noting that Ukraine still lacks the strategy of digitization of the national economy. Strategic documents such as the Strategy for Sustainable Development 'Ukraine-2020', the State Strategy of Regional Development for the Period until 2020, 'Ukraine 2030: Doctrine of Balanced Development' do not meet the requirements of time and need to be updated in line with modern, global, digital trends of economic development. For example, the Concept for the Development of Digital economy and Society of Ukraine for 2018-2020 (adopted by the Cabinet of Ministers of Ukraine in January 2018), is aimed at forming only certain elements of the digital economy. It is limited to the priorities of the development of e-governance and does not take into account the state stimulating complex influence on the digitalization of the economy [6].

In our opinion, the priority task is the approval of the project 'Digital Agenda for Ukraine 2020' at the state level and its harmonization with the Digital Agenda of the EU. The key targets are the formation of framework legislation for the creation and development of a uniform digital platform for the state digital services and implementation of effective institutional, infrastructure, legal, organizational, economic and financial mechanisms for the development of digital society. It is very important to mobilize resources of the State Fund for Regional Development to stimulate the digital modernization of the economy based on public and private partnership. In particular, it is necessary to use the competitive potential of the domestic IT industry through its reorientation from the outsourcing of the economies of other countries to the development of modern digital products for Ukraine, with their further spreading beyond the country and increasing the potential of intellectual rents.

B. Usage of Blockchain Technology to Solve the Problems of Public Finance Management in Ukraine

Ukraine has a number of unresolved economic problems. They are connected with macroeconomic imbalances, rising debt burden, rising risks in real economy, deteriorating investment climate and lending, excessive centralization of the budget system, inefficiency of government expenditures, etc. All of them point to the need to introduce modern mechanisms and innovative technologies for public finance management. One of these innovative technologies is blockchain technology. According to M. Swan, it aims at reliable accounting of various assets, new organization and coordination of any kind of activity [7].

Let's consider in more detail the application of blockchain technology in the directions of public finance management.

Improvement of the system of electronic purchases. Blockchain technology helps to simplify access and participation in purchases, to create a registry and a single buyer profile automatically, to change approaches to identifying reliability, to optimize operating costs and to improve efficiency, information transparency and security. The technology also allows forming information file from different sources of market data and to ensure effective decisions making process on the basis of multifactorial intellectual analysis. In 2016, the first project based on blockchain technology aimed to reform the system of privatization and lease of state-owned property in Ukraine was the blockchain-auction 'E-Auction 3.0', which allowed buying state-owned property with fiat money and cryptocurrency. At the same time, the implementation of blockchain technology into the public procurement system requires the introduction of changes to the tender legislation, the abolition of excessive procedural control, the strengthening of financial control over bidding results, simplifying the procedure and reducing the costs of participation for small and medium-sized business entities, etc.

International organizations give a negative assessment to the public investment management in Ukraine. The reasons for this are the following:

- the lack of an integrated system of public investment planning and management;
- the lack of strategic national development plan that defines the list of priority projects;
- the lack of institutional understanding of the fundamentals of public investment management;
- excessive politicization;
- high level of corruption;
- the lack of development of public and private partnership, etc.

In 2016, Ukraine implemented the monitoring of the state investment projects realizations on the principles of information publicity.

The next step, in our opinion, should be the transition to smart contracts. Important issues of public investment

management – the support of project documentation and an effective process of investment projects budgeting – can also be implemented on the blockchain technology basis.

Improvement of state registers maintenance, public asset management. Ensuring of effective budget planning and fiscal risks public management is impossible under conditions of incomplete information about public sector balance, indicating all liabilities and assets, in particular land and real estate, their current condition, level of wear and tear and value. Such information is of strategic importance. It requires reliable preservation, synchronization and protection, and, at the same time, openness, transparency and quick access. All this becomes possible due to the usage of blockchain technology. In this direction, the State Land Cadastre of Ukraine has been transferred to the blockchain technology. This project, along with cost reducing and transactions speed increasing, allows overcoming the corruption risk. However, its technical implementation has revealed the following problems:

1) the necessity for strict control of information reliability;
2) determination of a mechanism for access rights management;
3) high moral standards of system participants;
4) the necessity for legislative legalization of blockchain technology.

The next project is a specialized platform for conducting electronic online land auctions (CEA). The system was tested. It makes it possible to form a rates rating and a trading protocol, and by synchronizing with banking institutions – to conduct monetary transactions, to pay warranty and registration fees. In the near future, it is planed to introduce the State Register of Real Estate Rights, which will be synchronized with the State Land Cadastre and Electronic Trading System of Arrested Property (CETAM) on the platform OpenMarket. This innovation will help to conduct real-time monitoring of the bidding process and of contract conclusion, to record all actions in blockchain and to prevent any change of historical data, etc.

Thus, blockchain technology transforms land and property relations, preventing manipulation, speculation and fraud. It provides the opportunity to carry out regular monitoring and control, to minimize the influence of human factor and corruption risk. It ensures reliable protection of owner's rights.

III. DIGITAL TRANSFORMATIONS IN THE REAL ECONOMY SECTOR - INDUSTRY 4.0

A. Industry 4.0 Concept: Basic Technologies and Principles

The digital transformations of the real economy are connected with the concept of Industry 4.0 or 'the fourth industrial revolution'.

Industry 4.0 is a new approach to building a digital model of production processes (of plants or enterprises) that are becoming more complex, integrated, service-oriented and flexible. It is also a significant potential for restructuring and creation of industrial giants based on the construction of an industrial Internet infrastructure, reducing dependence from the human factor and increasing the level of intellectual work.

The basic principles of Industry 4.0 are:

1) compatibility and the ability to interact for all the components of enterprise ecosystem with the help of technology 'Internet of Things' (IOT);
2) transparency – virtual simulation of a real object (process) and creation its digital copy, which allows to collect complete information about functioning and provide the proper level of control and management for real objects and processes;
3) technical assistance – complete automation and robotization, especially routine and dangerous technological processes of production;
4) decentralization of managerial decisions – minimization of uncertainty and human factor in controlling of the production processes of automated systems, automatic control strengthening.

Digital transformations of Industry 4.0 involves full automation and introduction of fundamentally new technologies, in particular by significance degree of industry impact or business model: 'Internet of Things', Artificial Intelligence, robotics, 3D printing, Augmented and Virtual Reality, drones, blockchain, 'big data', Predictive Analytics, Cloud Computing.

Industry 4.0 involves the digital transformation of all spheres of life, giving them significant economic and social effects, and offers new powerful opportunities for the state, society and citizens [8].

The effects of Industry 4.0, which will change the profile of modern production, may be [9]:

- IT-enabled mass customization of manufacturing products, meaning that production should be adapted to the needs of the individuals.
- Production chain's adaptation in a flexible and automatic way to the requirements of the rapidly changing environment.
- Tracking and self-awareness of different parts and products and their mutual communication with other products and machines.
- Advanced human machine interaction paradigms, which includes new radical ways to interact and operate in the factories.
- Production optimization thanks to 'Internet of Things' enabled communication in the Smart Factories.
- Appearance of completely new business models which will contribute to the radically new ways of interaction in the value chain.

The greatest changes from digital transformations are expected from 'Internet of Things' technology in such spheres of economy as industry, agriculture, transport and

logistics, energy, healthcare. The distinctive features of innovative business models on its basis will be: customer-oriented and service-oriented interaction; integration and processing, corporate principles of working with big data; flexible structure of organization and execution of interrelated business processes.

A. The Experience of the European Union

The evidence of understanding of the importance of building a digital economy in the EU member states are the initiatives, taken by the European Commission, in particular:

- Europe 2020 Strategy, which covers seven flagship initiatives for the development of a social market economy in the 21st Century– Industrial policy for the globalisation era, Digital Agenda for Europe, The Innovation Union etc., (2010).
- The Entrepreneurship 2020 Action Plan (2013).
- The Small Business Act for Europe (2008).
- Adapting e-business policies in a changing environment: the lessons of the Go Digital initiative and the challenges ahead (2003).

According to the EU evaluation, the digital economy is growing seven times faster than the rest of the economies in the world, in particular [10]:

1) the EU digital economy is growing at 12 % each year;
2) the Internet economy creates five jobs for each lost;
3) there are 7 million jobs in the ICT sector in Europe;
4) labour productivity has increased by 50%, this productivity growth derives from investment in ICT.

Conceptually important for the EU is the formation of Digital Single Market, on condition that investment is sufficient for the development of modern communication facilities, research, production, artificial intelligence, big data technology. The adoption of special legislation regulating digital market innovations is of great importance.

In its turn, the EU's Digital Single Market Strategy aims at:

1) improvement of access to digital goods and services, which will create open, fair competition and market conditions for consumers, investors and enterprises; harmonization of copyright legislation; reduction of administrative pressure by introducing a unified taxation approach, a single VAT rate, etc.;
2) creation of a legislative basis for the development of digital networks and innovative services – regulation of the EU's telecommunications market; security of data and digital services, increase of confidence; consolidation of global efforts to fight cyber crime;
3) maximizing the growth potential of the digital economy – free movement of information; adoption of uniform standards for data transmission, functional interaction between different sectors of economy; e-society with equal opportunities for all, support for an inclusive digital society [11].

The digitization of the EU's economy aims at ensuring stable economic and social benefits from a Digital Single Market.

B. Creation of Industry 4.0 landscape in Ukraine

Priorities of the state policy of Ukraine for stimulating the development of Industry 4.0 landscape are [6]:

1) creation of Industry 4.0 infrastructure – industrial parks, industry centers of technologies, etc.;
2) access to capital to create new innovative productions;
3) development of digital skills for training personnel capable of working with Industry 4.0 technologies.

Today Industry 4.0 landscape is formed by domestic and foreign brands in such directions as Industrial Internet of Things (IToT), Big Data and new technologies.

Thus, in the direction of Industrial Internet of Things the following companies offer their products:

Kaeser Kompressoren (Germany) – Sigma Air Manager 4.0, compressor station with a new business model based on automated life-cycle management, predictive maintenance, adaptive regulation, real-time data processing, cyber security, machine learning and communication management;

General Electric (USA) –industrial cloud platform Predix (GE) to test assets and predict their behavior, to manage all types of risks, etc .;

SoftElegance (Great Britain) – IT-solutions for automation of business processes and development of corporate systems;

IT-Enterprise (Ukraine) – SmartEAM, system for preventive equipment maintenance.

In the direction of Big Data: machine learning – IT-Enterprise (Ukraine) – SmartTender.biz, e-procurement platform for industry; cloud computing solution – Oracle, IBM, Microsoft, etc.

New technologies on the domestic market are represented by: Sensorama (Ukraine) – virtual and augmented reality applications (VR/AR), 3D computer graphics and animation, recording and playback of surround sound, software and hardware video stabilization systems, motion capture systems, etc.; IMATEK (Ukraine) – solution for 3D printing; Fabricator (Ukraine) – tools for rapid modeling and prototype production of industrial equipment [12].

It is worth recognizing that Ukraine is lagging behind many countries in digitalization of the real sector of the national economy. All hopes are mainly based on the existing potential of IT innovators, the formation and cooperation of professional associations and communities, enterprises, integrators and other market participants for the implementation of sectoral road maps, transfer mechanisms, concrete projects of real sector digital transformations.

IV. FINTECH: DIGITALIZATION OF FINANCIAL SERVICES

Due to emergence and development of the latest financial technologies – FinTech – the financial services industry without exaggeration is experiencing a change in the paradigm of its existence. According to the Financial Stability Board, FinTech are technology-backed financial innovations that can lead to the emergence of new business models, applications, processes or products with a material impact on financial markets and institutions, and provision of financial services [13].

C. Types of FinTech-innovations

According to Ravi Menon, Managing Director of the Monetary Authority of Singapore (MAS), key technologies underlying financial innovations are:

1) distributed ledger technology, in particular Blockchain;
2) Big Data;
3) Artificial Intelligence (AI);
4) Cloud Technologies [14].

According to KPMG experts, such technologies as Machine Learning, AI and Internet of Things (IoT) will be particularly popular in Fintech global industry in 2018, and Big Data analytics, application programming interface (API), robotics and robo-advising – in the nearest three years [15].

The outlined innovations complement and reinforce each other. For example, Cloud Computing uses Big Data, as well as AI and cryptography to create efficient distributed ledgers that are used in Internet. This characteristic complementarity enhances the potential for transformations in financial sector. FinTech popularity may also increase nonlinearly, taking into account network effects.

D. FinTech-companies Versus Traditional Financial Intermediaries

The application of the outlined innovative technologies gives FinTech-companies a chance:

1) to create a wide range of individualized, affordable and user friendly solutions;
2) to provide high quality, impeccable, fast and twenty-four-hour service;
3) to increase business efficiency and profitability by reducing transaction costs;
4) to promptly respond to changes in regulatory requirements;
5) to apply the latest payments models of and distribution of financial services;
6) to reduce risks (in particular, credit, moral, compliance risk) etc.

As a result, according to KPMG, in 2017 total investment in FinTech global market amounted to US $ 31 billion, with US $ 8.7 billion – in Q4 (307 transactions) [15].

The described trends indicate that FinTech-companies are turning into a significant competitive alternative that can threaten the dominance of traditional intermediaries in the financial market. According to PwC forecasts, in the next five years FinTech-companies can take about a quarter of the financial market. In general, more than 20% of companies in the field of financial services will affect the competition from the FinTech-segment by 2020. 28% of the companies providing banking services and 22% of insurance companies and companies with assets management and private capital can be in the 'risk zone' [16].

The response of traditional financial intermediaries to competition with the FinTech segment is complicated by burdensome regulation, cultural confrontation to changes, substantial business costs and obsolete IT systems. As a result, the reactions spectrum is quite broad and varies from a defensive position and an orientation towards the internal capability of research and product development (R&D) to aggressive acquisition of young FinTech start-ups. The results of a survey conducted by KPMG experts show that the majority of traditional financial intermediaries (81%) plan to establish and/or intensify cooperation with Fintech-companies during 2018, 52% plan to focus on their own corporate resources in the development of innovative products, 33% – apply outsourcing, and 37% – to be engaged in mergers and acquisitions of FinTech-companies [15].

However, taking into account the fact that traditional financial intermediaries have well-established infrastructure, necessary licenses, significant operations scale, financial resources, reputation, customer and information base, various forms of cooperation between them and FinTech-companies can generate significant synergizing effects for both parties.

E. FinTech in Ukraine

According to the study conducted by experts from USAID Financial Sector Transformation Project and UNIT.City Innovation Park, FinTech is at the early stage in Ukraine. About 80 companies are active in the market, the vast majority of them (58%) have appeared since 2015. At the same time, only 84% of FinTech-companies have already started to offer products and services, and 16% are currently at the formation stage [17].

Mostly, these projects are created and operate in the direction of payments and remittances (31.6%), technology and infrastructure development (19.3%), lending (14%), marketplaces (7%), InsureTech (5.3%), digital and neobanks (5.3%), etc. [17].

FinTech began to attract attention of players of the financial sector of Ukraine only in 2017. According to a survey of representatives of the banking sector conducted by Mastercard in 2017, 87% of Ukrainian bankers fully support the introduction of financial innovations. At the same time, 58% of respondents proved that their bank is ready for the introduction of FinTech, and 71% consider it appropriate to track and buy effective FinTech solutions [18].

V. Conclusion

Positive changes in the processes of digital transformations of the national economy of Ukraine can be expected providing that the public and private partnership is intensified and relied on state strategy and policy that correlates with the global digitalization trends. For Ukraine, it is important to restore and recover the real economy. Introduction of Industry 4.0 Concept can be a driving force behind these changes. Despite the fact that today we observe the overwhelming influence of the financial sector on the Ukrainian economy, there is a stable relationship between the financial and real sectors of the economy. We can see it in providing financial services, financial investment and lending, etc. In turn, it requires the continuous development of the latest financial technologies – FinTech. Taking into account the global trends and potential of the domestic IT industry, banks as traditional financial intermediaries, have the opportunity and in order to maintain their own positions they are to head FinTech development in Ukraine. Consolidated efforts of banking and business communities and IT professionals will enable the introduction of FinTech-startups and moderate regulatory and integration problems with existing services and business solutions.

Along with the expected positive effects, digital transformations generate challenges and threats. In particular, the greatest concern for Ukraine is the threat of staff cuts. Under the conditions of emigration of many young prospective people abroad and lack of proactive measures of professional reorientation, it can slow down the processes of digital transformation, as well as contribute to the growth of society stratification and to exacerbate social tension.

The prospects for further research are in the study of world experience in order to solve the problem of normative regulation, to forecast changes and possible social consequences of the digital transformations of the sectors of the national economy of Ukraine.

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