Taxation Transformation under the Influence of Industry 4.0

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***Abstract*—Today the growing level of automation and the new concept of online technologies are transforming the traditional industry. Value is generated with the help of Industry 4.0 technologies that not only increase the efficiency and agility of supply chains, create new products and offer new ways of connecting businesses and consumers but also have a major impact on the traditional tax system. This study aims at determining changes in the modern industrial economy and substantiating possible directions for transforming the tax system to adapt it to the requirements of Industry 4.0. The objective is to identify the relationship between the digitalization of the economy, the use of blockchain technologies, robotics, automation, M2M technologies offered by Industry 4.0, and taxation. The article demonstrates how these technologies influence taxes and proposes measures to address possible tax issues. The authors of the article have concluded that the reasons (and goals) for transforming the current tax system as a result of the development of Industry 4.0 technologies are as follows: 1) to increase or stabilize tax revenues to compensate for tax losses and finance new education needs; 2) to introduce innovations for the development of Industry 4.0 and further digitalization of the economy; 3) to create an automatic tax administration system.**

***Keywords*—Digitalization; cryptocurrency; blockchain; robotics; automation; innovation; tax**

I. Introduction

New technologies, principles, and approaches to production, automation, and robotics are influencing the level of employment [1], the amount of operating costs [2, 3], tax revenues [4], and the traditional taxation system as a whole [5].

The existing taxation system is built on the principles that have not changed over a long time, namely: fairness (all people pay taxes in proportion to their income and capabilities); certainty (the elements and overall organization of tax payments are clear); convenience (the mechanism for paying taxes should be as easy as possible for taxpayers); efficiency (the cost of administering taxes should be minimum) [6].

In our opinion, technological progress and globalization determine other priorities for socio-economic development, the specifics of production and sources of income [7], transforming the structure of tax systems, the organization of tax collection, shifting emphasis from one taxation object to another, expanding tax bases or reducing benefits [8, 9]. Thus, we want to answer the following questions: what are the consequences of the modern taxation system for introducing Industry 4.0 and the digitalization of the economy as a whole? How will the introduction of Industry 4.0 affect the taxation system's organization? How will Industry 4.0 technologies affect the tax structure and will new taxes be introduced?

Literature Overview

Different scholars are trying to answer these questions about the impact of the changes brought by Industry 4.0 on the development indicators of enterprises, households, and countries as a whole. Within the framework of studies [10, 11], an attempt was made to determine the potential tax implications for enterprises using new technologies and approaches to their production. The impact of Industry 4.0 on the tax strategy is analyzed in [12, 13]. Some studies conducted by specialists in taxation [14, 15] dwell on tax evasion in the digital economy. Recently, more and more scientific works have been prepared on the relationship between new technologies (such as robotics and the blockchain system) and taxes [15, 16]. Much attention is paid to electronic tax administration and control [17, 18].

Since digitalization, robotics, M2M technologies, and blockchain lead to significant changes both in national tax systems and in international taxation [19], some scholars offer several approaches to solving emerging problems: 1) to apply taxation to new technologies and their products and applications, for example, to extend traditional taxes to such objects as personal data, cryptocurrencies, and imputed income of robots [20]; 2) to replace digital transactions and shortfalls in revenues by traditional taxation objects in the form of tangible assets and/or increase tax pressure and the degree of progressive taxes already levied on such objects [21]; 3) to build a new tax system and transfer it to automatic taxation using blockchain technologies [22].

We believe that participants in global economic processes are entering a new technological era, therefore the development of Industry 4.0 does not affect individual spheres but rather concerns the whole world community.

Thus, the article aims at studying changes in the modern industrial economy and substantiating possible directions for transforming the tax system for its adaptation in the context of the development of Industry 4.0.

The research tasks are as follows:

- To reveal the main technological changes as a result of the development of Industry 4.0 and the digitalization of the economy as a whole;

- To identify economic changes in connection with the development of Industry 4.0;
- To analyze the consequences for the tax sphere, the impact on taxation objects and tax bases, which will cause economic changes in connection with the development of Industry 4.0;
- To propose measures in the tax sphere that need to be taken to solve the problems that arise.

The research hypothesis is as follows: economic changes as a result of the development of Industry 4.0 technologies affect (and will affect) the tax policy and tax system, which requires the transformation of the modern tax system and the use of both traditional and innovative tax tools.

II. METHODS

To solve the above-mentioned tasks, we used theoretical and empirical methods of research, tested in scientific research devoted to the economic and information spheres of social development. Among the theoretical methods, we include the collection and analysis of scientific sources on the topic [23]. We used empirical research methods (expert survey) to collect quantitative data [24] with mathematical processing of results using the Kendall concordance coefficient (W) [25].

The study was conducted in three stages from February to April 2022 at the Financial University under the Government of the Russian Federation.

At the first stage of the study, we examined scientific and analytical works on the research topic.

The analysis of the relevant publications allowed us to identify the main technological changes as a result of the development of Industry 4.0: the digitalization of the economy, the use of blockchain technologies, robotics, automation, M2M technologies (machine-to-machine, data transfer directly between devices).

At the second stage of the study, we communicated online with the experts. The expert survey was carried out in Russian via e-mail.

The e-mails containing the above-mentioned questions were sent to 68 respondents, including 39 employees of high-tech companies from the top 15 of the Techuspekh 2020, 14 employees of analytical and information technology departments of the central office of the Federal Taxation Service of Russia, and 15 lecturers of the Financial University under the Government of the Russian Federation. The respondents were asked to justify their answers in a free form. As a result, we received answers from 61 experts.

In connection with the research topic, the experts were asked the following questions:

1) What are the consequences of digitalization, the use of blockchain technologies, robotics, automation, and M2M technologies for the economy and the tax sphere?

2) What measures should be taken in the field of taxation to offset the negative (positive) consequences of this influence?

All the respondents were informed about the purpose of the survey and that the authors planned to publish its results in a generalized form.

When receiving the answers, we asked the experts, depending on the significance of emerging problems, to arrange the consequences for the economy and the tax sphere on a scale of order, and to assign points. After that, each consequence of the economy and the tax sphere was ranked according to the points assigned by the experts.

For a more objective analysis of the data obtained during the expert survey, the consistency of expert opinions was measured through the mathematical processing of the results using the Kendall coefficient of concordance (W):

$$W = 12S/n^2(m^3-m),$$

where S is the sum of the squared deviations of all the ranks of each consequence for the economy and the tax sphere from the average value; n is the number of experts; m is the number of estimated economic/tax consequences.

Then the information obtained during the expert survey was processed to determine the impact of each consequence on the economy and the tax sphere, as well as to build a rank transformation matrix and calculate the arithmetic average of impacts for each consequence of the development of Industry 4.0 for the economy and the tax sphere, respectively.

The final impacts determine the significance of the consequences of Industry 4.0 for the economy and the tax sphere from the viewpoint of experts. All calculations were carried out using Excel 365 programs and the Stattech online service (https://stattech.ru/).

III. RESULTS

The analysis of the expert survey has revealed the main consequences in the economy and taxation due to the introduction of new technologies and forms of doing business (Table I).

TABLE I. THE KEY ECONOMIC AND TAX CONSEQUENCES OF INDUSTRY 4.0

Changes	Consequences					
	Economy	Ranking	Impact	Taxation	Ranking	Impact
Digitalization	Increasing the purchase and sale of digital services and digitized goods	1	0.27	Reducing tax revenues on the consumption of traditional goods and services	1	0.36
	Protecting personal and corporate data	3	0.14	Protecting personal and corporate data	4	0.14
	Growing transnational stateless income	4	0.11	Erasing the tax base when taxing profits upon concluding agreements with citizens of other countries without their physical presence in these countries	3	0.16

Use of blockchain technology	Transparent operations	6	0.05	Possibility of a fundamental change in the tax administration system based on the automatic calculation of tax liabilities and their withdrawal from accounts	5	0.02
	Free access to transaction information	8	0.02			
	Minimizing the risk of losing documents	9	0.03			
Robotics, automation, M2M	Reducing the number of low-skill jobs	7	0.04	The need to compensate for the losses of social taxes that are currently paid by those employed in production	2	0.32
	Lack of personnel	5	0.10			
	Growing unemployment and income inequality	2	0.24			

Note: based on the results of an expert survey

According to the calculation of the Kendall's coefficient of concordance (W) (W = 0.69), it can be argued that the expert opinions coincide since the value of W > 0.5 indicates the objectivity of the survey results. This circumstance allows determining the impact of economic and tax consequences in connection with the development of Industry 4.0.

In conformity with the calculation results, digitalization has the greatest impact on the economy and taxation. Thus, the most important consequences are an increase in the purchase and sale of digital services and digitized goods (0.27), and the associated decrease in tax revenues on the consumption of traditional goods and services (0.36).

The robotics and automation of production which increase unemployment and income inequality (0.24) are no less important. As a result, it is necessary to compensate for losses in social taxes that are paid by those employed in production (0.32).

TABLE II. THE MEASURES TO BE TAKEN TO SOLVE TAX PROBLEMS

Changes	Consequences for the tax sphere	Measures to be taken to solve problems
Digitalization	Reducing the amount of tax revenues on the consumption of traditional goods and services	Introduction of a tax on digital goods and services or expansion of the existing tax base
	Protection of personal and corporate data	Introduction of a tax on the collection and use of personal data for Big Data owners
	Erosion of the tax base when taxing profits upon concluding agreements with citizens of other countries without their physical presence in these countries	Alignment of national legal norms with international tax legislation by improving transfer pricing for digital goods and services
Use of blockchain technologies	Possibility of a fundamental change in the tax administration system based on the automatic calculation of tax liabilities and their withdrawal from accounts	Development of a plan, tools and methods for implementing blockchain technologies for automated tax collection and unification of tax administration
Robotics, automation, M2M	Need to compensate for the losses of social taxes that are currently paid by those employed in production	Determining the possibilities of introducing new compensatory forms of taxes (tax on robots, universal basic dividend, etc.). Introduction of a tax credit for education and retraining loans

Note: based on the results of an expert survey

Further analysis of the expert survey determines the appropriate tax measures that need to be taken in order to overcome possible consequences for the tax sphere in connection with the development of Industry 4.0 (Table II).

IV. DISCUSSION

As our analysis showed, the main technological changes caused by the development of Industry 4.0 are the digitalization of the economy, the use of blockchain technologies, robotics, automation, and M2M technologies (machine-to-machine, data transfer directly between devices), which has a direct impact on changes in the tax sphere.

The digitalization of the economy will manifest itself in various aspects of business sectors, which will affect the development and adaptation of the tax system both in the context of international cooperation and in the context of the development of taxation systems at the national level. Let us consider the typical examples faced in practice by taxation specialists and researchers. We presented all the examples taking into account the rank of the consequences for the economy and taxation received as a result of our study.

A. Digital Goods and Services and their Tax Administration

Under the research results [22], industrial enterprises will annually reduce costs by 3.6% and increase revenues by 2.9% over the next five years due to the digitization of products and services, and the development of new digital services. From a tax standpoint, this is a positive trend since income growth also increases tax revenues. However, scholars highlight [13] that digital goods reduce the tax base in several ways: firstly, the cost of digitized goods is lower (for example, books and audio albums); secondly, digital goods and services can be paid for not in cash but in the form of barter (subscription to advertising, newsletter, and other forms of generally B2B communication services); thirdly, digital goods are sold via the Internet (the buyer might be from one country, the seller from another), therefore there is stateless income that is less subject to the current tax laws.

Thus, some countries do not rely on growing revenues from the sale of electronic goods and services of domestic manufacturers and review their taxation systems in order to adapt them to the changes caused by total digitalization. This grants foreign IT companies more access to their markets [26]. However, as the results of our expert survey show, these trends may lead to a decrease in the level of protection of personal and corporate data, so the access of foreign IT companies will be severely limited by the national legislation of countries [27], thereby hindering the development of digital goods and services.

B. The Use of Tax Instruments as a Way to Protect Personal Data

An additional way to protect information can be the use of tax instruments [28]. At the World Economic Forum of 2011, personal data was recognized as a new asset, whose possession and use can generate income [9]. In the EU, it is allowed to tax enterprises that collect, integrate, and use such data in their activities but this right has not been implemented yet [13]. In France, an attempt was made to introduce a tax on the collection of personal data for Big Data owners (the taxation of Google, Amazon, and Facebook was considered a pilot project) but the corresponding law was not adopted. The reasons include the lack of statistics and schemes for calculating the company's profit from owning such data: on the one hand, their collection and use generate income; on the other hand, it is rather difficult to calculate its share in total income [29].

Researchers [1] believe that work has begun to protect national tax systems and minimize the risks of tax non-payment by digital companies and platforms. One of the proposals is the introduction of specific taxes (a tax on purchases of goods and services via the Internet, or a turnover tax on commercial activities on the web) to prevent the liability of digital businesses.

Currently, additional provisions on the taxation of foreign supplies of digital services and goods are being introduced into the tax codes of some countries. Since 2017, all digital goods and services provided by foreign companies are subject to an indirect tax (Goods and Services Tax) of 10% in Australia; 15% in New Zealand, 8% in Japan; a 5% VAT rate on online purchases in Taiwan [2].

C. Transfer Pricing of Digital Services

Another feature of the development of Industry 4.0 is transnationalization, therefore an important aspect for tax purposes is the transfer pricing of digital services [19, 30]. According to the experts [17], this can be either quite difficult (if the company's smart connection is installed between a data center located in one jurisdiction and factory floors located in another jurisdiction) or relatively simple (when the intellectual property developed in one jurisdiction (country) is licensed in another jurisdiction).

In the first case, the company's departments where the production facilities are located should, according to transfer pricing rules, pay for the asset (smart connection) the fair market price that a third party could pay for them. However, it is almost impossible to determine the price due to the uniqueness of the asset. Thus, the current transfer pricing models are not always useful. In the second case, when licensing, legal rights to intellectual property usually remain in the country where it was developed, and economic rights are transferred to a foreign jurisdiction. There are no changes in the location of investments: investors use transfer pricing and record the costs of a unit in the country where the property is developed, and the profit is received by a unit in another country that has economic rights [11]. Although it is quite easy to set the price, tax evasion is still possible since, on the one hand, the expenses in the country of the developer (the parent company) will reduce the tax base; on the other hand, the affiliated party might incur minimum expenses and receive excess profits due to lower tax rates. Therefore, the transfer pricing of companies using new technologies remains open and requires additional research.

D. Blockchain Technologies' Effect on the Organization of the Taxation System

According to the experts [21], the use of **blockchain technology** will provide internal revenue service field offices with free access to the operations of enterprises as it allows them to simultaneously and automatically calculate tax liabilities, withdraw funds from bank accounts to pay taxes, and eliminate the gap between reporting and paying taxes. Thus, the functions of tax authorities can be significantly reduced, as well as the number of the administrative staff of local tax offices. At the same time, the use of blockchain in order to obtain taxation data will reduce the likelihood of tax disputes and audits.

The first changes might be the elimination of tax returns and the transition to digital tax accounts, which allows one to view and update tax information, receive timely news, and pay tax liabilities. Consequently, society will have a single, centralized digital tax system or platform that will work in real time. Many countries have already been taking steps in this direction. They aim to create a modern and efficient internal revenue service field office, easy to use and with simplified administration in the form of digital taxation.

E. The Impact of Robotization Processes, Automation, and M2M on Changing the Taxation Organization and System

The introduction of robots into industrial production is quite expensive [31]. To renew assets and maintain the competitiveness of industrial enterprises in the world, a tax credit (R&D) is used [32], which allows for a reduction of the tax base by the amount of an enterprise's costs for the development and implementation of innovations [19].

Besides the advantages of robotics and fully automated production (increase in productivity [33] or wages [34]), there are also disadvantages, in particular, a reduction in the number of jobs, a decrease in demand for low- and medium-skilled workers, an increase in the income gap, i.e. the risks of growing unemployment [12].

According to the study results [15], one of the solutions to growing income disparities can be the redistribution of income with the help of fiscal tools. It is worth mentioning that there are several ways in which such tools can be used for equalization purposes. For example, the introduction of progressive taxes: in the short term, a larger redistribution can be achieved by combining an increase in tax rates for property, the establishment of progressive income taxes, and government programs to support those affected by digitalization and globalization [22].

Another way to address the issue of income inequality with the help of fiscal tools is to introduce a tax on robots [35], i.e. taxing the contribution of robotics and artificial intelligence to the economic results of enterprises. According to scholars [15], such a tax can slow down (at least temporarily) robotics advancement and provide the income

necessary to finance the adaptation of people through retraining programs for dismisses. However, there is an opinion [4] that a serious disadvantage of taxing robots will be the erosion of the tax base and the very concept of robot for tax purposes because this category can include any semi-automatic mechanism. The scholars [4] emphasize that there is a high risk of evading such a tax since elements of robotics will be embedded into mechanisms that are not robots. A possible solution is to create a state trust and introduce universal basic dividends financed by income from the total capital. Thus, an increase in automation and robotics will cause an increase in the income of enterprises that implement them. The automatic distribution of profits in the form of universal basic dividends will be carried out through a state trust that owns a share of such enterprises, which will solve a complex social problem [4].

At the same time, it is impossible to digitalize, introduce robotics and use digital platforms without highly qualified specialists, retraining production personnel, and improving the digital skills of enterprise management [36]. In this regard, we believe it is necessary to introduce loans for students who obtain higher education in the field of science, technology, engineering, and mathematics and are employed in their specialty [16], or an earned income tax credit when taxing the income of teachers who train highly qualified personnel. In Russia, a preferential mortgage program for IT specialists has been developed and is being implemented [37].

V. Conclusion

The study results have confirmed the hypothesis that economic changes as a result of the development of Industry 4.0 technologies affect (and will affect) the tax policy and tax system, which requires the transformation of the modern tax system and the use of both traditional and innovative tax tools.

Transformation of the tax system change the traditional instruments of taxation: the adoption of a progressive tax (for individuals and legal entities); the expansion of taxation objects that emerge due to the digitalization of the economy (electronic goods and services, personal data, Big Data); the introduction of R&D and/or investment tax credit, tax credit for student loans, and preferential mortgage mechanisms for young professionals.

Under the influence of Industry 4.0, innovative tax instruments are being created and introduced into the practice of taxation. In our opinion, the most promising are the introduction of a tax on robots as a tax on the contribution of robotics and artificial intelligence in the economic results of enterprises; taxes on the digital economy (on payments made for the purchase of goods and services via the Internet, or from the turnover from commercial activities on the web).

The limitations of the study include the limited sampling of experts and the geographical representation of experts, as well as the authors' deliberate limitation of focus on technological changes of a certain group: digitalization, blockchain technologies, robotics, automation, and the use of M2M technologies.

This study lacks expert sampling and geographical diversity. In this regard, further research should dwell on the transformation of taxation as a result of the development of such digital technologies as 3D printing, virtual and augmented reality technologies, digital twin technology, artificial intelligence, Big Data, etc.

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