The modern system of relations between countries is being transformed with the spread of digitalization. Accordingly, there is a need to study the practical aspects of digitalization of trade as a major component of international relations. Therefore, this study aims to determine the impact of digitalization processes on the performance and economic security of trade. The main directions for the development of digitalization in trade were determined and the influence of digital technologies on the economic security of trade entities (enterprises) was investigated.

The main components of the economic security of trade enterprises were identified. The main difficulties in the development of the digital economy were highlighted. The main directions for the development of digitalization of trade enterprises were determined.

The list of factors that most influence the formation of trade turnover was substantiated: income of the population, number of trade workers, inventories, producer price indices, digital technologies (telecommunications, data processing, etc.).

Methods of economic statistics (statistical observation, dynamic and structural analysis) were used to test the hypothesis of the relationship between informatization and economic security of trade enterprises. Methods of correlation and regression analysis were used to study the strength of the relationship between the volume of turnover and the factors that determine it.

Based on the modeling, a statistically significant relationship was identified between the indicators of the volume of information and related services and trade volumes, which confirms the dependence of the economic security of trade enterprises on digitalization. The proposal to supplement the already existing methodology for assessing the economic security of the trade enterprise with indicators reflecting the impact of digital technologies was justified. The results of the study can be useful for adapting strategies for the development of trade enterprises in the context of the global digital ecosystem

Keywords: economic security, digitalization, trade enterprises, multi-factor model, risks, sales volume, integration

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DETERMINING THE IMPACT OF DIGITALIZATION ON THE ECONOMIC SECURITY OF TRADE

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1. Introduction

In the conditions of the modern development of society, the dynamism of economic and political changes, information technology (IT) is significantly developing. Information technology is widely used in business process management at enterprises. Current trends in the development of information and communications technology determine the special place of information among the main resources and the latest technologies in the innovation potential of any enterprise and trade enterprise, in particular. These components of the enterprise's potential form a system of its economic security. In such conditions, more and more attention is paid to the study of the main factors of influence and ways to ensure the economic security of the enterprise, among which little is known about the impact of digitalization.

Digitalization is gaining significant impact and exceptional importance for trade enterprises. These companies, trying to best meet the interests and demands of consumers, are constantly looking for innovative ways and methods of selling goods and servicing transactions, and COVID challenges further exacerbate these trends.

Trade, as a branch of the economy, provides trade operations in the market and makes a significant contribution to the country's GDP. Foreign and domestic trade is distinguished on the basis of crossing the customs border by good flows. Foreign trade refers to trade between countries, including exports and imports of goods and services. Domestic trade is a branch of the economy that sells marketable products of various industries in the domestic market. The state of domestic trade is an important indicator of economic development. Assessing the state of domestic trade and the factors that affect it is important to analyze the economic security of the state as a whole. The main forms of domestic trade are wholesale and retail trade. The criterion for classifying trade as wholesale or retail is the prevailing type of buyers (consumers) and how goods are used. In wholesale trade, it is the resale (sale without processing) of goods to other entities for use

in production activities or resale. In retail trade, it is the resale (sale without processing) of goods for personal consumption or home use, mainly by the population. Trade entities are trade enterprises, which are legal entities and entrepreneurs providing trade services. Trade enterprises make the largest contribution to trade development, as they account for the largest volume of trade.

World integration is linked to the development of international trade and global distribution of goods and services. Transformational changes in the world and national markets are influenced by the formation and development of trade networks, which are being integrated into the digital world at an unprecedented speed. Therefore, it is important to study the impact of digitalization on the activities of trade enterprises.

Digital solutions permeate all trade processes. This applies to internal business processes such as digitalization of goods supplies, integration of artificial intelligence and cloud services, the use of SRM and ERP systems. Digitalization affects customer-oriented business processes: online sales, the use of self-service cash registers, the introduction of mobile applications and electronic services, the use of cashless and contactless payment devices, and other tools.

Such rapid rates of digitalization in trade naturally lead to changes in the volume and structure of expenses and incomes of trade enterprises and have a significant impact on their economic security. All this requires expanding the list of factors and a new look at the presentation of statistical models for assessing the level of economic security of a trade enterprise.

In modern conditions, the processes of introducing digitalization in the activities of trade enterprises are becoming increasingly important. However, the economic consequences of this practice for the security of trade entities and the justification of the need for further implementation of digital transformations in trade remain insufficiently studied. This is why it is necessary to identify and study new factors that determine the performance and efficiency of the trade business. This requires substantiation of the economic model to determine the impact of a set of factors on the economic security of the trade enterprise with an emphasis on the main factors. Among the identified factors is the volume of telecommunications products (services) sold; the scope of information services provided; the amount of data processing, posting information on websites, and related activities.

2. Literature review and problem statement

In today's world, the issue of building a safe living environment is very acute. A number of scientists in their research suggest using new information tools to control the financial and economic security of the enterprise using a comprehensive methodological approach to creating automated decision support system. Thus, [1] proposes a mathematical model to identify threats and predict their consequences, identify areas that require enhanced control and monitoring of the enterprise's security level [1]. However, the authors [1] did not explain why polynomial models were chosen for forecasting. Also, this work does not define factor variables of influence on the level of economic safety of research objects (seaports). The purpose of this study was different.

The author of [2] focused on the study of globalization risks. The work [2] did not aim at determining all the factors influencing the economic security of the state, which led to the emergence of a field for further research.

In [3], the issues of economic security are mainly considered in terms of purposeful activities of state and public institutions (as well as citizens) to identify and prevent such threats to individuals, society, and the state. The paper [3] presents a study of the impact of globalization and regionalism on the country's development. It is noteworthy that the author identified a model of the ideal type of globalization-regionalism relationships, based on the theory of strategic trade. This paper did not aim to explore the partial aspect of trade digitalization.

Analytical studies publish economic security indices for different countries. Thus, the authors [4] define the indicator of economic insecurity, the Economic Security Index (ESI) for different countries. ESI individually estimates a significant reduction in available household resources from year to year, taking into account fluctuations in income and expenditure [4]. This indicator also assesses the availability of liquid financial resources to offset the impact of this reduction. In [4], the cyclical nature of these processes is revealed. This work did not aim to explore all the factors influencing the country's economic security.

At the beginning of the XXI century, the focus of research on this topic has shifted towards analyzing the impact of globalization on the economic security of countries, for example, in [5]. At the same time, the paper did not consider the issues of economic security in trade.

Given the complementary nature of the relationship between economic security at the macro-, meso- and micro-levels, many scholars consider the provision of economic security at the enterprise level as the key to achieving it at the highest levels of the hierarchy. Micro-level economic security also cannot be separated from the irreversible process of globalization, which has accelerated economic, technological, and social integration, strengthened interdependence between states and non-state actors in global markets. Current global trends, primarily related to the introduction of digital technologies, are radically changing the business sector, increasing their efficiency on the one hand, and forming new challenges of the digital age on the other.

Modern approaches to defining the category "economic security of the enterprise" were studied by a team of authors [6]. The authors [6] also consider the features of the formation of important subsystems of economic security: assessment methods, innovation strategy, and ways to increase the efficiency of companies' operating activities. The purpose of this study was achieved, the theoretical and methodological principles of determining the nature and components of the economic security of the enterprise were considered. However, it is not defined how exactly these components (including information) affect the level of economic security of the enterprise.

The issues of implementing the information and communication policy of high-tech enterprises in the digital environment are considered in [7]. The authors specify the concepts related to the content of information and communication policy, the direction of its formation, and management. Express diagnostics of the current level of adaptation of the information and communication policy of Russian enterprises in the digital economy was carried out [7]. However, even in this work, the quantitative relationship between digitalization and performance was not

estimated. In addition, the authors considered high-tech enterprises, not trade enterprises. This left room for further study of the impact of digitalization on trade.

In [8], the security challenges of SMEs are investigated and cybersecurity management solutions for SMEs are proposed [8]. The authors focus on the digital security of manufacturing companies, while the results of digital transformation also affect the security of service providers. The impact of digitalization on economic performance is not defined, although the authors consider this process as a factor influencing the enterprise competitiveness.

The work [9] studied digitization clusters, analyzed factors and consequences of digitization within the European Union. The results of the study show significant differences between EU member states and clusters [9]. At the EU level, five homogeneous groups of countries have been identified, showing large differences between countries. Implementing the digital single market strategy for the manufacturing sector requires more detailed information. At the same time, the authors of [9] did not study the issue of trade digitalization.

An empirical assessment of the impact of innovation on entrepreneurship in different European countries was conducted in [10]. The paper describes the influence of digital transformation on business activities in 29 European countries. The study is based on the partial least squares (PLS) method. It would be appropriate to use more variables, such as countries' GDP, to build structural models.

Approaches to regulating cross-border data flows in international trade, the protection of personal data as a key element to ensure consumer confidence are covered in [11–15]. An approximate taxonomy of national approaches to regulating cross-border data flows and local storage requirements has been developed [11]. Also, the authors [12] explore international tools that address the issues of international data transmission. [12] discusses how the principles of good regulatory practice regarding market openness and international trade can provide guidance in approaching some new challenges to help implement the rules of the digital age. In [13], emphasis is placed on finding a balance between ensuring privacy and consumer security while maintaining the benefits of free data flow, including the benefits of growth and inclusivity of digital commerce. The paper [13] argues that getting the most out of digital transformation for trade requires more common thinking about measures that affect goods, services, and digital connectivity, as well as measures that affect the entire value chain. The authors of [11–13] focused on the means of digitalization and rules of trade in goods and services provided in digital form. At the same time, the authors of [11–13] did not aim to determine the effectiveness of introducing digitalization in trade.

The paper [14] examines the definitions, dimensions, and implications for digital commerce policy, and proposes an indicative typology of digital commerce that can be used to decipher transactions and analyze problems. The work [14] is devoted to digital trade, its measurement. The purpose of this work was exclusively online trading, which leaves unresolved the impact of other digital technologies on trade.

In [15, 16], the author analyzed existing and new trade barriers, suggested using the Index of restrictions (regulatory barriers) affecting trade in digital services (Digital STRI). It is a new tool that catalogs and quantifies barriers to trade in digitally supported services in all G20 countries [15, 16]. In [15], the author examines digital STRI, which shows that the regulatory environment in the G20 is complex and diverse, and there are opportunities to reduce trade barriers. Possible changes include transformations in communications infrastructure and burdensome measures affecting cross-border data transmission. In [16], the author notes that the rapid acceleration of digital transformation has had serious consequences for trade in services, but the benefits of digitalization risk being undermined by existing and new trade barriers. The aim of the author's papers [15, 16] was to study the problems of trade digitalization, in particular trade barriers. This goal did not determine the quantitative impact of digitalization on trade revenues.

In [17], the necessity and importance of timely business optimization in the context of digital transformation, including in the retail sector, are substantiated. The author considers the possibilities of search engine optimization (SEO) in order to increase the efficiency of the store by increasing traffic in Google, conversions, click-through rate (CTR), and providing the most profitable positions in the Local Pack [17]. The area of research on the impact of digitalization on retailers' activities and the recommendations provided relate to local business optimization in Google. A narrow approach was applied to determine the impact of digitalization on the activities of retail enterprises.

The analysis of the most effective practices of retail adaptation to new crisis conditions was carried out in [18]. The authors propose directions for changing the business model of retailers through focusing on digital or omni-channel business models, developing the delivery function, and focusing on interaction with key partners [18]. This paper identifies the negative impact of COVID-19 restrictions on the activity of trade enterprises. However, the authors did not study other factors influencing the financial performance of trade enterprises.

The considered studies [1–18] present a significant contribution of researchers' works to the development of methods for ensuring the economic security of states, individual territorial units, and businesses in the modern transition to the digital economy. At the same time, the issues of assessing the impact of digitalization on the economic security of trade enterprises and developing an up-to-date model for measuring it in modern conditions remain insufficiently studied.

3. The aim and objectives of the study

The aim of the study is to determine the impact of digitalization processes on the performance and economic security of trade. The model of dependence of trade turnover on five main factors of influence, which can be used for the further forecasting and elaboration of trade development strategies, has practical value.

To achieve the aim, the following objectives were set:

– to study the phenomenon of digitalization in the era of the information economy;

– to define the concept of economic security of the enterprise and its components, directions of development of digital technologies in trade;

– to analyze the trends of digitalization in the economy of the studied country.

4. Research materials and methods

The study of the impact of factors on the development of trade and economic security of enterprises in this industry has led to the hypothesis that digital transformations affect the economic security of trade enterprises.

The empirical basis of the study was formed according to the State Statistics Committee of the country.

The research was conducted using the methods of scientific abstraction and systematization, quantitative and qualitative comparison, analysis and synthesis, forecasting methods. Using the method of logical generalization allowed us to analyze the theoretical foundations and determine the factors influencing the economic security of trade enterprises, which were used as elements necessary to build a multi-factor econometric model. Methods of statistical analysis and grouping were used to form the original data.

The main focus is on the application of econometric models. This is due to the fact that most decisions related to the management of complex economic systems require prior econometric modeling of a particular process or its parts.

Most of the processes taking place in the economy are nonlinear. Accordingly, a functional multi-factor relationship is built between economic parameters, one of which is a dependent variable – the volume of trade of the country, and others are independent (income of the population, number of employees in trade, etc.).

The sequence of the study follows from the logic of building an econometric model:

1) determining the purpose of the study;

2) building a system of indicators and logical selection of factors that affect them most;

3) choosing the form of relationship of the studied indicators;

4) selection of initial data (statistical data of 2010–2019 were used);

5) construction of the econometric model;

6) checking the quality of the model, in particular, the adequacy of the economic process;

7) use of the model.

The use of econometric modeling has automated the process of identifying the relationships between various factors affecting the economic security of the enterprise. The results of the modeling serve as an evidence base for the hypothesis of the impact of digitalization processes on the economic security of trade enterprises, in particular, in terms of increasing trade.

The theoretical and methodological basis of the study is the foundations of socio-economic theory and management. In the course of the research, we used the works [1–21], statistical data on macroeconomic trade indicators.

General scientific and special research methods were also used:

– the economic and statistical method was used to assess the current state of trade in the country by financial and statistical indicators, to build a multi-factor model of the dependence of the country's trade on the selected factors, to verify the adequacy of the model;

– tabular and graphical methods were used for visual display of indicators;

– the system-analytical method was used for the theoretical generalization of scientific approaches to determining the impact of digitalization on the state of trade and proposals for its improvement;

– analysis and synthesis methods were used to detail the factors influencing the state of trafe enterprises;

– the abstract-logical method was used to reasonably formulate the conclusions of economic research.

5. Results of the study of the impact of digitalization on the economic security of trade enterprises

5. 1. Digitalization in the era of the information economy

The rapid development of information technology has created a market for information services. Digitalization has long been present in our lives. These include robots in car factories (such as the Skoda plant), computers connected to cutting lasers in light industry plants, and conventional battery-powered tonometers, which are available in almost every family.

Entities that are participants in the information services market seek to optimize business processes, which leads to a significant increase in their performance. Most global corporations (60 %) develop their own digitalization strategies, which are primarily aimed at technological transformation.

The information economy presupposes that the productivity and competitiveness of economic entities depend mainly on their ability to generate, process, and effectively apply information based on knowledge [19].

Along with the term "information economy", the term "information society" came, for which the processing of information using information and communications technology creates significant economic and social value. The information society is formed on the basis of sustainable development using information and communications technology.

The concepts of "digital economy", "knowledge economy", "information society" form a new economic system that replaces the industrial paradigm. This economic model provides an opportunity to sell highly competitive products with high added value, create new quality jobs [20, 21].

Digital transformation and high levels of offline and online competition have a significant impact on business, which requires regulation by governments that pay close attention to the formation and regulation of the digital economy. Thus, for the EU countries in the transition to the digital economy, the Digital Agenda, which was initiated back in 2010, has become a regulatory document. An important point is the creation of the Digital Single Market [22, 23].

The European Commission publishes the Digital Economy and Society Index (DESI) every year. According to the Commission, Finland, the Netherlands, and Belgium are the leading countries in the "digital orientation of business 4a" in 2020. Estimates of the mentioned countries exceed 60 points in the overall ranking. Bulgaria, Hungary, Poland, Romania, Latvia, and Slovakia lag behind in the introduction of e-business technologies, having less than 40 points [24, 25].

Ireland, the Czech Republic, Denmark, Belgium, and Sweden, meanwhile, are in the top five e-commerce countries with a score of more than 60. Ireland leads in all three indicators of e-commerce (SMEs selling online, e-commerce turnover, and online sales across borders). The worst results are in Bulgaria, Greece, Luxembourg, and Romania with scores below 25 points [24].

In the digital economy, the following areas are singled out: business to business (B2B), business to government (B2G), and business to consumer (B2C).

11 % of EU businesses report online sales to businesses and governments. 13 % sell online to consumers, from 9 % in Latvia, Luxembourg, Italy, and Bulgaria to 28 % in Ireland.

As a rule, the issue of digitalization is regulated at the state level. The Ministry of Digital Transformation has been established in the country under study, and by 2024 all public services for businesses and citizens are planned to be transferred online. Despite the fact that the state encourages the development of innovative technologies that facilitate the creation and development of business, the development of the digital economy in the studied country faces the following difficulties:

– lack of specialists;

– lack of orientation of software producers and entities creating a digital product on the domestic market;

– widespread use of illegal and pirated software;

– slow response of the state to the transformation of the economy using information technology in the legal field.

As to trade, the digital transformation in this area is actively happening right now, in a pandemic. These processes involve not only large trade enterprises but also small traders. Quarantine and COVID-19 became an unprecedented catalyst for digital transformation in trade, which had to adapt quickly to the new reality. The main trend was the active development of e-commerce [27].

The state of e-commerce market development is being investigated by the EVO group of companies. According to EVO group calculations, the total amount of physical goods and services purchased by Ukrainians on the Internet in 2020 reached UAH 107 billion. This is 41 % more than last year. The number of online payments has also increased by at least 50 %. Now almost 9 % of all purchases in Ukraine are made online: on marketplaces, online stores, and social networks. China, where more than 30 % of all purchases are made online, is still far away, but the growth over the year is significant. For comparison, in 2019 the share of e-commerce in retail in the studied country was estimated at 7 %, and the market then grew by 17 % per year [28].

The largest and most developed sectors in 2020 were clothing and electronics. Internet sales of electronics in the studied country increased to $291 million in 2020, and since 2016 it has grown by an average of 26 % annually. The share of e-commerce in clothing retail in 2020 was 6.8 %, and the average check was $24–31. At the same time, the volume of the e-commerce food market in 2020 amounted to $150 million. Medicines and food are relatively new categories with the strongest growth potential.

Marketplaces, which are essentially trading platforms and earn on sales commissions from other market operators, are actively building up the e-commerce ecosystem. The largest marketplaces in the country are Rozetka, Prom, Allo, Bigl, Epicentr. In 2020, 63 % of Ukrainian online shoppers preferred to buy through marketplaces, and the remaining 37 % bought in specialized online stores of household goods, cosmetics, clothing, toys for children [29].

The active introduction of digital transformations in trade is facilitated by the development of social networks, where consumer demand accumulates and creates unique conditions for the promotion of goods and services in both the B2C and B2B segments.

Facebook and Instagram in Ukraine are constantly growing. From the beginning of 2020 to the beginning of 2021, the Ukrainian social network audience increased by seven million people. This was reported by GlobalLogic with reference to its own research conducted on the basis of open data. Thus, at the beginning of 2020, there were 19 million users, and in 2021 the figure reached 26 million. At the same time, the penetration of social networks has increased by half: 60 % of the country's population is currently registered in them, while in January 2020 it was slightly more than 40 % [30].

The main directions for the development of digitalization of trade enterprises are shown in Fig. 1.

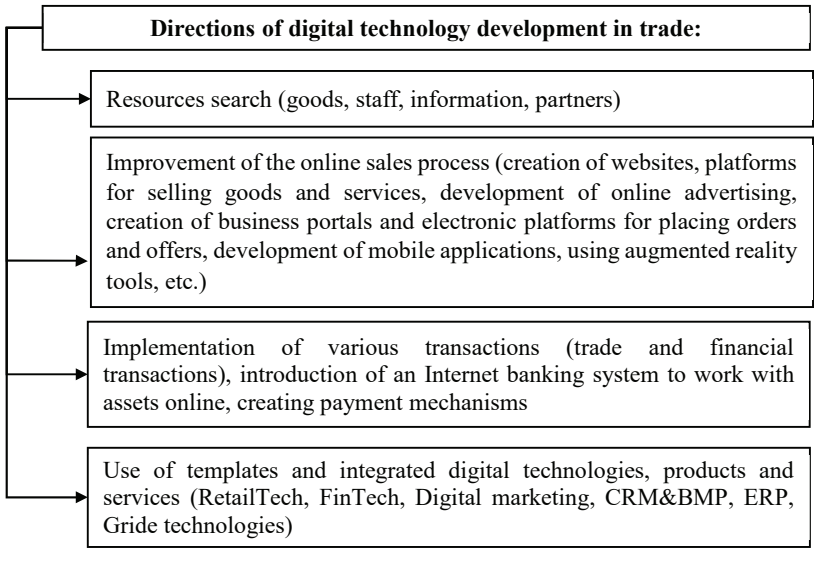


Fig. 1. Directions of digital technology development in trade

Digitalization of trade is not just a trend, but a new vector of trade development, as an industry that penetrates all business processes of a modern trade enterprise. The use of digital tools affects the main indicators of performance, efficiency, and economic security of business entities. During the Corona crisis, it was the digital transformation of retail that became the major factor in ensuring the competitiveness and economic stability of trade enterprises, helped develop new sales tools, channels, and markets.

5. 2. Economic security of the enterprise

The definition of "economic security of the enterprise" has gone from the level of a concept to the level of an economic category. The concept of economic security of the enterprise is the state of the enterprise in which it is competitive, effectively uses its potential, and develops steadily. This definition takes into account the property of dynamism (development); resource component (potential); the main criterion for evaluating the enterprise activities is competitiveness. The category of state is compared with the categories of quality and action, which in turn form dynamic and static approaches to determining the essence of the economic security of the enterprise, the study of which distinguishes the terminological relationship between statics and dynamics.

Economic security of the enterprise is the protection of the enterprise from negative effects of the external and internal environment, the ability to quickly eliminate various threats or adapt to external conditions without negative consequences. In addition, the economic security of the enterprise is the most efficient use of resources that ensure stable operation [1, 31].

In the system of economic security of trade enterprises, it is expedient to allocate the following components: security of operating activities, financial, investment, innovation, intellectual and personnel activities.

The security of operating activities is ensured primarily by increasing the sales volume of the trade enterprise. This indicator, which is essentially an indicator of trade turnover, is the main performance indicator of trading activity. Revenue from goods sales is a source of income for the trade enterprise, covering all costs of its operating activities and making a profit. This, in turn, creates prerequisites for stable operation of the enterprise and implementation of its strategic goals. According to the State Statistics Service of Ukraine in 2020, 25.9 % of wholesale and retail trade enterprises were unprofitable [32]. That is, the income they received from goods sales did not cover the costs of the sale process. This indicates a crisis and a threat to the economic security of a quarter of the industry's enterprises.

In turn, the security of operating activities includes two components: market security (marketing) and technical and technological. Thus, the marketing component of the security of the retail enterprise is influenced by several main factors: the level of market prices, changes in market conditions, the level of competition, the format of the trade enterprise, the adaptability of the enterprise. The marketing component is responsible for promoting goods on the market. This component reflects the level of compliance of internal production capabilities of the enterprise with external ones, which are formed in the market environment, i.e. the extent to which research, production, and sales activities meet market demands and specific consumer needs.

New sales technologies are being introduced: FRID technologies, SAP technologies, electronic price tags, energy-saving technologies, barcode technologies. Within the framework of operating activities, the following tools are used: search engine optimization (SEO), Google my business, new sales technologies, logistics and management schemes, information systems.

The financial component can be defined as the state of the most efficient use of corporate resources of the enterprise, expressed in the best values of financial performance. In the analysis of the activities of the trade enterprise, especially its financial indicators, digitalization means are widely used.

Investment security of the enterprise is a state of efficient use of its resources and market opportunities to prevent threats to the external and internal environment that arise in the investment activities of the enterprise, which contributes to its sustainable development.

The innovation component is a process of providing conditions under which the negative impact of external and internal factors on the stability and efficiency of the innovation process is leveled and neutralized, which is the basis of efficiency and competitiveness of the enterprise as a whole.

The personnel component is a set of actions and relationships of staff, which is the effective economic functioning of the enterprise, its ability to withstand internal and external influences and threats. These threats are related to personnel, accordingly, it is possible to diagnose and predict the impact of personnel on performance, its intellectual potential, and labor relations in general.

The intellectual component of the economic security of the enterprise includes the preservation and development of the intellectual potential of the enterprise, i.e. the set of rights to intellectual property or its use, and to supplement the knowledge and professional experience of employees.

With regard to innovation and intellectual and personnel components of the economic security of the enterprise, they use the already considered means of digitalization.

The main thing in compiling a system of economic security is the ability to correctly identify threats and ways to reduce their impact. In the digital economy, in addition to the already known threats to trade enterprises, there are also threats from digitalization. The complexity of the problem of trade informatization is determined by the fact that it occurs in conditions of instability of economic mechanisms due to permanent political and internal challenges and external geopolitical factors. Network and information security are already becoming key factors in the development of the information society. Attacks on information systems can have serious consequences, such as communications system failures, leaks of confidential information, and so on. Therefore, the concept of "cybersecurity" has emerged. On February 7th, 2013, the European Commission approved the Cybersecurity Strategy of the European Union: An Open, Safe and Secure Cyberspace. This document presents the EU's comprehensive vision on how best to prevent and eliminate cyber threats. The economic security system must provide its own protection against digitization risks.

Guided by the principle of a systematic approach, it is necessary to identify a set of key factors that affect the main performance indicator of the trade enterprise, which is turnover, and hence the economic security of such an enterprise. These factors must be taken into account when building a statistical model that is an abstract scheme of relations between the quantities (factors) that characterize the properties of the real process, in this case, the process of forming the turnover of the trade enterprise. Prominent among such factors is digitalization.

The list of such factors should include indicators that have the strongest impact on the formation of trade turnover and are studied by the state statistics service. Such indicators include, first of all, the income of the population, which forms the volume of demand in the commodity market. The next indicator is trade inventory, as the mass of goods in circulation and intended for resale, i.e. represents the commodity supply formed in trade.

An important factor is the number of trade employees, as the main component of the resource potential of the trade enterprise, which activates other types of resources and creates added value. Producer price indices also affect sales volumes, as they are an indicator of price changes over time when purchasing goods.

Finally, it is worth adding to this list a study of the impact of digital technologies on the results of trading activities. In particular, we are talking about the development of telecommunications, the volume of information services, the volume of data processing, posting information on websites and related activities; web portals.

The expansion of information space and telecommunications technologies has become a priority for most countries in the world, and this sector is associated with the development of a competitive digital environment, both external

and internal. Changes in the processes of digitalization of the economy can be traced to the performance of enterprises operating in the segments of telecommunications and information services.

5. 3. Analysis of digitalization trends in the economy

The dynamics of financial performance of the business of the studied country in the information and telecommunications industry are shown in Table 1. There is a gradual reduction in operating costs, sales growth, which indicates an increase in the competitiveness of enterprises in this activity.

The study of the results of trade enterprises and the degree of influence of the digital component on the activities of trade enterprises began with the analysis of data on sales (goods, services) by economic activities in 2010–2019 (Table 2) and study of development graphs (Fig. 2, 3).

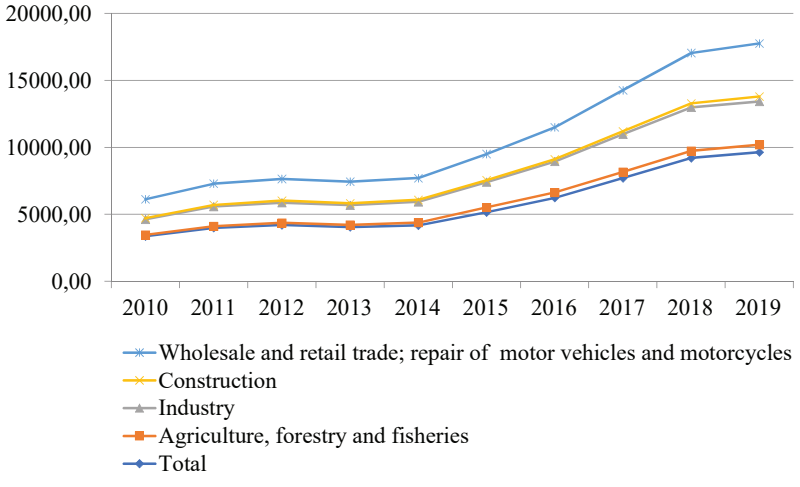


Fig. 2. Sales dynamics of enterprises by types of activity [32]

Table 1

Performance indicators of enterprises in the information and telecommunications industry

Year	Costs of production (goods, services), thousand c.u.	Sales volume, thousand c.u.	Share of costs, %	Share of profit, %
2012	59,912,893.60	79,354,861.50	75.50	24.50
2013	60,732,863.10	80,410,367.30	75.53	24.47
2014	61,973,633.80	84,103,557.80	73.69	26.31
2015	74,444,318.20	100,590,378.00	74.01	25.99
2016	86,466,927.20	117,407,180.00	73.65	26.35
2017	98,512,790.30	139,117,053.00	70.81	29.19
2018	120,797,891.00	165,282,458.00	73.09	26.91
2019	141,708,807.60	198,276,656.00	71.47	28.53

Source: formed by the authors of [32]

As can be seen from the graph in Fig. 2, the sales volumes for the studied period increased. This can be explained by the presence of inflation and growing sales in the industry, wholesale and retail trade (including repair of motor vehicles and motorcycles).

The sales dynamics of enterprises whose activities are closely related to the use of digital tools is presented in Fig. 3.

The analysis of the influence of the main factors on trade development was carried out using the modeling of sales volumes (Table 3).

Trading activity (Y – sales volume) was studied in order to identify the main factors influencing it. The factors of influence include:

X_1 – income of the country's population, billion c.u.;

X_2 – number of trade workers, people;

X_3 – inventories, billion c.u.;

X_4 – producer price indices of industrial products;

X_5 – volume of telecommunications products (services) sold, billion c.u.;

X_6 – volume of information services provided, billion c.u.;

X_7 – amount of data processing, posting information on websites and related activities; web portals, billion c.u.

A multi-factor linear model is constructed using Excel functions (Fig. 4).

The model is as follows:

$$\hat{Y} = 0.25X_1 - 0.001X_2 + 1.37X_3 + 3510.1X_4 + \\ + 171.08X_5 + 111.26X_6 - 293.84X_7 - 7613.94. \quad (1)$$

The obtained coefficient of determination R^2=0.997 indicates that the variation in the sales volumes in trade by 99.7 % is determined by the variation of the factors considered and only 0.3 % of Y variations are unaccounted factors. That is, the influencing factors are selected correctly.

The adequacy of the model was checked by the t-test of parameter evaluation. The critical value of t is found from the t-statistics table for α=0.05 significance level and $n-m$=10–7= =3 degrees of freedom, the critical value for the two-way test is 2.353, which is more than the calculated values (Fig. 4). So, all the model parameters are insignificant and it is necessary to pick up other types of models with these factors.

We do not accept the above-mentioned model and assume the presence of a nonlinear relationship of another form.

We use the extended power function of the form

$$Y = a_0 \times X_1^{\alpha} \times X_2^{\beta} \times \cdots \times X_7^{\mu}. \quad (2)$$

We reduce the function to a linear form by taking the logarithm.

$$\ln Y = \ln A + \alpha \times \ln X_1 + \beta \times \ln X_2 + \gamma \times \ln X_3 + \\ + \delta \times \ln X_4 + \theta \times \ln X_5 + \vartheta \times \ln X_6 + \mu \times \ln X_7. \quad (3)$$

A multi-factor power model is built using Excel functions (Fig. 5).

The result of the calculation is: A'=11.68; α=1.07; β=–1.26; γ=0.004; δ=1.06; θ=1.9; υ=–0.16; μ=–0.43.

The power model is as follows:

$$Y_{calc} = \exp(11.68) \times X_1^{1.07} \times X_2^{-1.26} \times X_3^{0.004} \times \\ \times X_4^{1.06} \times X_5^{1.9} \times X_6^{-0.16} \times X_7^{-0.43}, \quad (4)$$

$$Y_{calc} = 117{,}848.1 \times X_1^{1.07} \times X_2^{-1.26} \times X_3^{0.004} \times \\ \times X_4^{1.06} \times X_5^{1.9} \times X_6^{-0.16} \times X_7^{-0.43}. \quad (5)$$

The coefficient of determination is equal to 0.998, which confirms the relationship of variables. In the power model, the variance of residuals in the statistical information is less than in the linear additive model. So, we conclude that the power dependence better describes the relationship between variables.

Table 2

Sales volumes (goods, services) of enterprises by types of economic activity in 2010–2019, million c. u.

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Total	3,366,228.25	3,991,239.44	4,203,169.57	4,050,214.97	4,170,659.91	5,159,067.14	6,237,535.21	7,707,935.22	9,206,049.55	9,639,730.60
Agriculture, forestry and fisheries	99,891.44	126,961.25	162,611.13	161,130.34	213,929.85	362,309.99	403,645.80	454,380.10	525,096.89	556,325.87
Industry	1,159,231.45	1,464,792.12	1,498,929.68	1,473,091.47	1,546,614.90	1,887,535.36	2,305,695.87	2,817,768.91	3,248,378.63	3,230,045.24
Construction	96,725.33	120,419.48	155,790.68	141,125.70	150,466.56	142,871.94	169,705.34	221,404.89	302,718.03	370,760.61
Wholesale and retail trade;repair of motor vehicles and motorcycles	1,406,132.71	1,587,116.48	1,623,609.58	1,612,134.35	1,629,690.59	1,953,257.73	2,385,691.55	3,061,652.95	3,764,364.90	3,958,371.10
Wholesale and retail trade in motor vehicles and motorcycles, their repair	72,158.13	100,328.75	113,367.92	109,834.39	83,623.38	97,737.85	158,057.36	201,687.31	218,365.71	242,362.59
Information and telecommunications	65,925.60	74,348.22	79,354.86	80,410.37	84,103.56	100,590.38	117,407.18	139,117.05	165,282.46	198,276.66
Telecommunications	38,651.89	41,366.75	44,574.49	44,088.68	44,832.68	47,650.79	50,766.19	55,103.02	59,712.89	67,982.61
Provision of information services	3,718.44	3,968.63	5,120.32	5,604.75	5,886.32	8,185.99	9,530.41	13,155.05	18,510.97	22,412.53
Data processing, posting information on websites and related activities;web portals	1,989.90	2,895.03	3,765.95	4,344.51	4,916.01	7,047.16	8,336.71	10,825.22	15,501.50	18,763.74

Source: formed by the authors of [32]

Table 3

Initial data for the multifactor model

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Wholesale and retail trade (billion c.u.)	1,334	1,487	1,511	1,502	1,546	1,855	2,228	2,860	3,546	3,716
Incomes of the population of Ukraine (billion c.u.)	866	1067.2	1457.86	1548.73	1516.77	1772.02	2051.33	2652.08	3248.73	3744.06
Number of trade workers (people)	1,847,874	1,864,623	2,425,209	2,391,404	2,284,458	2,088,202	2,068,256	2,104,012	2,225,348	2,252,559
Inventories (billion c.u.)	140.56	148.38	150.02	159.06	166.83	171.95	58.34	326.01	369.57	385.69
Producer price indices of industrial products	1.019	1.013	0.992	1.003	1.005	1.023	0.989	0.997	1.142	0.926
Telecommunications, (billion c.u.)	39	41	45	44	45	48	51	55	60	68
Provision of information services (billion c.u.)	4	4	5	6	6	8	10	13	19	22
Data processing, posting information on websites and related activities; web portals (billion c.u.)	2	3	4	4	5	7	8	11	16	19

Source: formed by the authors of [32]

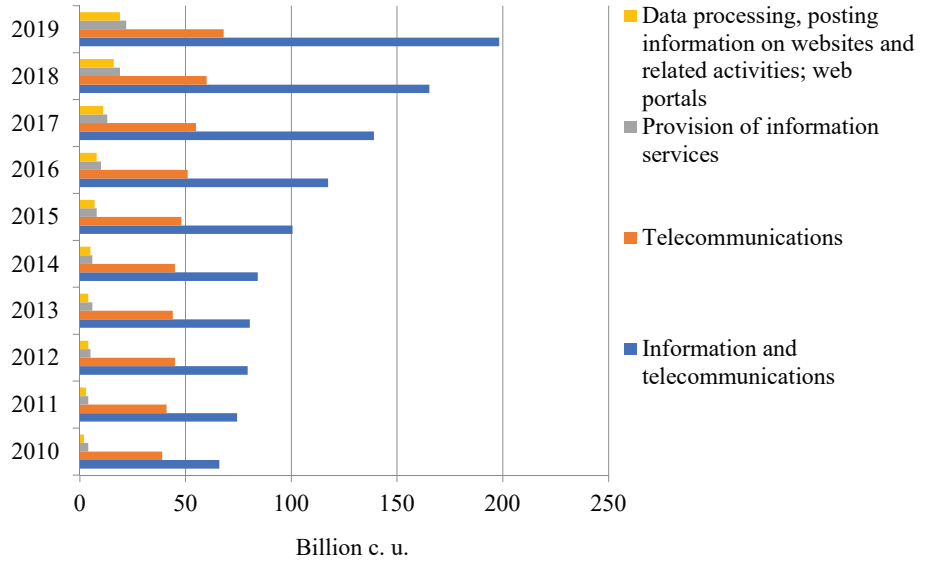
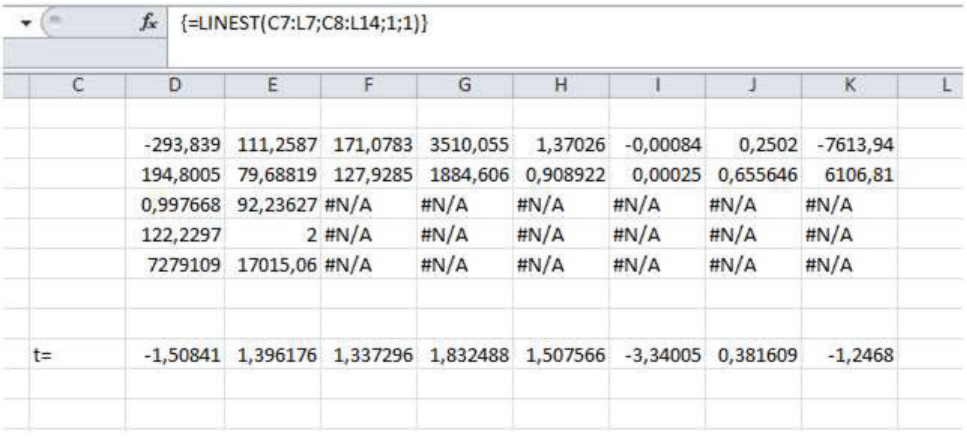


Fig. 3. Sales dynamics in the field of communications, telecommunications and information technologies [32]



	C	D	E	F	G	H	I	J	K	L
		-293,839	111,2587	171,0783	3510,055	1,37026	-0,00084	0,2502	-7613,94	
		194,8005	79,68819	127,9285	1884,606	0,908922	0,00025	0,655646	6106,81	
		0,997668	92,23627	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
		122,2297	2	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
		7279109	17015,06	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
	t=	-1,50841	1,396176	1,337296	1,832488	1,507566	-3,34005	0,381609	-1,2468	

Fig. 4. Result of calculations of the linear dependence of sales volumes

Checking the reliability of the model by the *F*-test showed that the model is reliable (F_{calc}=155.57>F_{table}=4.76 with a significance level at α=0.05).

Analysis of the parameters of the regression dependence shows that all factors affect the sales volumes of wholesale and retail trade.

To test the significance of the correlation coefficient *R*, the Student's *t*-test was used:

Using statistical tables at a significance level α=0.05, degrees of freedom equal to 6, t_{table}=1.895 was selected. Since $t<t_{table}$, it is concluded that the correlation coefficient is insignificant. A similar situation with statistical parameters occurs, as a rule, when there is an interdependence of factor features. Factor features were tested for multicollinearity. The Farrar-Glauber test was used for this purpose. This algorithm contains three types of multicollinearity criteria.

$$t_\alpha = \frac{R\sqrt{(n-m)}}{\sqrt{1-R^2}} = \frac{\sqrt{0.998^2 \times (10-7)}}{\sqrt{1-0.998^2}} = 1.728. \quad (6)$$

The multicollinearity of the whole data set is checked using the χ^2-test. According to calculations, χ^2=158.362 was obtained. We compare this value with the table under conditions that there are 21 degrees of freedom and the significance level α=0.95, $\chi^2_{table} = 32.66$. $\chi^2 > \chi^2_{table}$, there is multicollinearity in the array of variables.

The multicollinearity of each explanatory variable with the rest of the explanatory variables is checked using the *F*-test. According to the calculations: F_1=261.75; F_2=307.87; F_3=544.52; F_4=252.96; F_5=1667.05; F_6=157.53; F_7=7.87. We compare the obtained values with the tabular ones at degrees of freedom γ_1=6 and γ_2=9 and significance level α=0.05, F_{table}=4.10. In this case, each of the explanatory variables is multicollinear with the others.

The *t*-test is used to determine the multicollinearity of a pair of explanatory variables. According to the calculations: t_{12}=7.746; t_{13}=−1.16; t_{14}=1.3; t_{15}=0.383; t_{16}=−0.272; t_{17}=0.301; t_{23}=0.757; t_{24}=−1.68; t_{25}=−0.02; t_{26}=0.123; t_{27}=−0.019; t_{34}=0.324; t_{35}=−2.748; t_{36}=−1.85; t_{37}=2.24; t_{45}=0.692; t_{46}=−0.213; t_{47}=0.167; t_{56}=2.012; t_{57}=−2.149; t_{67}=2.55. The results of *t*-test are compared with the tabular value (t_{table}=1.638) at degrees of freedom γ=3 and significance level α=0.1.

Since t_{12}, t_{37}, t_{56}, $t_{67}>t_{table}$, the corresponding pairs of variables are multicollinear with each other.

To correct the model, X_6 and X_7, which most often fell into the pairs of dependencies, have been removed from con-

sideration, i.e. provision of information services and data processing, posting information on websites and related activities, web portals.

We build a function of the form:

$$Y = a_0 \times X_1^{\alpha} \times X_2^{\beta} \times \cdots \times X_5^{\mu}. \quad (7)$$

The results of the calculations are shown in Fig. 6.

The result of the calculation is: **A'**=11.903; α=0.307; β=−0.854; γ=0.027; δ=0.724; θ=1.467.

The power model:

$$Y_{calc} = \exp(11.903) \times X_1^{0.307} \times X_2^{-0.854} \times \times X_3^{0.027} \times X_4^{0.724} \times X_5^{1.467}, \quad (8)$$

$$Y_{calc} = 147{,}667.2 \times X_1^{0.307} \times X_2^{-0.854} \times \times X_3^{0.027} \times X_4^{0.724} \times X_5^{1.467}. \quad (9)$$

The coefficient of determination is equal to 0.993, which confirms the relationship of variables. In the power model, the variance of residuals in the statistical information is less than in the previous models, so it is concluded that the power dependence with fewer factors better describes the relationship between variables.

Checking the model for reliability by the *F*-test showed that the model is reliable (F_{calc}=105.6>F_{table}=4.76 at a significance level α=0.05).

Analysis of the parameters of the regression dependence shows that all factors affect the sales volumes of wholesale and retail trade.

To test the significance of the correlation coefficient *R*, the Student's *t*-test was used:

$$t_{\alpha} = \frac{R\sqrt{(n-m)}}{\sqrt{1-R^2}} = \frac{\sqrt{0.993^2 \times (10-5)}}{\sqrt{1-0.993^2}} = 18.798. \quad (10)$$

Using statistical tables at a significance level α=0.05 and degrees of freedom equal to 5, we choose t_{table}=2.015. Since t>t_{table}, we can conclude about the significance of the correlation coefficient.

The model was tested for adequacy by analyzing the direction and size of deviations of the resulting variable according to the actual and calculated values (Table 4).

The model is adequate, as confirmed by the graph of the set and calculated values of the dependent variable in Fig. 7.

The adequacy of the model was checked by the *t*-test of parameter evaluation. The critical value of *t* is found from the table of *t*-statistics for α=0.05 significance level and $n-m$=10−5=5 degrees of freedom, the critical value for the two-way test is 2.015, which is less than the calculated values. Therefore, all the model parameters are significant and the correct form of relationship is chosen.

-0,43297	-0,15601	1,900608	1,059107	0,004292	-1,26419	1,074054	11,67715
0,173844	0,187195	0,613612	0,343238	0,029615	0,270339	0,383403	2,835018
0,998167	0,034986	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
155,5728	2	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
1,332955	0,002448	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A

Fig. 5. Calculation of parameters of the functional dependence of trade volumes by the power model

1,466729	0,724013	0,026667	-0,85399	0,307174	11,90272
0,716545	0,395188	0,040016	0,251576	0,271005	4,057724
0,992481	0,050101	#N/A	#N/A	#N/A	#N/A
105,6016	4	#N/A	#N/A	#N/A	#N/A
1,325363	0,01004	#N/A	#N/A	#N/A	#N/A

Fig. 6. Calculations of parameters of the functional dependence of trade volumes by the power model on five variables

The constructed model showed a significant impact of the most significant factors on turnover. These include household income, the number of trade workers, trade inventories, producer price indices of industrial products, the volume of telecommunications products (services) sold. The most influential factor was telecommunications services. Thus, digitalization processes create significant advantages in the activities of trade enterprises, increase their competitiveness and strengthen economic security.

Digitalization is an integral part of the economy, offering many benefits for development, but also poses new risks, including cybersecurity threats, illegal economic activity, and encroachment on the inviolability of private property. New technologies can make a significant contribution to achieving the goals of sustainable development, but the socio-economic potential of digital technologies can have negative consequences. Therefore, understanding the models of effective management of the process of digital technology development and methods to avoid undesirable consequences is the task of a wide range of parties. Finding new solutions requires joint efforts of the state, society, business, the scientific community, and the technology sector

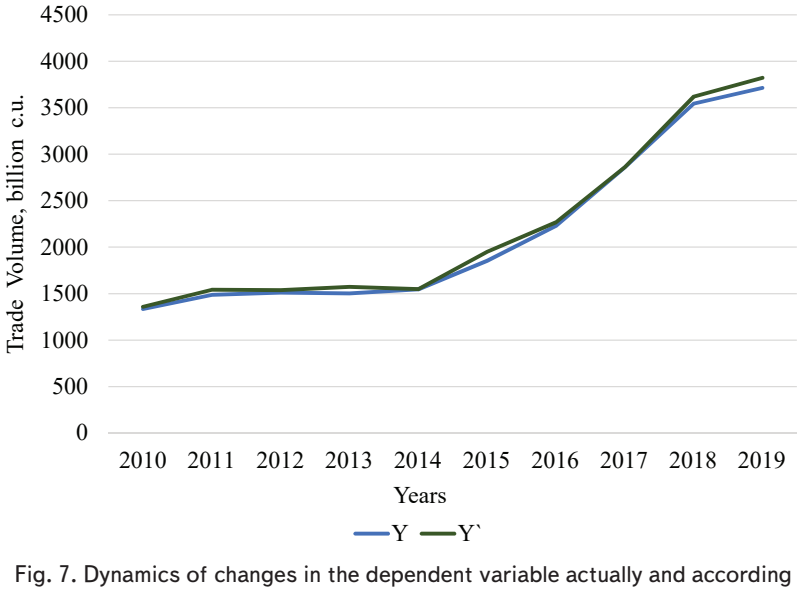


Fig. 7. Dynamics of changes in the dependent variable actually and according to the model

Table 4

Determining the correctness of the constructed model through the calculation of the sign and size of deviations of the values of the dependent variable calculated by the model and the actual values

Y	$Y^$	$e=Y^-Y$
1,334	1,310.286	−23.7143
1,487	1,487.692	0.692081
1,511	1,477.278	−33.722
1,502	1,487.874	−14.1263
1,546	1,593.155	47.15471
1,855	2,010.782	155.7816
2,228	2,196.653	−31.3466
2,860	2,757.189	−102.811
3,546	3,518.262	−27.7375
3,716	3,758.895	42.89498

6. Discussion of the results of studying the impact of digitalization on the economic security of trade enterprises

As a result of the research, a multi-factor nonlinear model of the influence of the most significant factors on the sales dynamics of trade enterprises was built. Among the list of key factors indicated in the model, the most statistically significant relationship was observed between the indicators of the volume of information and related services and trade volumes (Fig. 6). These results are explained by the rapid development of information and telecommunications technologies (Table 1), globalization of retail, predominant development of online trade formats due to the COVID-19 pandemic.

This affected the main parameters of economic security of trade enterprises, which are characterized primarily by increasing sales. Thus, we can talk about the growth of revenues of such enterprises through the active introduction of digital technologies, and thus the formation of preconditions for economic stability and security protection.

The proposed method of the results obtained, based on the methods of economic statistics and correlation and regression analysis allowed us to determine the impact of digitalization on the economic security of trade enterprises in combination with other macroeconomic factors. This created prerequisites for determining and analyzing the synergetic effect of such interaction and allowed concluding on the positive impact of this set of factors on the economic security of trade enterprises.

The proposed methodology was tested on the example of Ukraine (Tables 2, 3) and can be used to assess the impact of digitalization on the economic security of trade enterprises in other countries that are actively developing and implementing digital tools.

However, there are some limitations to this type of research, as the threats and risks associated with the use of digital technologies are well known, including the cybersecurity of trade enterprises. The proposed model does not take this into account.

These shortcomings can be eliminated in the future with a methodology for measuring the network and information security of enterprises and determining its impact on the economic security of the business entity.

7. Conclusions

1. The results of the study confirmed the hypothesis of the relationship between digitalization and turnover of trade enterprises. The main directions for the development of digital technologies in trade were defined.

2. The main components of the economic security of trade enterprises were identified: security of operating activities, financial, investment, innovation, intellectual and personnel activities. Accordingly, digitalization affects all components of the economic security of the enterprise.

The main difficulties for the development of the digital economy have been identified: lack of specialists and Ukrainian software, use of illegal software, slow adoption of legislation on digitalization.

The main directions for the development of digitalization of trade enterprises were identified: search for resources, improvement of the online sales process, digitalization of transactions, use of templates and integrated digital technologies.

The list of factors that most influence the formation of trade turnover was substantiated: income of the population, number of trade workers, inventories, producer price indices, digital technologies (telecommunications, data processing, etc.).

3. By means of the statistical and qualitative analysis of the performance indicators of enterprises of various spheres, it was defined that sales volumes have essentially increased at the enterprises of the sphere of communications, telecommunications, and information technologies. The power model of the dependence of the turnover volume of trade enterprises on five main factors was constructed and checked for adequacy. The calculations show that the activity of telecommunications enterprises has the greatest impact on the formation of trade turnover (the power index of 1.467). A statistically significant relationship between the indicators of the volume of information and related services and trade volumes was determined. There is probably a large share of trade enterprises that use digital technologies.

Turnover growth is one of the most important factors in the economic security of trade enterprises and has a positive effect on their business activities. Obviously, regression analysis also indicates the relationship between the level of digitalization and the size of enterprises, as large businesses have more opportunities to invest in digital technologies.

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