

This paper reports a comprehensive approach devised to assess the impact of innovative development on the level of financial security of households. The study considers the peculiarities of the interpretation of the concepts of "household" and "innovation" and identifies the main factors influencing the financial security of households. The indicators characterizing the state of financial security of households and innovative development were analyzed in dynamics.

The study's result produced a SWOT analysis that ensures the financial security of households. Among the strengths are the high economic potential of the country, the process of reforming state systems, the transition to complete digitalization (digitalization), and the presence of highly educated specialists. It was clarified that the factors that have the greatest negative impact are the low level of investment attractiveness, corruption component, the impact of the global economic crisis, and the high level of shadowing of the economy.

The method of correlation-regression analysis was used to prove the hypothesis put forward regarding the existence of a connection between the indicators characterizing innovative development and the level of financial security of households. The adequacy of the developed model has been confirmed on the basis of the Fisher's F-criterion. The existence of a strong relationship between independent and dependent variables (multiple correlation coefficient $R=0.9875$) was mathematically confirmed, which proves the expediency of stimulating innovative development to strengthen financial security. It was established that with an increase in both independent variables at the same time by 1 % (the cost of scientific research, the total amount of expenditures in the areas of innovative activity of industrial enterprises), the volume of GDP per capita (an indicator of the state of financial security of households) increases by 1.75 %

Keywords: financial security of households, economic security, national security, innovation, innovative development

DEVELOPMENT OF AN INTEGRATED APPROACH TO ASSESSING THE IMPACT OF INNOVATIVE DEVELOPMENT ON THE LEVEL OF FINANCIAL SECURITY OF HOUSEHOLDS

Anastasiia Poltorak

Corresponding author

Doctor of Economics Sciences, Associate Professor*

E-mail: poltorak@mnau.edu.ua

Oliha Khrystenko

PhD, Associate Professor

Department of Business Economy**

Anna Sukhorukova

PhD

Department of Management and Marketing**

Tetiana Moroz

PhD, Associate Professor

Department of Information Systems and Technologies**

Oleksandr Sharin

Senior Lecturer

Department of Economic Theory and Social Sciences**

*Department of Management and Marketing**

** Mykolayiv National Agrarian University

Heorhiia Honhadze str., 9, Mykolayiv, Ukraine, 54020

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1. Introduction

The development of approaches to assessing the impact of innovative development on the level of financial security of households, taking into consideration the specificity of the transformation of the world financial system, is one of the most important world problems of national security of states. Financial security of households characterizes the level of security of their finances, directly affects the socio-economic indicators for a particular state, the level of their resilience and financial security in general.

Factors that affect the formation of financial security of households and countries of the world are transformed in accordance with the changes around. Important tasks of economic development are to create favorable conditions for improving

the level of financial security of households as the main stimulant for improving the financial system of the world.

Given the current conditions of active introduction of innovations in various industries and systems, it is important to study the existence of a connection between the innovative development of the state financial system and the financial security of households. The implementation of innovations in any field or industry can lead to various risks that should be foreseen and develop ways to neutralize them. The analysis of indicators characterizing the state of financial security of households in the state and trends in innovative development will determine the type and density of relationship between these elements.

The relevance of the chosen scientific topic is justified by the presence, at present, of conditions for both additional

opportunities to strengthen the state of financial security of households, as well as new threats, the negative impact of which must be timely eliminated.

2. Literature review and problem statement

Previously conducted bibliometric analysis using special tools Vosviewer v.1.6.15 allowed us to identify international research groups, the scientific work of which is directly related to the problems of our research. The importance of this issue is also determined by its connection with the state of financial security of the state as a whole and the development of the country's economy. Paper [1] uses the concept of identity to prove the hypothesis that household behavior directly affects the level of their financial security. However, other factors influencing the integral indicator remained out of the author's attention.

Study [2] analyzes the impact of financial incentives on safety but does not take into consideration the link between innovative development and changes in the level of financial security.

Paper [3] presents an essential characteristic of the concept of "financial security of households" but insufficiently investigates factors that affect trends in changing its level. Article [4] pays attention only to theoretical understanding of the basic category of research without a thorough analysis of the factors that form its level.

This aspect is taken into consideration in [5], whose author considers and analyzes the main factors that affect the financial security of households, presents different views of scientists regarding their grouping. The cited work would have a higher level of completion if there was a mathematical analysis of the relationship of various factors with the integrated indicator. Work [6] notes that the comprehensive development of the innovative potential of the state is the basis of the financial security of the state but it is also necessary to investigate the connection of innovative development with the level of financial security at the household level.

Approaches to assessing the financial security of an enterprise are investigated in article [7], and the mechanism for ensuring the financial security of households and the basis for assessing its condition were considered in [8]. Article [9] considers the analysis of the state of financial security of households and mathematically confirms the presence of its impact on the level of financial security of the state. Ways to ensure the financial security of the state and business entities and the mechanism for managing the economic security system of the enterprise are investigated in [10]. The authors of [11] consider specific barriers in the public sector that can affect the level of innovative development. However, further research requires feedback analysis: the impact of innovative development on the level of financial security.

The logic of optimization of innovative development is specified in work [12], the efficiency of digital modernization is analyzed. The existing relationships between human capital and innovation and organizational productivity are found in [13], which is a significant scientific result but does not take into consideration aspects of financial security of households.

Article [14] emphasizes the importance of innovative productivity, provides critical leadership strategies for team

development, but innovative development is not seen as a basis for strengthening the financial security of households. Paper [15] thoroughly analyzes team innovative behavior and its impact on economic indicators. In [16], the authors draw attention to the fact that financial support of the agricultural sector is carried out through a set of programs, including through an innovative component. The authors of study [17] analyzed various types of risks in the system of economic security of enterprises but the financial security of households remained out of sight.

Lack of research containing proof of the impact of innovative development in the country on the level of financial security of households requires the scientific community to further investigate this area.

3. The aim and objectives of the study

The purpose of this seminal study is a systematic substantiation of theoretical and methodological principles and practical approaches to the development of an integrated approach to assessing the impact of innovative development on the level of financial security of households. This will make it possible to identify effective directions for strengthening and ensuring the financial security of households by stimulating innovative development in the state.

To accomplish the aim, the following tasks have been set:

- to assess the indicators characterizing the state of financial security of domestic households;
- to analyze trends in innovation development as a source of strengthening the financial security of households;
- to develop a comprehensive approach to economic and mathematical analysis of the impact of innovative development on the financial security of households.

4. The study materials and methods

The object of our study was the processes of influence of innovative development on the level of financial security of Ukrainian households, given that in developing countries, the active introduction of innovations is a decisive factor in strengthening the financial security of households.

In the process of this copy paste study, general scientific and special methods were used. The method of analysis and synthesis is applied to group factors of influence on the level of financial security of households. SWOT analysis was employed to identify strengths and weaknesses in the system of ensuring the financial security of state households and identifying existing opportunities and threats. The comparison method is used to compare similar values of indicators of innovative development and the state of financial security of households of different periods. Statistical analysis is used in the process of comparing the generated data with each other and with other data. Economic and mathematical method, correlation-regression analysis is used to quantify the relationship between the identified indicators of innovative development and the main indicator that characterizes the state of financial security of households. Abstract-logical method is used in the process of formation of theoretical generalizations and conclusions.

5. Results of developing an approach to assessing the impact of innovative development on the financial security of households

5.1. Results of assessment of the state of financial security of households

Financial security of households is a generalized characteristic of the quality of life of the country's population and a defining component of the financial security of the state. Any subsystem of financial security of the state (budget, debt, currency, tax, banking, non-bank financial sector) is associated with households.

The Law of Ukraine "On the All-Ukrainian Population Census" No. 2058-III defines the concept of household. It is noted that "this is a set of persons who jointly reside in the same dwelling or part of it, provide themselves with the necessary for life, lead a joint household, fully or partially combine and spend money" [18]. The Law states that household participants can both be in a family relationship with each other or a relationship with their ownership, and not be in any of these relationships. A household can consist of one person.

There are many factors that influence the level of financial security of households and, accordingly, the state of financial security of the state.

External factors influencing the level of financial security of households include [7]:

- fluctuations in socio-economic indicators;
- the impact of the global financial crisis;
- unstable economy in the country and threats to the functioning of the financial system of the state;
- imperfection of legislation and work of state systems; uncontrolled financial globalization;
- political situation in the country, the presence of hostilities;
- quality of life of the population.

Internal factors include [7]:

- the volume of income and expenses of households;
- the level of financial literacy of citizens;
- rational use of available funds, ability to dispose of them; financial relations between household members;
- legality of conducting activities and obtaining income (tax liability), etc.

Also, the level of financial security of the household is formed by other factors that characterize both actions on the part of the government of the country, international organizations, other states, and on the part of the citizens (households) themselves. The policy of the state should be aimed at timely neutralization of the negative impact of these factors and increasing the level of financial awareness and literacy of the population of the country.

To further assess the impact of innovative development on the financial security

of households, it is necessary to monitor the dynamics of its condition.

One of the main indicators that form the level of financial security of households is their number. Consider the dynamics of the number of households in Ukraine during the analyzed period 2010–2020 (Fig. 1).

According to Fig. 1, it was clarified that during the study period of 2010–2020, the number of households in general tends to decrease: in 2020, this figure is less than in 2010 by 2,266 thousand units or by 13.29 percentage points. The dynamics of reducing the number of households during that period in general is stable but in 2014 there was a sharp decline in this indicator – to 14,455 thousand units.

Table 1 gives the results of determining the dynamics of aggregate resources and household expenditures during 2010–2020.

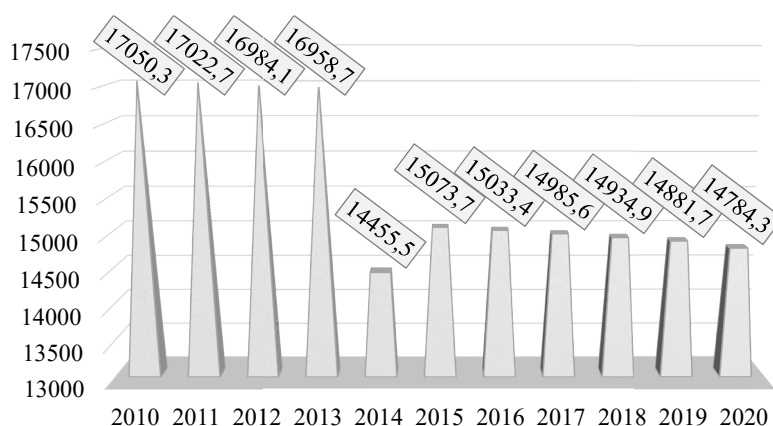


Fig. 1. The number of households in Ukraine in 2010–2020, thousand units

Table 1

The dynamics of aggregate resources and expenditures on average per month per household in 2010–2020

Year	Total resources per month per household, UAH	Deviation of the indicator relative to the previous year, percentage points	Total expenses per month per household, UAH	Deviation of the indicator relative to the previous year, percentage points
2010	3,481.00	–	3,073.30	–
2011	3,853.90	10.71	3,458.00	12.52
2012	4,144.50	7.54	3,592.10	3.88
2013	4,470.50	7.87	3,820.30	6.35
2014	4,563.30	2.08	4,048.90	5.98
2015	5,231.70	14.65	4,952.00	22.30
2016	6,238.80	19.25	5,720.40	15.52
2017	8,165.20	30.88	7,139.41	24.81
2018	9,904.06	21.30	8,308.61	16.38
2019	12,118.50	22.36	9,670.20	16.39
2020	12,432.27	2.59	9,523.57	–1.52

Source: compiled by authors based on statistical data [19]

Note: the official exchange rate of UAH against USD: USD 1 – 2010 – UAH 7.94; 2011 – UAH 7.97; 2012 – UAH 7.99; 2013 – UAH 7.99; 2014 – UAH 11.89; 2015 – UAH 21.84; 2016 – UAH 25.55; 2017 – UAH 26.6; 2018 – UAH 27.20; 2019 – UAH 25.85; 2020 – UAH 26.96

The dynamics of aggregate resources and costs on average per month per household have a constant tendency to grow. Thus, the total resources per household (on average per month) in 2020 increased by UAH 8,951.24 (or 3.5 times) compared to 2010. Total expenditures per household (on average per month) for the same period increased by UAH 6,450.27 (or 3 times).

The main indicator that characterizes the financial security of households is the amount of GDP per capita. Fig. 2 shows the results of determining the dynamics of GDP per capita in Ukraine in 2010–2020.

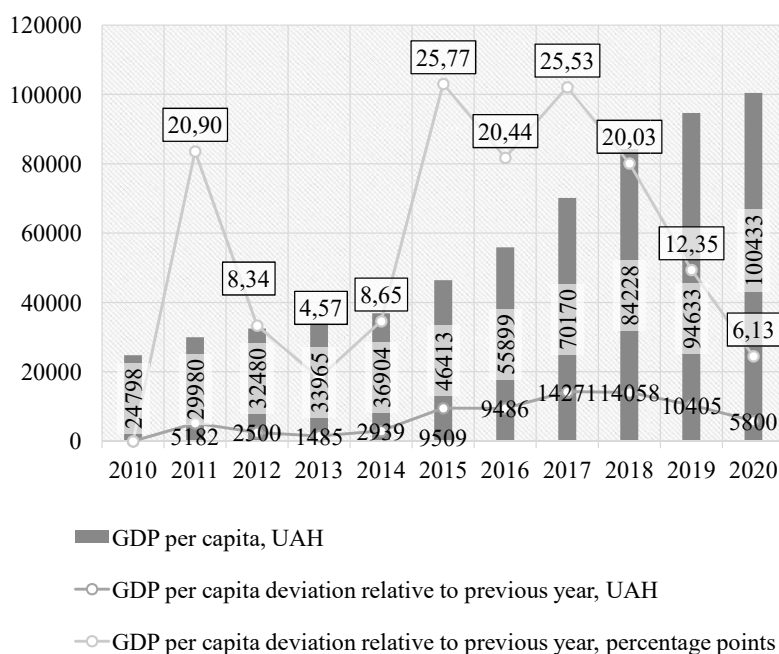


Fig. 2. The dynamics of GDP per capita in Ukraine in 2010–2020

After analyzing the dynamics of GDP per capita in Ukraine during 2010–2020, it was found that it has a generally growing trend. As of 2020, the indicator increased by UAH 75,635 or 4 times compared to 2010. Such dynamics are associated with a number of factors, including the growth of inflation in the country, an increase in the subsistence minimum, minimum and average wages, etc.

Having examined the dynamics of indicators that form the level of financial security of Ukrainian households and the main factors influencing it, it is advisable to consider the current opportunities for strengthening the financial security of households.

Based on an expert survey, a SWOT analysis of improving the financial security of Ukrainian households was carried out, the results of which are summarized in Table 2. The expert survey was conducted in the form of a standardized interview. It was attended by experts with a scientific degree in economic sciences. The information obtained as a result of the survey was used to determine the average expert assessments on weightings and ballroom assessments of specific elements of SWOT analysis. The gender structure of respondents in study process is as follows: 50 % of the questionnaires sent to the addresses of female economists (100 people), and 50 % of male economists (100 people).

Thus, among the strengths of the system of ensuring financial security of households, the high economic potential of the country, the process of reforming state systems, the transition to complete digitalization (digitalization), and highly educated specialists are highlighted.

Table 2

SWOT-analysis of the system of ensuring financial security of households

Elements of SWOT analysis	Weighting factor	Score	Product	Elements of SWOT analysis	Weighting factor	Score	Product
<i>S</i> – Strengths				<i>W</i> – Weakness			
1. High economic potential of the country	0.22	4	0.88	1. Low level of investment attractiveness	0.20	4	–0.80
2. Reforming state systems (mechanisms)	0.29	5	1.45	2. Corruption component	0.28	5	–1.40
3. Highly educated specialists	0.22	4	0.88	3. The impact of the global financial crisis	0.22	4	–0.88
4. Transition to full digitalization	0.27	5	1.35	4. High level of shadowing of the economy	0.30	5	–1.50
Total:			4.53	Total:			–4.58
Internal drivers (<i>Y</i>)= <i>S</i> – <i>W</i> =4.53–4.58=–0.05							
<i>O</i> – Opportunities				<i>T</i> – Threats			
1. Innovative development	0.30	5	1.50	1. Economic influence of creditors on government processes	0.25	4	–1.00
2. Increasing the level of financial literacy of the population	0.25	5	1.25	2. Inflationary processes	0.26	4	–1.04
3. Growth of budget potential of regions	0.20	4	0.80	3. Increasing military conflict (risks of national danger)	0.25	4	–1.00
4. Entrepreneurship development	0.25	4	1.00	4. Threats in cyberspace	0.24	5	–1.20
Total:			4.55	Total:			–4.24
External drivers (<i>X</i>)= <i>O</i> – <i>T</i> =4.55–4.24=0.31							

Source: calculated by authors

According to the results of the SWOT analysis, it was clarified that the factors that have the greatest negative impact are the low level of investment attractiveness, corruption component, impact of the global economic crisis, and a high level of shadowing of the economy. However, their negative impact can be fully eliminated by promoting innovative development, increasing the level of financial literacy of the population, increasing the budget potential of the regions of Ukraine, and developing entrepreneurship.

Based on the expert assessment, it was found that innovative development is one of the main opportunities to strengthen the state of financial security of households and, accordingly, the entire financial system of the state.

5.2. Results of the analysis of innovative development as a source of strengthening the financial security of households

Based on the global experience, innovative development contributes to improving socio-economic indicators in the country. In order to obtain such an effect, it is necessary to create and implement an effective mechanism of state support and stimulation of innovative development in Ukraine.

According to the Law of Ukraine “On Innovation Activity”, innovations are “newly created (applied) and (or) improved competitive technologies, products or services, as well as organizational and technical solutions of a production, administrative, commercial or other nature that significantly improve the structure and quality of production and (or) the social sphere” [16]. And innovation, in turn, is an activity related to the implementation of these innovations (innovative products).

Innovation activity in Ukraine is based on the following regulations:

- Constitution of Ukraine;
- laws of Ukraine “On investment activity”, “On scientific and scientific-technical activity”, “On scientific and scientific-technical expertise”;
- laws of Ukraine “On the special regime of innovative activity of technological parks”, “On the special economic zone “Yavoriv”, “On priority directions of innovation activity in Ukraine”, “On innovation activity” [20];
- other normative legal acts regulating social relations in this area.

On July 10, 2019, by order of the Cabinet of Ministers of Ukraine, the “Strategy for the Development of the Sphere of Innovation Activity for the Period up to 2030” was approved [21]. This document defines the current state of innovation development in comparison with other states and further actions to create favorable conditions for the development of the national innovation ecosystem.

For further analysis of the connection between innovative development in the country and financial security of households, it is necessary to investigate the dynamics of innovative development in Ukraine.

One of the important indicators that characterize the state of innovative development and the process of innovation in the country as a whole is the amount of costs. The results of study of the total amount of costs in the areas of innovation activity in Ukraine are given in Table 3.

Thus, analyzing the statistics given in Table 3, it was clarified that in general, the costs of innovation activities in Ukraine during 2010–2020 tend to grow. The cost of research and development in 2020 increased by UAH 8,915.3 million

compared to 2010 (2 times). The cost of basic scientific research increased by UAH 2,084 million (by UAH 95.82 per year). p.), applied – by 149.87 percentage points, scientific and technical (experimental) developments – by 102.46 percentage points. The total amount of costs in the areas of innovation activity of industrial enterprises for the analyzed period increased by 1.8 times, including for scientific research and development – by 249.89 percentage points.

Table 3

Total expenditures in the areas of innovation in Ukraine in 2010–2020

Year	Total	Expenditures for research and development, UAH million		
		including		
		basic research	applied research	scientific and technical (experimental) developments
2010	8107.1	2,175.0	1,589.4	4,342.7
2011	8513.4	2,200.8	1,813.9	4,498.7
2012	9419.9	2,615.3	2,023.2	4,781.4
2013	10248.5	2,698.2	2,061.4	5,488.9
2014	9487.5	2,452	1,882.7	5,152.8
2015	11003.6	2,460.2	1,960.6	6,582.8
2016	11530.7	2,225.7	2,561.2	6,743.8
2017	13379.3	2,924.5	3,163.2	7,291.6
2018	16773.7	3,756.5	3,568.3	9,448.9
2019	17254.6	3,740.4	3,635.7	9,878.5
2020	17022.4	4,259.0	3,971.4	8,792.1
Total expenditures by areas of innovation of industrial enterprises, UAH million				
Year	Total	including		
		research and development (R&D), UAH million	other costs of innovation (excluding R & D), UAH million	
2010	8045.5	996.4	7,049.1	
2011	14333.9	1,079.9	13,254.0	
2012	11480.6	1,196.3	10,284.3	
2013	9562.6	1,638.5	7,924.1	
2014	7695.9	1,754.6	5,941.3	
2015	13813.7	2,039.5	11,774.2	
2016	23229.5	2,457.8	20,771.7	
2017	9117.5	2,169.8	6,947.7	
2018	12180.1	3,208.8	8,971.3	
2019	14220.9	2,918.9	11,302.0	
2020	14406.7	3,486.3	10,920.6	

Source: compiled by authors based on statistical data [19]

Table 4 summarizes data of the number of persons and organizations involved in the implementation of scientific research and innovations in Ukraine during 2010–2020.

After examining the data in Table 4, it was found that the dynamics of the number of persons and organizations involved in the implementation of scientific research and the introduction of innovations in Ukraine during the analyzed period (2010–2020) tends to decrease. Thus, the number of employees who were involved in the process of research and development in 2020 decreased compared to 2010 by 103,624 people (by 56.79 percentage points). The number of organizations that carried out research work over the same period decreased by 534 units (by 40.98 percentage points).

The number of innovatively active enterprises decreased by 738 units (by 50.48 percentage points), and the number of industrial enterprises that introduced innovations – by 592 units (by 48.64 percentage points).

The dynamics of the number of implemented types and volume of innovative products sold in Ukraine during 2010–2020 are shown in Fig. 3.

Thus, the volume of innovative products sold during 2010–2020 according to Fig. 3 have an ambiguous trend, the dynamics of the recession have been observed since 2011, and since 2018 – growth. In general, this figure increased in 2020 compared to 2010 by UAH 25,813.2 million or by 76.60 percentage points. It is worth noting that in 2016 the calculation of this indicator was not carried out. The number of introduced types of innovative products also has a changing dynamic: in 2020, this indicator increased by 1,658 units compared to 2010, or by 68.85 percentage points.

5.3. The results of the economic and mathematical analysis of the impact of innovative development on the financial security of households

There are reasons to believe that innovative development is a kind of incentive and, according to the results of the SWOT analysis, an opportunity to improve the financial security of households.

Thus, the closeness of the connection of the main indicator characterizing the state of financial security of households is investigated – the volume of GDP per capita (Y) and indicators characterizing the state of innovative development in the country: the cost of research and development (X_1), and the total amount of costs in the areas of innovation of industrial enterprises (X_2).

The hypothesis was put forward regarding the existence of a connection between these indicators, which could be proven using the method of correlation-regression analysis and the formation of an appropriate econometric model [18].

Table 4

The number of persons and organizations involved in the implementation of scientific research and the introduction of innovations in Ukraine in 2010–2020

Year	Number of employees involved in research and development – in total, individuals	Number of organizations that carried out research, total units	Number of innovative enterprises, total units	Number of industrial enterprises that implemented innovations (products and/or technological processes), total units
2010	182,484	1,303	1,462	1,217
2011	175,330	1,255	1,679	1,327
2012	164,340	1,208	1,758	1,371
2013	155,386	1,143	1,758	1,312
2014	136,123	999	1,715	1,208
2015	122,504	978	1,609	723
2016	97,912	972	824	735
2017	94,274	963	759	672
2018	88,128	950	777	739
2019	79,262	950	782	687
2020	78,860	769	724	625

Source: compiled by authors based on statistical data [19]

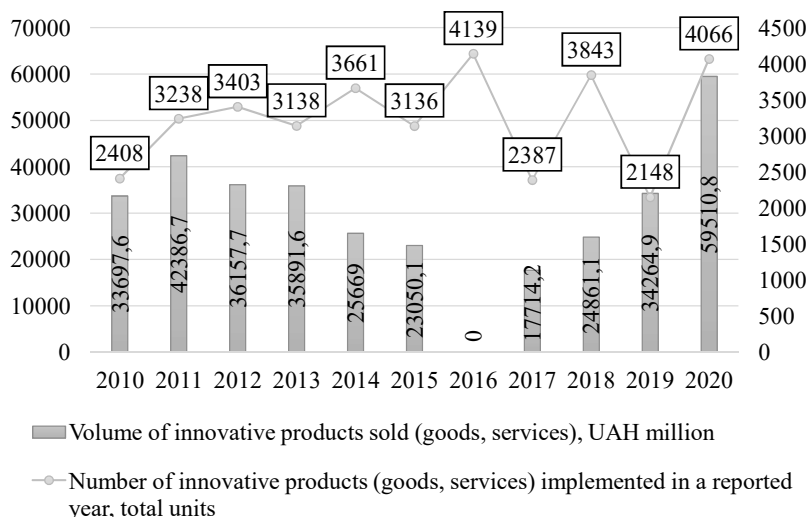


Fig. 3. Dynamics of the number of implemented types and volume of innovative products sold in Ukraine in 2010–2020

The initial data used in the analysis of the hypothesis put forward are given in Table 5.

The calculated means and average quadratic deviations Y , X_1 , and X_2 are summarized in Table 6.

The parameters of the econometric model of paired regression are calculated ($\hat{a}_0, \hat{a}_1, \hat{a}_2$):

$$Y = -41749.48 + 7.6732 \cdot x_1 + 0.3665 \cdot x_2, \quad (1)$$

The results of the variance analysis (ANOVA) are given in Table 7.

The determination coefficient (2) is calculated, which characterizes the density of the statistical relationship between the indicators used in the model.

$$R^2 = \frac{SSR}{SST} = 1 - \frac{SSE}{SST}. \quad (2)$$

Table 5

Source data for building an econometric model of paired regression

Year	No.	X_1 (costs for research and development, UAH million)	X_2 (total expenditures in the areas of innovation of industrial enterprises, UAH million)	Y (volume of GDP per capita, UAH)
2010	1	8,107.1	8,045.5	24,798
2011	2	8,513.4	14,333.9	29,980
2012	3	9,419.9	11,480.6	32,480
2013	4	10,248.5	9,562.6	33,965
2014	5	9,487.5	7,695.9	36,904
2015	6	11,003.6	13,813.7	46,413
2016	7	11,530.7	23,229.5	55,899
2017	8	13,379.3	9,117.5	70,170
2018	9	16,773.7	12,180.1	84,228
2019	10	17,254.6	14,220.9	94,633
2020	11	17,022.4	14,406.7	100,433

Source: generalized and systematized by authors

ANOVA results

Variance source	Degree of freedom	Sum of squares	Variance (mean squares)
Regression	$k_1 = m - 1 = 3 - 1 = 2$	SSR=7,418,057,016	MSR=3,709,028,508
Residual	$k_2 = n - m = 11 - 3 = 8$	SSE=188,887,460.2	MSE=23,610,932.52
Total variable	$n - 1 = 11 - 1 = 10$	SST=7,606,944,476	MST=760,694,447.6

Source: calculated and systematized by authors

Average values and standard deviation of indicators

Indicator	Y	X_1	X_2
Mean value: $\bar{Y}, \bar{x}_1, \bar{x}_2$	55,445.73	12,067.34	12,553.36
Variance: $\sigma_Y^2, \sigma_{X_1}^2, \sigma_{X_2}^2$	691,540,406.90	11,094,323.36	17,355,449.05
Standard deviation: $\sigma_Y, \sigma_{X_1}, \sigma_{X_2}$	26,297.16	3,330.81	4,165.99

Source: calculated and systematized by authors

The indicator $R^2=0.9752$ means that the variation in GDP per capita by 97.52 % is determined by the variation in the cost of research and development and the total

amount of costs in the areas of innovation of industrial enterprises.

The multiple correlation coefficient (3) is a measure of the linear relationship of the dependent variable Y with independent variables X_1, X_2 ; its calculated value $R=0.9875$ characterizes a sufficiently strong relationship between the indicators that are analyzed.

$$R = \sqrt{R^2}. \quad (3)$$

The values of the partial coefficients of elasticity (4), (5) $E_{\frac{Y}{x_1}} = 1.670$ and $E_{\frac{Y}{x_2}} = 0.083$ show that these indicators have a direct effect on the dependent variable (4.5).

$$E_{\frac{Y}{x_1}} = \hat{a}_1 \cdot \frac{\bar{X}_1}{\bar{Y}}, \quad (3)$$

$$E_{\frac{Y}{x_2}} = \hat{a}_2 \cdot \frac{\bar{X}_2}{\bar{Y}}. \quad (4)$$

where $E_{\frac{Y}{x_1}}$ is the elasticity coefficient of costs for scientific research; $E_{\frac{Y}{x_2}}$ – the elasticity coefficient of the total cost in the areas of innovative activity of industrial enterprises.

Thus, with an increase in the cost of scientific research by 1 %, the volume of GDP per capita will increase by 1.67 % provided that other factors of influence are unchanged. With an increase in the total amount of expenditures in the areas of innovation of industrial enterprises by 1 % of GDP per capita will increase by 0.08 %. The total elasticity shows that with an increase in both independent variables at the same time by 1 %, the volume of GDP per capita increases by 1.75 %.

Using the Fisher's F -criterion, the adequacy of the presented econometric model was checked with actual data. It was clarified that since $F_{\text{fact}} > F_{\text{table}}$ (157.09 > 4.46), the econometric model is adequate, that is, the hypothesis of the

significance of the relationship between variables is confirmed.

Thus, as a result of our calculations, a sufficiently strong connection between the indicators of innovative development in the country and the main indicator characterizing the state of financial security of households has been proven. It is substantiated that the increase in the cost of scientific research and/or the total amount of costs in the areas of innovation of industrial enterprises leads to an increase in the dependent variable Y , which confirms the assumption.

Table 6

6. Discussion of results of developing an integrated approach to assessing the impact of innovative development on the level of financial security of households

During study, an assessment of indicators characterizing the state of financial security of domestic households was carried out. Financial security of households was considered as a generalized characteristic of the quality of life of the population and the main component of the financial security of the state. It is proved that

during 2010–2020 the growth rate of aggregate resources and expenditure per household is different (Table 1). Total resources per household for study period increased by 3.5 times, and total expenditures – by 3 times. The dynamics of GDP per capita as the main indicator of the state of financial security of households is analyzed (Fig. 2). It was clarified that this figure has increased by 4 times, which is associated with an increase in inflation, an increase in the subsistence minimum, minimum and average wages, etc. The main results of the SWOT-analysis of improving the financial security of households are summarized in Table 2. It is noted that the action of factors characterized by the greatest negative impact can be eliminated by promoting innovative development, increasing the level of financial literacy of the population, increasing the budget potential of the regions of Ukraine, and developing entrepreneurship.

The trends of innovative development as a source of strengthening the financial security of households were analyzed. The results of the analysis of the costs of scientific research, summarized in Table 3, allowed us to conclude that in general, the costs of innovation activities during 2010–2020 tend to grow. The total amount of costs in the areas of innovation of industrial enterprises for the analyzed period increased by 1.8 times, including: for scientific research and development – by 249.89 percentage points. However, the number of individuals and organizations involved in the implementation of scientific research and innovation in Ukraine during 2010–2020 (Table 4), significantly decreased. This in the future may lead to a significant decrease in the pace of innovation development. Dynamics of the number of implemented types and volume of innovative products sold in Ukraine during 2010–2020 (Fig. 3) are characterized by instability.

A comprehensive approach to economic and mathematical analysis of the impact of innovative development on the financial security of households has been developed, which involves:

- determining the main factors that shape the financial security of households under modern conditions;
- monitoring the state of financial security of households, indicators that form it;
- analysis of trends in the innovative development in Ukraine;
- implementation of economic and mathematical analysis and confirmation of the impact of innovative development on the financial security of households and the closeness of their connection.

It is confirmed that there is a close link between innovative development in the state and the financial security of its households, which is the basis for further research. In the future, it is also necessary to develop an effective mechanism for stimulating innovative development in the state in order to improve the financial security of its households.

The closeness of the connection between GDP per capita and indicators characterizing the state of innovative development in the country is investigated: the cost of scientific research and development and the total amount of costs in the areas of innovative activity of industrial enterprises. The initial data for the construction of an econometric model of paired regression are summarized in Table 5. The parameters of the econometric model of paired regression (1) are calculated, the results of the variance analysis are given in Table 7. The determination

coefficient (2) is calculated, which made it possible to prove that the variation in GDP per capita by 97.52 % is determined by the variation in the indicators of innovative development in the country. The coefficient of multiple correlation (3) and the value of partial coefficients of elasticity (4), (5) made it possible to confirm that the selected independent indicators have a direct impact on the dependent variable.

The advantages of the proposed approach to assessing the impact of innovative development on the level of financial security of households are as follows. In contrast to [2], the presented approach takes into consideration the influence of the factor of innovative development on the state of financial security of households. This becomes possible due to mathematical proof of the influence of factors of innovative development on ensuring the financial security of households.

The obtained solutions make it possible to timely and fully assess the impact of factors of innovative development on ensuring the financial security of households. In addition, it will contribute to further forecasting of indicators of the state of financial security of households, subject to changes in the indicators of innovative development of the state.

In the process of applying the proposed approach to assessing the impact of innovative development on the level of financial security of households, it is necessary to take into consideration the change in factors of influence due to the internal transformation of the financial system of the state. It is also necessary to comprehensively and systematically analyze systemic changes in the global conditions for the functioning of the world's financial systems and corresponding changes in the factors influencing the level of financial security of households.

The disadvantages of this study are the lack of consideration of the proposed approach in different groups of countries, the focus of study on the economies of developing countries. Further development of this study may consist in its application for different groups of countries, distributed according to the indicators of innovative development and criteria for financial security of households.

7. Conclusions

1. The peculiarities of interpretations of the concept of “household” are considered, the main factors of influence on their financial security under modern conditions are determined. The indicators characterizing the state of financial security of households are analyzed. During a study period of 2010–2020, the number of households decreased by 2,266 thousand units. Total resources per month per household increased by 3.57 times, and total expenditures increased only by 3.10 times. GDP per capita for the study period increased by 4 times. A SWOT analysis of ensuring financial security of households was carried out and strengths, weaknesses, opportunities, and threats were identified. It is assumed that weaknesses can be eliminated thru the innovative development, increasing the level of financial literacy of the population, increasing the budget potential of regions, and developing entrepreneurship.

2. The peculiarities of innovative development as a source of strengthening the financial security of households are analyzed. It was found out that the costs of research and de-

velopment for 2010–2020 increased by only 2.1 times, which is insufficient for effective innovation development. The total amount of costs in the areas of innovation of industrial enterprises for the analyzed period increased by 1.8 times. In addition, the number of employees involved in the process of research and development in 2020 decreased compared to 2010 by 103,624 people. The number of organizations that carried out research work over the same period decreased by 534 units. Such indicators indicate extremely unsatisfactory trends in innovative development in the state during the study period.

3. A comprehensive approach to economic and mathematical analysis of the impact of innovative development on the financial security of households has been developed. The econometric model of paired regression between the indicators of innovative development and financial security of households has been formed. It is proved that the developed model is adequate in accordance with the Fisher's F-criterion. The existence of a strong connection between independent and dependent variables is mathematically established, which confirms the expedi-

ency of stimulating innovative development in Ukraine in order to strengthen the financial security of households and the state as a whole. The determination coefficient is calculated, which proves that the variation of the dependent variable (GDP per capita) by 97.52 % is determined by a variation of independent variables. The value of the multiple correlation coefficient ($R=0.9875$) characterizes the presence of a sufficiently strong and close relationship between the corresponding indicators. It was found that with an increase in independent variables, the dependent also increases, that is, there is a direct influence. Thus, with an increase in the cost of research and development by 1 %, the volume of GDP per capita increases by 1.67 %, provided that the remaining factors are stable. With an increase in the total amount of expenditures in the areas of innovation of industrial enterprises by 1 %, the volume of GDP per capita increases by 0.08 % under the same conditions. It is confirmed that with an increase in both independent variables at the same time by 1 %, GDP per capita (the main indicator characterizing the state of financial security of households) increases by 1.75 %.

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