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Innovation Policy of Countries: Analysis and Key Development Trends

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ANNOTATION. The article comprehensively studies the essence of innovation policy and its impact on the competitiveness of countries. The types of innovation policy of countries are grouped by many criteria, in particular, by the strategy of innovation development, object of orientation, degree of regulation and direction. The study notes that in order to form an effective innovation policy, it is necessary to combine different types, based on the level of development of the country, resource potential and goals of the country. The instruments for implementing the innovation policy have been allocated and generalised, and a tendency to increase the use of indirect financial instruments has been identified. It is proposed to use a number of indices and databases to evaluate the results of innovation policy, namely the Global Innovation Index, the Global Competitiveness Index, the European Innovation Scoreboard, and the Frontier Technology Readiness Index. The article analyses the innovation policies of such countries as the USA, China and Germany, identifies their key characteristics and impact on competitiveness. Innovations shape the competitive advantages of countries, ensuring their leadership on the world stage. The semiconductor industry is studied as a key one in the field of innovative competition between the USA and China. The indicators of development of the innovation ecosystem of the selected countries according to the Global Competitiveness Index are analysed. The problems of forming and implementing innovation policy in Ukraine are highlighted: insufficient state funding, formal legislation, bureaucratic procedures, unfavourable investment climate, brain drain and lack of knowledge in the field of innovation management. The article highlights Ukraine's place in global indices and provides recommendations for improving innovation development and innovation policy. The role of innovation in the socio-economic development of countries is emphasised. The main social problems that should be taken into account when formulating innovation policy are raised, in particular, the problem of inclusion, gender inequality in the innovation sphere, and solving global problems. It is emphasised that innovative solutions should be designed to help achieve the goals of sustainable development, in particular decarbonisation and zero emissions.

KEY WORDS: innovation policy, competitiveness, innovation, research and development, socio-economic development, sustainable development.

Introduction

In today's world, intensified international competition necessitates the development and implementation of a state innovation policy to ensure

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national competitiveness. Innovation has always been a driver of economic and social development: it is the main source of economic growth, helps to increase productivity, and is the basis for competitiveness and welfare. National governments play an important role in advancing technology by promoting and implementing innovation policies.

Given the importance of innovation policy in countries, there is a need for a more detailed study of the theoretical and practical aspects of its implementation and execution. There is a need for a deeper understanding of how different types of innovation policy affect competitiveness and socio-economic development, what tools are available and how countries use them in implementing innovation policy. This analysis of countries' innovation policies and their trends in this study allows us to develop recommendations for Ukraine that will help improve the efficiency of formulating and implementing the national economy's innovation policy.

The topic of innovation policy is still insufficiently disclosed, despite the fact that the issue of formation and implementation of innovation policy has been the subject of research by many foreign and domestic researchers. In particular, the theoretical foundations of innovation policy formation and classification of state instruments of innovation policy are set out in the works of such foreign scholars as J. Edler, M. Peters, J. Fagerberg. The contribution of Ukrainian researchers of innovation policy is represented by the works of V. Brych, I. Kurinna, V. Kushniruk, P. Mykytyuk, V. Prodanets, L. Shvaika and M. Shkilnyak.

The aim of the article is to study the impact of the state innovation policy of the country on its competitiveness and socio-economic development.

Essence, objectives and types of state innovation policy

In general, in the modern sense, the concept of innovation was popularised by the Austrian economist Joseph Schumpeter and his "Theory of Innovation" in the 1930s[3]. And according to Godin, innovation is the latest incarnation of previously used terms such as imitation and invention[4]. Innovation policy, on the other hand, has existed under different names, as the boundaries between science, technology and innovation have often remained blurred. For example, in the 1960s, the focus was on science (and the term "science policy" was most often used), later the focus shifted to technology (and thus "technology policy"), and then to innovation (with the term "innovation policy")[5].

[3] Liberto D. Who Was Joseph Schumpeter, and What Was He Known For? Investopedia. 2022. URL: https://www.investopedia.com/terms/j/josephschumpeter.asp.

[4] Green E. Innovation: The History of a Buzzword. The Atlantic. 2013. URL: https://www.theatlantic.com/business/archive/2013/06/innovation-the-history-of-abuzzword/277067/.

[5] Fagerberg J. Innovation Policy: Rationales, Lessons and Challenges. Journal of Economic Surveys. 2017. № 31(2). P. 497–512. URL: https://onlinelibrary.wiley.com/doi/full/10.1111/joes.12164.

According to the official website, the European Parliament defines innovation policy as the interaction between research and technological development policy and industrial policy, which aims to create a framework that facilitates the bringing of ideas to the market[6].

In defining the state innovation policy, domestic scientists Kushniruk V. S.[7], Mykytyuk P. P.[8] and Shvaika L. A.[9] note the special role of the state in ensuring favourable conditions for innovative development. The authors emphasise the complexity of the State innovation policy, which should include various areas and measures of State regulation, including the provision of a regulatory framework, infrastructure, resources and the creation of a system of motivational factors.

Based on this, it is worth analysing different approaches to the classification of innovation policy. Thus, the criteria used to classify innovation policy reflect its focus, the degree of government intervention, and the strategy of innovation development (Table 1).

According to Table 1, we can state that since historically different countries have had different scientific and technological potential and have been at different stages of development, there has been an asymmetry in the development of innovations. Government officials should be fairly objective when planning innovation policy and choose the path of development that they are able to provide.

For example, consider the types of innovation policy according to the strategy of innovation development. For example, the use of the "build-up" strategy, which aims to create new innovations and introduce them into the real sector of the economy using the country's own scientific and technical potential and attracting foreign scientists, is characteristic mainly of highly developed countries such as Switzerland, the USA, Sweden, the UK and the Netherlands.

The strategy of "borrowing", which is characterised by developing countries using technologies and knowledge developed in developed countries to create their own products using their own cheap labour and scientific and technological potential, has been widely used in China and some Southeast Asian countries.

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[6] European Parliament. Fact Sheets on the European Union 2023. URL: https://www.europarl.europa.eu/factsheets/en/sheet/67/innovation-policy#:~:text=Innovation %20policy %20is %20the %20interface,to %20bringing%20ideas %20to %20the %20market

[7] Kushniruk V. Innovation policy: a reference lecture notes – Mykolaiv: MNAU. 2016. – 71 p. – P. 32. URL: http://dspace.mnau.edu.ua/jspui/bitstream/123456789/2277/1/Kushniryk_Innov_polituka.pdf.

[8] Innovative management: textbook / P. P. Mykytyuk, V. Y. Brych, M. M. Shkilnyak, Y. I. Mykytyuk – Ternopil: Econ. Dumka TKEU, 2019. 518 c. URL: http://dspace.wunu.edu.ua/bitstream/316497/36441/3/ %D0 %9C %D0 %B8 %D0 %BA %D0 %B8 %D1 %82 %D1 %8E %D0 %BA %20 %281 %29.pdf

[9] Shvaika, L. A. State regulation of the economy: a textbook / L. A. Shvaika. – K. : Znannya, 2006. – 435 p. URL: http://politics.ellib.org.ua/pages-cat-82.html.

Table 1

CLASSIFICATION OF INNOVATION POLICY TYPES

Types of innovation policy		
According to the innovation development strategy		
The "build-up" strategy	The "borrowing" strategy	The "use" strategy
By object of orientation		
Mission-oriented policy	Invention-oriented policy	System-oriented policy
By object of orientation		
Policies aimed at changing the economic structure of the economic mechanism.	Social orientation policy (inclusive policy)	
By the degree of regulation		
Policy of technological advancement	Policy to stimulate demand	
By area of expertise		
Vertical policy	Horizontal innovation	

Source: created by the author on the basis of [10, 11, 12, 13, 14, 15].

Finally, the strategy of "use", which involves the attraction of foreign innovations through the use of licences and patents, was used by Japan after the Second World War. The Japanese bought licences for highly efficient technologies from the USA, UK, and France to master the production of new products. In contrast, according to the book Chip War: The Fight for the World's Most Critical Technology by Chris Miller in 2022, the Soviet Union once used a similar strategy of "leveraging" to try to catch up with the US

[10] A Practitioner's Guide to Innovation Policy. Instruments to Build Firm Capabilities and Accelerate Technological Catch-Up in Developing Countries. 2020. Washington, DC: *World Bank*. URL: https://documents1.worldbank.org/curated/en/158861581492462334/pdf/A-Practitioner-s-Guide-to-Innovation-Policy-Instruments-to-Build-Firm-Capabilities-and-Accelerate-Technological-Catch-Up-in-Developing-Countries.pdf.

[11] Prodanets V., Kurinna I. Strategies of innovative development for Ukraine. *Economics and Management 2017: Prospects for Integration and Innovative Development.* 2017. Vol. 3. – 100 p. URL: http://confcontact.com/2017-ekonomika-i-menedzhment/EIM_2017_tom3.pdf.

[12] Edler J., Fagerberg J. Innovation policy: what, why, and how. *Oxford Review of Economic Policy*. 2017. Vol. 33, no. 1. P. 2–23. https://doi.org/10.1093/oxrep/grx001

[13] Innovation law: a scientific and practical guide / edited by S. Hlibko, Y. Georgievsky, O. Rozgon. Kharkiv: Pravo, 2019. 246 c. URL: https://openarchive.nure.ua/server/api/core/bitstreams/1c12df97-cc65-43a6-bd78-ff89ea005ad2/content.

[14] Inclusive innovation policies: Lessons from international case studies. *OECD Science, Technology and Industry Working Papers*. 2017. URL: https://read.oecd-ilibrary.org/science-and-technology/inclusive-innovation-policies_a09a3a5d-en#page1.

[15] The impact of technology-push and demand-pull policies on technical change – Does the locus of policies matter? *Research Policy*. 2012. Vol. 41, no. 8. P. 1296–1308. https://doi.org/10.1016/j.respol.2012.02.004

in chip development[16] . However, the Soviet Union did not purchase technology, but used its best spies and intelligence officers to gain illegal access to innovations from the US Silicon Valley. It is because of this distortion of the "use" strategy that the Soviet Union was never able to catch up with the United States in the field of semiconductors.

According to another classification, researchers also distinguish policy types by the degree of regulation: technology-push policy and demand-pull policy. They are based on two relevant theories to explain technological change that emerged in the 1950s and 1960s[13]. This classification is important for selecting the right instruments for implementing innovation policy, which we will discuss later.

- Technological promotion policies include those government measures that aim to increase the supply of new technologies by directly promoting progress in science and technology. These policies are implemented as public funding for research and development (R&D) and can directly mitigate underinvestment in innovation.
- Demand-side policies are based on the hypothesis that anticipated market demand is a key driver of technological change, stimulating research in new directions. Demand-side policies include all government measures to stimulate innovation and accelerate the diffusion of innovation by increasing the demand for innovation, defining new functional requirements for products and services, or better articulating demand.

In general, the debate on the right type of innovation policy boils down to the need to combine different types and find the right balance between them, depending on market conditions and innovation policy objectives. When choosing the type of innovation policy, one should take into account the level of economic development of the country, its scientific and technological potential, as well as the problems to be solved through innovation. Those types of innovation policy characterised by a significant role of the state in the development of innovations are designed to compensate for and eliminate the so-called market failures, which are mainly the inability to attract sufficient resources for research and implementation of innovations.

Tools for implementing the state innovation policy

The next stage in the creation of innovation policy is the selection of instruments, as instruments are the means of actual policy implementation. The main task of the state is to select and combine the right instruments for implementing innovation policy that would best stimulate the movement of the gears of the innovation process.

[16] Chris M. Chip war: the quest to dominate the world's most critical technology. Simon & Schuster, Limited, 2022. 651 p.

A significant contribution to the classification of innovation policy instruments was made by Edler and Georgiou, who divide innovation policy instruments into supply-side and demand-side measures[12].

In the first case, those who generate innovations receive support in creating and disseminating innovations, incentives for accelerated implementation of innovations, and are encouraged to cooperate with different types of partners. Typical supply-side incentives include direct (grants, loans, innovation vouchers) and indirect (tax incentives, loan guarantees) financial support, and direct support in the form of accelerators, incubators, science and technology parks, technology centres, etc.

In the second case, the demand for innovation from end users is stimulated. Thus, tools to stimulate demand include public procurement, open innovation, supplier development programmes, and regulatory instruments. It should be added that tax incentive schemes for R&D expenditures are widely used in developed economies. For example, according to a study by KPMG, as of 2021, more than 50 jurisdictions have some form of R&D tax incentives[17]. In general, government support for business innovation is based mainly on supply-side instruments. However, in the last decade, demand-side instruments – primarily public procurement – have become increasingly important. According to an OECD study on strategic innovation procurement covering 35 countries, almost 80 per cent of respondent countries took measures to support innovative procurement in 2017, and 50 per cent were developing an action plan for innovative procurement[18].

Thus, the state has a large number of tools and methods for implementing innovation policy at its disposal. The selection and modification of instruments can be carried out in accordance with the objectives of the innovation policy, the method of implementation and the problems it is aimed at solving.

Indicators of the effectiveness of countries' innovation policy

In addition, it is important to analyse the effectiveness of various innovation policy instruments. Countries can find indicators for assessing the implementation of their innovation programmes from national and international reports, indices and expert reviews. For example, major international organisations such as the World Bank, UNESCO and the OECD have extensive statistical databases on which they calculate relevant

[17] Global R&D incentives guide. KPMG. 2022. URL: https://tax.kpmg.us/content/dam/tax/en/pdfs/2021/global-rd-incentives-guide.pdf.

[18] Public procurement for innovation. OECD, 2017. https://doi.org/10.1787/9789264265820-en

science and technology indicators. A separate statistical release of the OECD comparing countries by 66 indicators is devoted to the main S&T indicators[19].

The effectiveness of innovation policy at the macro level can also be assessed using global indices, comparing the country's progress in the ranking. The most well-known indices include the following: Global Innovation Index[20], Global Competitiveness Index[21], European Innovation Scoreboard [22], Frontier Technology Readiness Index[23]. In general, the indicators used to calculate the integrated index score usually relate to many areas, including education and the legal environment, which allow for a comprehensive assessment of the impact and effectiveness of innovation policy and its individual instruments.

Enterprises are also a valuable source of information on the effectiveness of the instruments applied, as they directly receive government incentives and participate in government programmes, so the government needs to conduct innovation surveys at the micro level. For example, a set of guidelines for measuring innovation known as the Oslo Manual offers a consistent framework for surveys to ensure their comparability and quality[24].

In summary, the system of innovation policy performance indicators is important not only for assessing the final results, but also for monitoring, adjusting and making decisions on the continuation or termination of innovation policy.

The practice of implementing state innovation programmes in countries around the world and their impact on national competitiveness

As we have already established, in the modern world, innovation is one of the key factors in a country's economic prosperity. Countries that invest in research and innovation gain an advantage in the international market and increase the competitiveness of their enterprises. To this end, many countries are implementing government innovation programmes to stimulate the development of new technologies and accelerate their introduction into production.

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[19] Main Science and Technology Indicators. Vol. 2022, iss. 1. 2022. OECD. https://www.oecd-ilibrary.org/deliver/4db08ff0-en.pdf?itemId= %2Fcontent %2Fpublication %2F4db08ff0-en&mimeType=pdf.

[20] Global Innovation Index 2022. WIPO. URL: https://www.wipo.int/edocs/pubdocs/en/wipo-pub-2000-2022-en-main-report-global-innovation-index-2022-15th-edition.pdf.

[21] Global competitiveness report special edition 2020: how countries are performing on the road to recovery. WEF. 2020. URL: https://www.weforum.org/reports/the-global-competitiveness-report-2020/.

[22] European Innovation Scoreboard 2022 – Methodology Report. *European Commission*. 2022. URL: https://research-and-innovation.ec.europa.eu/system/files/2022-09/ec_rtd_eis-2022-methodology-report.pdf.

[23] Technology and innovation report. UNCTAD. 2021. URL: https://unctad.org/system/files/official-document/tir2020_en.pdf.

[24] Oslo Manual 2018 – guidelines for collecting, reporting and using data on innovation. The measurement of scientific, technological and innovation activities. OECD. URL: https://www.oecd-ilibrary.org/deliver/ 9789264304604- en.pdf?itemId=/content/publication/9789264304604-en&mimeType=pdf

To begin with, let's rank the countries of the world by state funding of R&D (Fig. 1.1). Thus, according to OECD R&D tax incentives database, the largest state support for R&D in 2019 was received by enterprises of the terrorist state of Russia – 0.47 per cent of GDP[25]. At the same time, support is provided primarily through direct state funding of enterprises' R&D expenditures. In contrast, most other countries from Fig. 1 stimulate increased spending on R&D by introducing tax incentives. For example, in the top four developed countries – the UK, France, and Belgium – tax incentives account for more than 70 per cent of public R&D funding.

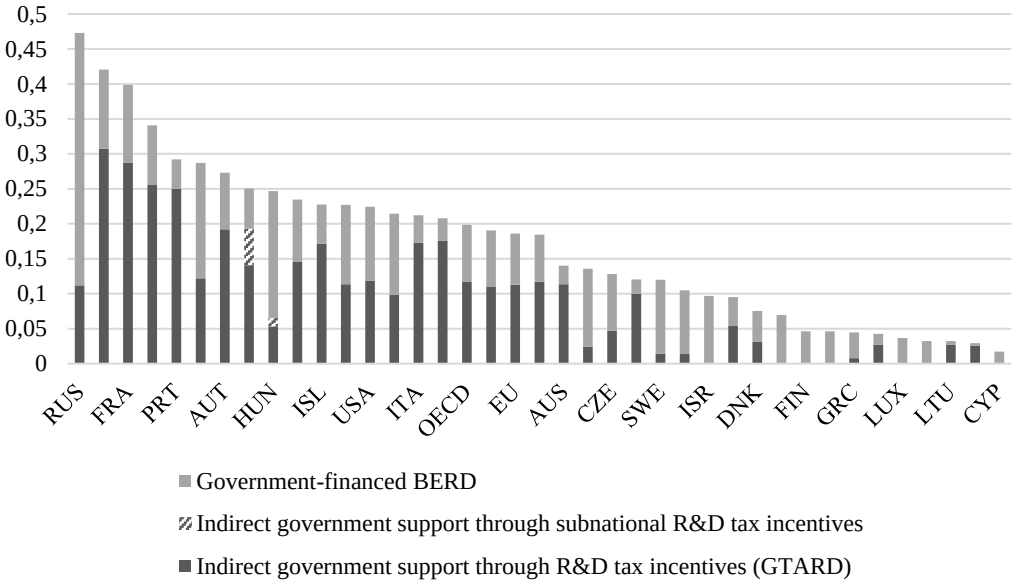

Figure 1. Government tax incentives and direct financing of R&D expenditures in 2019 (per cent of GDP)

Source: compiled by the author based on data from[25]

It is also worth noting the tendency to change the mechanisms of state R&D funding. For example, the mechanism of tax incentives has been used much more frequently in recent years, almost doubling since 2007. This trend

[25] OECD R&D tax incentives database. URL: https://data-explorer.oecd.org/vis?df[ds]=dsDisseminateFinalDMZ&df[id]=DSD_RDTAX %40DF_RDTAX&df[ag]=OECD.STI.STP&df[vs]=1.0&pd=2015 %2C&dq=.A..PT_B1GQ..&to[TIME_PERIOD]=false&ly[rw]=REF_AREA&ly[cl]=TIME_PERIOD&ly[rs]=MEASURE&lc=en&pg=0

is also illustrated by the fact that in OECD countries, tax incentives for R&D in 2021 accounted for about 60 per cent of total government support for business R&D, compared to 36 per cent in 2006[26]. At the same time, the share of direct government funding of R&D expenditures has decreased, reaching about 80 per cent of the 2007 level in 2020.

It is also noteworthy that the number of countries that have applied tax incentives to stimulate R&D for the first time is increasing: Germany in 2020 and Finland in 2021[25].

In general, this trend can be explained by governments trying to encourage companies to invest more in R&D and to promote market mechanisms over government intervention. In addition, tax incentives are better at ensuring a level playing field for all companies, as direct funding is usually channelled to selected projects or industries.

In this article, we will analyse in more detail the practice of implementing state innovation programmes in three countries – Germany, the United States and China – and consider the impact of these programmes on the competitiveness of companies in the countries under study.

For example, according to the Global Innovation Index[20], the United States ranks 2nd in the ranking, behind Switzerland, Germany ranks 8th, and China is 11th.

Starting with the US analysis, it is worth noting that we found that innovation policy is aimed at securing leadership in the semiconductor industry and in the military. The United States is the OECD country with the largest budgetary support for defence R&D as a percentage of GDP (approximately 0.4 per cent of GDP), and the US Department of Defence receives the largest share of funding from government innovation support programmes – 48 per cent of total funding in 2019[27].

The study showed that such significant amounts of investment by the US government in innovation programmes have a high return and multiplier effect on related industries. For example, according to the US Department of Defence's report on the national economic impact of SBIR/STTR innovation grant programmes in 1995–2018, the return on investment in these programmes was 22:1, meaning that for every dollar invested, another 22 dollars were created in related industries. In general, the total impact of the programmes, together with related industries, was over USD 347 billion. The total impact of the programmes, together with related industries, was over USD 347 billion. Other important outcomes include the creation or support of 1.5 million jobs over 23 years, with total labour income of USD111 billion[28].

[26] OECD science, technology and innovation outlook 2023. OECD. https://doi.org/10.1787/0b55736e-en
[27] SBIR/STTR Annual Report. SBIR.gov. 2019. URL: https://www.sbir.gov/annual-reports-files.
[28] Economic Impact Report. SBIR.gov. 2019. URL: https://www.sbir.gov/impact.

It is worth noting that the United States is ranked first in the Military Power Ranking 2023[29]. A small part behind the competitiveness of the US military industry is chips, as they are an integral element in the manufacturing process of modern military equipment. Since the 1990s, the US semiconductor industry has been a leader in global chip sales. Thus, according to the Semiconductor Industry Association, the US share of the semiconductor market was 46 per cent in 2021[30]. Semiconductor exports from the United States in 2021 totalled USD 62 billion. This is the fourth largest export of the US after aircraft, refined and crude oil.

For our work, it is important that R&D spending in the US semiconductor industry is consistently high (USD 50.2 billion in 2021), reflecting the link between US market leadership and continuous innovation[29].

It is also important to emphasise that the US semiconductor industry retains market leadership in those activities that are most intensive in research and development. For example, the US accounts for 72 per cent of the development of electronic design automation software and intellectual property cores, as well as 42 per cent of manufacturing equipment[29].

The importance of the semiconductor industry in the context of innovative development is also confirmed by the fact that in August 2022, the US Congress passed the CHIPS and Science Act, which provides for the allocation of more than USD 52 billion. USD for research, development and production in the field of semiconductors[31]. As for indirect financial instruments, the Law provides for a 25 per cent investment tax credit covering capital expenditures for the production of semiconductors and related equipment[32] . Regulatory instruments have also become an important tool for implementing the US innovation policy: the Biden administration has imposed a number of export restrictions against China, banning the export of advanced chips, advanced software, and the latest US equipment for the production of chips and their components[33].

In view of the above-mentioned US measures aimed at limiting China's innovative development in the semiconductor industry, the Chinese government needs to work on strengthening its domestic capacity for innovation and overcome institutional obstacles. The desire to establish the

[29] Military strength ranking. Global Firepower. 2023. URL: https://www.globalfirepower.com/countries-listing.php.

[30] State of the U.S. semiconductor industry. Semiconductor Industry Association. 2022. URL: https://www.semiconductors.org/wp-content/uploads/2022/11/SIA_State-of-Industry-Report_Nov-2022.pdf.

[31] Fact sheet: CHIPS and science act will lower costs, create jobs, strengthen supply chains, and counter China. The White House. 2022. URL: https://www.whitehouse.gov/briefing-room/statements-releases/2022/08/09/fact-sheet-chips-and-science-act-will-lower-costs-create-jobs-strengthen-supply-chains-and-counter-china/.

[32] American semiconductor research: leadership through innovation. Semiconductor Industry Association. 2022. URL: https://www.semiconductors.org/wp-content/uploads/2022/11/American-Semiconductor-Research-Rep.

[33] Commerce implements new export controls on advanced computing and semiconductor manufacturing items to the People's Republic of China (PRC). Bureau of Industry and Security. 2022. URL: https://www.bis.doc.gov/index.php/documents/about-bis/newsroom/press-releases/3158-2022-10-07-bis-press-release-advanced-computing-and-semiconductor-manufacturing-controls-final/file.

country's self-sufficiency in innovation is reflected in the roadmap of the Made in China 2025 programme. It is worth noting that the Chinese government spends a lot of money to implement this programme – the total amount of grants allocated reached about 100 billion yuan in 2020 (approximately 15 billion US dollars)[34]. However, the study found that a large share of the technologies associated with the "Made in China 2025" initiative was imported from other countries, and the purchase of such technologies was made by state-owned enterprises. For example, in 2016, about 35 billion euros were spent on the purchase of technologies from Europe[35]. The flip side of such state planning of innovation development is also the spread of the practice of so-called "paper mills", where scientific publications are stamped out to fulfil the plan and achieve targets[36] . However, one should not lose sight of the fact that, according to the World Intellectual Property Organisation, China still ranked first in terms of the number of patent applications in 2022, ahead of the United States and Germany in 2nd and 5th place respectively[37].

Among other things, to implement the "Made in China 2025" programme, China's central and local governments use a wide range of tools[38]: subsidies, grants, standards, creation of state investment funds, support from local authorities, technology investments abroad, mergers of state-owned enterprises, public-private partnerships, forced technology transfer in exchange for market access, restrictions on market access and public procurement for foreign-invested enterprises. In addition, China's Ministry of Commerce and Ministry of Science and Technology have created a Catalogue of technologies whose exports are prohibited or restricted, including drone technology, 3D printing and a range of cyber technologies[39].

Returning to the issue of chips and the semiconductor industry, China's own chip production is significantly inferior to the volume of imported chips, which shows the country's dependence in this area. Thus, in 2021, chip imports to the country were at 635.5 billion units[40], and domestic production

[34] Kawase K. Made in China 2025 plan thrives with subsidies for tech and EV makers. Financial Times. URL: https://www.ft.com/content/f7df0f64-25b5-4526-82fa-ca1b554b541b

[35] China manufacturing 2025. European Chamber. 2017. URL: http://docs.dpaq.de/12007-european_chamber_cm2025-en.pdf.

[36] Olcott E., Smith A., Cookson C. China's fake science industry: how 'paper mills' threaten progress. Financial Times. 2023. URL: https://www.ft.com/content/32440f74-7804-4637-a662-6cdc8f3fba86

[37] World intellectual property indicators 2022. WIPO. URL: https://www.wipo.int/edocs/pubdocs/en/wipo-pub-941-2022-en-world-intellectual-property-indicators-2022.pd.

[38] China manufacturing 2025. European Chamber. 2017. URL: http://docs.dpaq.de/12007-european_chamber_cm2025-en.pdf.

[39] Innovation Policy Reform – The China Dashboard Winter 2021. Asia Society Policy Institute. URL: https://chinadashboard.gist.asiasociety.org/winter-2021/page/innovation.

[40] China: number of imported integrated circuits 2021. Statista. URL: https://www.statista.com/statistics/1272761/china-integrated-circuit-import-volume/.

was slightly more than half of the imports – 359.4 billion units[41]. It is also worth noting that China has a problem with attracting foreign specialists for research[42]. To solve this problem, the Chinese government has created more than 200 recruitment programmes, the most famous of which is the One Thousand Talents Plan, as well as about 600 talent recruitment workstations in technologically advanced countries.

In Germany, its innovation policy is based on comprehensive support for small and medium-sized businesses in creating innovations through the programme "From Idea to Market Success", which covers various stages of the innovation process and aims to accelerate the transfer of technologies to the market. Through this government programme, Germany comprehensively supports innovative companies in terms of financing, advice, intellectual property protection and access to infrastructure. Germany uses a wide range of instruments to implement its innovation policy, including financial, regulatory and soft instruments. For example, Germany's total R&D expenditures as a percentage of GDP have been on an upward trend year on year, amounting to 3.14 per cent in 2020[43]. The dominant instrument for implementing innovation policy is direct R&D funding in the form of joint grants for consortia that bring together participants in public research and industry[44]. However, Germany also applies tax incentives for R&D in the form of tax breaks in the amount of 25 per cent of R&D personnel costs for in-house research, and 60 per cent of the contracted research[45].

In addition to direct financial assistance, the programme provides an innovation-friendly ecosystem that includes a quality education system, infrastructure and legal environment by ensuring a sufficient number of skilled workers, protecting intellectual property and setting standards for products and services, and by using the technical and economic infrastructure of research institutions[46]. For example, Germany ranks third in terms of the number of clusters (10 clusters) included in the 100 largest science and technology clusters, behind only the United States (21 clusters) and China (21 clusters)[20].

It is also worth noting that Germany has one of the highest levels of permanent research capacity in the world, with more than 750,000 full-time

[41] China: integrated circuit production volume 2021. Statista. URL: https://www.statista.com/statistics/873438/china-integrated-circuit-production-volume/.

[42] Lee K.-F. AI Superpowers: China, Silicon Valley, and the New World Order. Houghton Mifflin Harcourt Trade & Reference Publishers, 2019. 272 p

[43] Research and development expenditure (% of GDP) – Germany. World Bank Open Data. URL: https://data.worldbank.org/indicator/GB.XPD.RSDV.GD.ZS?locations=DE &view=chart

[44] OECD Reviews of Innovation Policy: Germany 2022. OECD. https://doi.org/10.1787/50b32331-en

[45] Germany: Guidance on research allowance granted as R&D tax incentive. KPMG. 2022. URL: https://kpmg.com/us/en/home/insights/2022/01/tnf-germany-guidance-on-research-allowance-granted-as-r-and-tax-incentive.html.

[46] Innovation policy. BMWK. URL: https://www.bmwk.de/Redaktion/EN/Dossier/innovation-policy.html.

researchers[47]. In the European Union, Germany is the leader in this indicator, but on the global stage, it is ahead of China, the United States and Japan.

Finally, we will analyse the impact of innovation policy on the competitiveness of the analysed countries according to the Global Competitiveness Index by the World Economic Forum (WEF). Thus, according to the latest edition of the Global Competitiveness Index in 2019, the United States ranked 2nd, Germany – 7th, and China – 28th [21]. A closer look at the indicators of innovation ecosystem development (Fig. 2) shows that China lags behind the United States and Germany in all respects.

The largest gap is in interaction and diversity, which includes the diversity of the workforce, the state of cluster development, international joint inventions per million people, and multi-stakeholder collaboration in innovation. The largest contribution to the US and Germany's integrated competitiveness score came from research and development: 100 points for the number of scientific articles and the importance of research institutions.

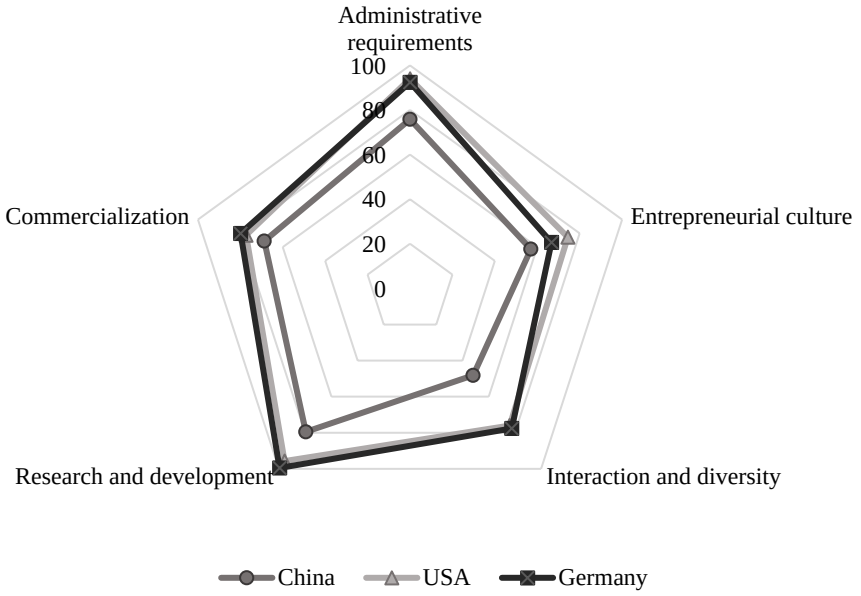

Figure 2. Innovation ecosystem development indicators according to the Global Competitiveness Index 2019

Source: compiled by the author based on data from[21]

[47] R&D personnel by sector of performance, professional position and sex. Eurostat. URL: https://ec.europa.eu/eurostat/databrowser/view/rd_p_persocc/default/table?la ng=en

Problems of formation and implementation of innovation policy in Ukraine

As it has been proved in the previous sections, the innovation policy of countries contributes to maintaining their national competitiveness. In this context, it is worth considering the innovation policy of Ukraine and identifying the problems that hinder its successful formation and implementation.

To begin with, let's look at the Global Innovation Index indicators to assess the state of Ukraine's innovation development in general. Thus, in 2018, Ukraine was ranked 43rd in the Global Innovation Index, and since then it has only been losing ground. In 2022, Ukraine ranked 57th in the ranking, which is the worst result in the last 5 years, and the downward trend in the ranking has been stable since 2020[20].

In addition, in terms of sub-indices, Ukraine has low scores for all indicators, which do not even exceed 50 points out of 100 (Fig. 3). The weakest links in innovation development in terms of the number of points are creative results, market development and business development. If we look at the ranking, Ukraine ranks 102nd in the world out of 132 in market development, 97th in institutional development, and 83rd in infrastructure. Therefore, we can conclude that there are institutional and infrastructural barriers to innovation in Ukraine as a basis for the formation of an innovative environment, as well as insufficient market development, which is a source of investment and credit, as well as demand for innovation.

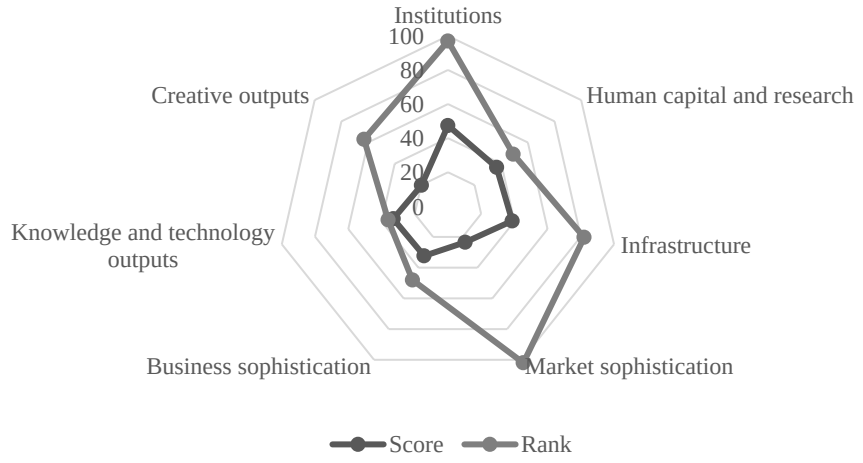

Figure 3. Sub-indices of indicators in the Global Innovation Index ranking for Ukraine, 2022

Source: compiled by the author based on data from[20]

One of the most acute problems in the implementation of Ukraine's innovation policy is insufficient funding for R&D. According to the State Statistics Service, Ukraine's total expenditures on innovation activities of industrial enterprises in 2020 amounted to only UAH 14.4 billion, which is 0.34 per cent of GDP[48], and according to the World Bank, Ukraine's R&D expenditures amounted to 0.41 per cent of GDP[49]. In terms of sources of funding for industrial enterprises' innovation activities, the lion's share of funds comes from the enterprises themselves, while the state budget did not exceed 6 per cent of the total funding in 2014–2020. In relation to GDP, state budget funds did not even reach 0.3 per cent[47].

Among the problems of financing Ukraine's innovative development are the low development of the Ukrainian stock market and insufficient investment in innovative projects. The capitalisation of the Ukrainian market was only 4.3 per cent of GDP in 2022, while for the US this figure was 166.7 per cent[20]. Ukraine also lags behind in terms of venture capital investment in technology startups, which is an important tool for financing innovative projects. Thus, in 2021, Ukrainian startups raised USD 779.6 million. USD, showing an increase of 46 per cent compared to 2020[50]. However, compared to highly developed countries, this is a rather small amount, given that 61 per cent of investments were made by 5 companies.

A separate issue of Ukraine's innovative development is the readiness of Ukrainian companies to implement innovations. For a deeper analysis of this issue, let's look at the results of the Innovation Index 2021 from the Mind business portal. Thus, the ranking is headed by such companies as Privatbank, Silpo Food, Agroprosperis, Nova Poshta, and Kyivstar[51]. However, it should be noted that these companies can afford to finance and develop innovative projects. As for small businesses, the work of their innovation units is limited to the digitalisation of document flow, as the introduction of more significant innovations is a rather costly process.

It should be added that, in addition to financing problems, micro and medium-sized enterprises are not ready to innovate due to a lack of knowledge. For example, according to a 2020 survey conducted by the Ministry of Education and Science of Ukraine in cooperation with the Ministry of Digital Transformation, 86 per cent of respondents indicated the

[48] Economic statistics / Science, technology and innovation. State Statistics Service of Ukraine. URL: https://ukrstat.gov.ua/operativ/menu/menu_u/ni.htm.

[49] Research and development expenditure (% of GDP) – Ukraine. World Bank Open Data. URL: https://data.worldbank.org/indicator/GB.XPD.RSDV.GD.ZS?locations=UA.

[50] Ukraine Deal Review 2021. Kreston Ukraine. URL: https://kreston.ua/wp-content/uploads/2022/05/Ukraine-Deal-review.pdf.

[51] Mind Disrupt Innovation Index 2021: which Ukrainian agribusiness companies are ready to become innovative. Mind. URL: https://mind.ua/publications/20234607-mind-disrupt-innovation-index-2021-yaki-kompaniyi-ukrayinskogo-apk-gotovi-stati-innovacijnimi

need for additional training in innovation management, technology transfer, digital skills, and intellectual property rights protection[52].

One important aspect for our study is the impact of the Ukrainian government on the development of innovation potential. For example, the most successful projects include the creation of "Diia.City", which is an alternative version of special economic zones in the IT sector. The goal of this project from the Ministry of Digital Transformation is to create a favourable ecosystem for the development of the IT sector and attract venture capital investment in this area. For Diia.City residents, the government offers a number of tax benefits, including the possibility of applying a 9 per cent corporate tax on withdrawn capital instead of the 18 per cent income tax. For investors, there are tax rebates in the amount of investments in Ukrainian startups and 0 per cent on dividend income, provided that they are paid no more than once every 2 years[53]. The effectiveness and attractiveness of this project is proved by the fact that as of 2023, more than 530 companies have already become residents of Diia.City, including Revolut, monobank, Rozetka, EPAM, MacPaw, and many others.

For our study, it is also important to analyse the state of Ukraine's innovation infrastructure as an integral component of the innovation ecosystem and a driver of innovation development. Let's start with technology parks, which are usually centres of research and innovation generation. In Ukraine, only 16 technoparks are officially registered (4 of which are still undergoing the registration process)[54]. Since 2008, not a single new technology park has been registered in Ukraine, which is partly due to the burdensome bureaucratic procedures provided for in the CMU Resolution "Some Issues of Organising the Activities of Technology Parks"[55] and the Law of Ukraine "On the Special Regime of Innovation Activities of Technology Parks"[56]. In addition, despite the fact that the Law provides for the allocation of financial assistance from the state budget, there is no actual data on the funding of technology parks.

In 2021, Ukrainian officials tried to resume the development of technology parks and industrial parks by amending the Law on Industrial Parks. For example, the founders of industrial parks are to be compensated up to 50 per

[52] Survey of business representatives on innovation activities and current R&D needs. Ministry of Education and Science of Ukraine. 2020. URL: https://mon.gov.ua/storage/app/media/innovatsii- transfer- tehnologiy/2020/08/28.08/opituvannya-28-08-2020.pdf

[53] Diia.City. URL: https://city.diia.gov.ua.

[54] Technology parks. Ministry of Education and Science of Ukraine. URL: https://mon.gov.ua/ua/nauka/innovacijna-diyalnist-ta-transfer-tehnologij/tehnologichni-parki.

[55] Some issues of organising the activities of technology parks: Resolution of the Cabinet of Ministers of Ukraine of 29 November 2006. of Ministers of Ukraine dated 29.11.2006 No. 1657: as of 14 November. 2019 URL: https://zakon.rada.gov.ua/laws/show/1657-2006-п#Text

[56] On special regime of innovation activity of technological parks: Law of Ukraine of 16.07.1999 No. 991-XIV: as of 5 December 2012. 2012 p. URL: https://zakon.rada.gov.ua/laws/show/991-14#Text.

cent of the costs of connecting to the power grid, and companies operating in the parks are to be compensated for loan payments[57]. However, it is worth noting that the Law and new draft government resolutions do not specify any specific amounts to be allocated for financing technology parks or sources of funds. In this situation, there is still hope for multinational companies, which, in addition to investments, opened 8 R&D centres and 2 engineering hubs in 2021[49]. Thus, the problem of innovation infrastructure development is related to the chronic lack of public funding.

Human capital is also an integral element that shapes Ukraine's innovation potential, and its development should be taken into account when formulating and implementing innovation policy. The trend observed over the past decades indicates a chronic brain drain problem, which results in a decrease in the number of researchers in Ukraine. Thus, according to UNESCO, the number of researchers per million people in Ukraine has almost halved from 1006 in 2015 to 587 in 2021[58]. Unfortunately, the war has only contributed to the problem, as of July 2022, the scientific journal Nature reported 22,000 Ukrainian scientists, or almost a quarter of researchers, who fled the country because of the war[59].

However, it is worth noting the strengthening of ties between Ukrainian and Polish scientists, as many refugee scientists and students have been accepted to Polish research institutions. Poland is the country's leading partner in research, as 30 per cent of scientific publications were co-authored by Polish scientists, while the share of Russia as a co-author of Ukrainian scientific publications has dropped significantly since the outbreak of the war[58].

As for the measures aimed at returning scientists to Ukraine, based on China's experience, we can conclude that Ukraine is unlikely to have much success in their implementation. With significant financial incentives, China was able to attract only a small number of scientists, not to mention that Ukraine does not have the funds to conduct such recruitment programmes. On the other hand, it should also be noted that the government is taking steps to foster an entrepreneurial spirit in university circles. For example, at the initiative of the Ministry of Digital Transformation, a new discipline was added to 85 universities – "Innovative Entrepreneurship and Startup Project Management"[60].

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[57] Innovation parks: what they are and where they will be created in Ukraine. Word and Deed. URL: https://www.slovoidilo.ua/2021/04/16/infografika/suspilstvo/innovaczijni-parky-ce-vony-budut-stvoreni-ukrayini.

[58] Researchers (in full-time equivalent) per million inhabitants. UIS Statistics. URL: http://data.uis.unesco.org/index.aspx?queryid=3685.

[59] Seven ways the war in Ukraine is changing global science / N. Gaind et al. Nature. 2022. Vol. 607, no. 7919. P. 440–443. https://doi.org/10.1038/d41586-022-01960-0

[60] A new discipline "Innovative Entrepreneurship and Management of Startup Projects" will be taught in 85 universities. Ministry of Digital Transformation of Ukraine. URL: https://thedigital.gov.ua/news/u-85-vishakh-vikladatimut-novu-distsiplinu-innovatsiyne-pidpriemnitstvo-ta-upravlinnya-startap-proektami.

Finally, let us consider the Strategy for the Development of the Innovation Sector until 2030 from the Cabinet of Ministers of Ukraine, according to which there is an urgent need to improve legislation and innovation infrastructure, as well as to create networks for the professional development of employees of scientific institutions[61]. However, the Strategy does not specify any specific implementation programmes. There are also no coordination mechanisms between ministries and other government agencies that should be responsible for implementing the Strategy.

In addition, given the problems associated with the implementation of innovation policy, the prospect of achieving the Strategy's targets looks rather unrealistic: by 2030, 3 per cent of GDP for research and development, 10 per cent of innovative products in total industrial output, etc.[60]. In general, the Strategy contains rather broad and general goals that are not supported by specific measures to achieve them.

On the other hand, our country may have a certain amount of optimism about the implementation of post-war reconstruction projects. Thus, according to the Ukraine recovery plan, which was presented in July 2022, our country will need at least USD 750 billion. For rapid reconstruction within 10 years after the end of the war, the country will need at least USD 750 billion[62]. For our study, it is important that most of the points of the plan include the development and stimulation of innovation. For example, it is planned to attract more than USD 50 billion to strengthen Ukraine's defence capabilities. The plan is to raise more than USD 50 billion. Part of these funds will be allocated for the development of new innovative types of weapons, as well as for the creation of accelerators and incubators for the development of military technologies. Even more ambitious is the USD 130 billion project. The project to develop energy independence and participate in the Green Deal is even more ambitious.

To summarise, the following problems in the formation and implementation of Ukraine's innovation policy are worth highlighting: lack of public funding, insufficient attention to measures aimed at increasing investment and improving the investment climate, neglect of the needs of innovation infrastructure, chronic brain drain and the formality of government strategies as part of innovation policy.

Directions for the development of countries' innovation policy as a factor of socio-economic growth

In this section, we take a closer look at innovation through the lens of socio-economic growth. Innovation policy plays an important role in socio-

[61] On approval of the Strategy for the Development of the Innovation Sector for the period up to 2030: Decree. of the Cabinet of of Ministers of Ukraine dated 10.07.2019 No. 526-p. URL: https://zakon.rada.gov.ua/laws/show/526-2019-p#Text.

[62] Ukraine's recovery plan. URL: https://recovery.gov.ua/en.

economic growth, as it helps to create new jobs, improve the quality of life and solve global problems. One of the important aspects of innovation policy development is the involvement of various social groups in the process of creating innovations. For example, the priority areas of the EU Innovation Policy 2021–2027 include ensuring an inclusive European society and empowering all citizens to act in the context of the environmental and digital transition[63].

Another important aspect of innovation policy development is the involvement of women in the process of developing innovations. However, despite countries' attempts to increase the number of women in innovation research, the share of women researchers is still low: 31.2 per cent on average globally and 34.8 per cent in Europe in 2020[64] . In this context, we have identified a number of socio-economic issues that should be taken into account when formulating the innovation policy of any state, including the problems of attracting women, pay inequality, a high proportion of women employed part-time due to the need for childcare, etc.

A related problem in this context is the gender pay gap, defined as the difference between the median earnings of men and women. Thus, according to the OECD, in 2021, the gender gap was 10.6 per cent in the EU and 11.9 per cent for OECD countries[65]. Moreover, the gender pay gap is particularly significant in engineering and computer science (almost 27 per cent), as well as in senior management positions (15 per cent)[66].

In the context of our work, it is also worth considering the issues of sustainable development, which have become an integral part of the formation of innovation policy in countries around the world, as innovations play an important role in the transformations associated with achieving the Sustainable Development Goals. The Sustainable Development Goals (SDGs) are a set of 17 interrelated goals adopted by the United Nations to overcome global challenges such as poverty, inequality, climate change and sustainable development[67]. In this context, innovation is a means of effectively achieving the above goals, so countries should formulate innovation policies in a way that promotes the development of sustainable innovations. One of the key technologies that are promising in achieving zero emissions by 2050 is the technology related to the production of "green hydrogen" as an alternative to traditional fuel and energy resources. For example, Germany presented its National Hydrogen Strategy in 2020, which

[63] Innovation for inclusive green and digital transition. European Investment Bank. URL: https://www.eib.org/attachments/publications/innovation_for_inclusive_gree n_and_digital_transition_en.pdf
[64] UNESCO Institute for Statistics. URL: http://data.uis.unesco.org/.
[65] Gender wage gap. OECD iLibrary. URL: https://www.oecdilibrary.org/employment/gender-wage-gap/indicator/english_7cee77aa-en
[66] It's time to close the gender gap in research. OECD. URL: https://www.oecd.org/gender/data/it-is-time-to-close-the-gender-gap-in-research.htm.
[67] The 17 goals. UN Sustainable Development. URL: https://sdgs.un.org/goals.

envisages the allocation of EUR7 billion for hydrogen research and development and EUR2 billion for international cooperation in the field of hydrogen[43].

In general, there is an upward trend in public funding for research and development in the energy and environment sectors worldwide. For example, in 2020, spending on healthcare and medicine increased significantly (115 per cent of the 2018 level), as well as total public spending on R&D (about 117 per cent of the 2018 level), outpacing the growth in spending on green energy and environmental research[26].

Looking at R&D expenditures in the energy sector, we can see that over the past decade, there has been a trend towards increased public funding for energy efficiency and reduced spending on nuclear power. As of 2021, energy efficiency programmes (USD 6 billion), renewable energy (USD 3.3 billion), and cross-sectoral technologies and research (USD 3.5 billion) are the favourites in the development of new technologies in the energy sector[26]. However, spending on nuclear energy research reached its peak in the late 1970s and early 1980s, reaching 0.07 per cent of the GDP of the IEA member states, which was approximately USD 10–12 billion annually. US dollars annually. However, later the share of these expenditures slightly decreased to the level of 3–6 billion US dollars. US dollars.

In general, innovation policy aimed at stimulating innovation in the field of green energy is a factor of socio-economic growth, as its mission is to ensure national energy security, public health and the future of future generations.

Conclusions

Innovation policy programmes of countries have a positive impact on strengthening national competitiveness, as they result in the formation of competitive advantages of the country in the global market from the possession of innovations, creation and dissemination of scientific knowledge, stimulation of investments and intensification of entrepreneurial activity in innovation-related areas. The role of the government in implementing innovation policy is mainly to overcome market failures related to the problem of attracting resources for innovation, providing innovation infrastructure, protecting intellectual property rights and developing scientific and technological potential.

Using the example of the US innovation programmes, we have identified the multiplier effect of public investment, which leads to an increase in production and employment in related industries. And after analysing China's innovation policy, we concluded that globalisation not only promotes technology transfer and division of labour, but also carries the risk of dependence on imported innovations, intellectual migration and a lack of

self-sufficiency of national innovation actors to develop and implement local innovations.

The problems with the development and implementation of innovation policy in Ukraine reveal much deeper systemic problems, primarily related to the formality of legislation, bureaucratic procedures, unfavourable investment climate and brain drain. Ukraine's innovation strategies and programmes lack clear implementation measures, funding, and consistency. Building on the practice of OECD countries, Ukraine should use more tax incentives to trigger market-based drivers of innovation, and systematise all grant programmes and funds, as Germany has done, for better access and information. We also recommend deepening cooperation of Ukrainian scientists outside Ukraine with Ukrainian research institutions and conducting joint research to mitigate the effect of intellectual migration.

The state innovation policy is an important factor in socio-economic growth by promoting inclusiveness in the innovation sector and following the goals of sustainable development, which involves the creation of technologies designed to increase energy efficiency and environmental friendliness of production, as well as to combat social problems of inequality and inclusion.

**This article was translated from its original in Ukrainian*

References

1. "A new discipline "Innovative entrepreneurship and management of startup projects" was launched in 85 HEIs". *Ministry of digital transformation of Ukraine.* URL: https://thedigital.gov.ua/news/u-85-vishakh-vikladatimut-novu-distsiplinu-innovatsiyne-pidpriemnitstvo-ta-upravlinnya-startap-proektami [In Ukrainian].

2. A Practitioner's Guide to Innovation Policy. Instruments to Build Firm Capabilities and Accelerate Technological Catch-Up in Developing Countries. 2020. Washington, DC: *World Bank*. URL: https://documents1.worldbank.org/curated/en/158861581492462334/pdf/A-Practitioner-s-Guide-to-Innovation-Policy-Instruments-to-Build-Firm-Capabilities-and-Accelerate-Technological-Catch-Up-in-Developing-Countries.pdf.

3. American semiconductor research: leadership through innovation. *Semiconductor Industry Association.* 2022. URL: https://www.semiconductors.org/wp-content/uploads/2022/11/American-Semiconductor-Research-Rep.

4. China manufacturing 2025. *European Chamber*. 2017. URL: http://docs.dpaq.de/12007-european_chamber_cm2025-en.pdf.

5. China: integrated circuit production volume 2021. *Statista*. URL: https://www.statista.com/statistics/873438/china-integrated-circuit-production-volume/.

6. China: number of imported integrated circuits 2021. *Statista*. URL: https://www.statista.com/statistics/1272761/china-integrated-circuit-import-volume/.

7. Chris M. *Chip war: the quest to dominate the world's most critical technology*. Simon & Schuster, Limited, 2022. 651 p.

8. Commerce implements new export controls on advanced computing and semiconductor manufacturing items to the People's Republic of China (PRC). *Bureau Of Industry And Security*. 2022. URL: https://www.bis.doc.gov/index.php/documents/about-bis/newsroom/press-releases/3158-2022-10-07-bis-press-release-advanced-computing-and-semiconductor-manufacturing-controls-final/file.

9. Deiaki pytannia orhanizatsii diialnosti tekhnolohichnykh parkiv: Postanova Kab. Ministriv Ukrainy vid 29.11.2006 r. № 1657: stanom na 14 lystop. 2019 r. URL: https://zakon.rada.gov.ua/laws/show/1657-2006-p#Text [In Ukrainian].

10. Diia.City. URL: https://city.diia.gov.ua [In Ukrainian].

11. Economic Impact Report. *SBIR*. 2019. URL: https://www.sbir.gov/impact.

12. Economic statistics / Science, technology and innovation. *State Statistics Service of Ukraine*. URL: https://ukrstat.gov.ua/operativ/menu/menu_u/ni.htm [In Ukrainian].

13. Edler J., Fagerberg J. Innovation policy: what, why, and how. *Oxford Review of Economic Policy*. 2017. Vol. 33, no. 1. P. 2–23. https://doi.org/10.1093/oxrep/grx001

14. European Innovation Scoreboard 2022 – Methodology Report. *European Commission*. 2022. URL: https://research-and-innovation.ec.europa.eu/system/files/2022-09/ec_rtd_eis-2022-methodology-report.pdf.

15. Fact sheet: CHIPS and science act will lower costs, create jobs, strengthen supply chains, and counter China. *The White House*. 2022. URL: https://www.whitehouse.gov/briefing-room/statements-releases/2022/08/09/fact-sheet-chips-and-science-act-will-lower-costs-create-jobs-strengthen-supply-chains-and-counter-china/.

16. Fact Sheets on the European Union. *European Parliament.* 2023. URL: https://www.europarl.europa.eu/factsheets/en/sheet/67/innovation-policy#:~:text=Innovation per cent20policy per cent20is per cent20the per cent20interface, to per cent20bringing per cent20ideas per cent20to per cent20the per cent20market

17. Fagerberg J. Innovation Policy: Rationales, Lessons and Challenges. *Journal of Economic Surveys*. 2017. №31(2). P. 497–512. URL: https://onlinelibrary.wiley.com/doi/full/10.1111/joes.12164.

18. Gender wage gap. *OECD iLibrary*. URL: https://www.oecdilibrary.org/employment/gender-wage-gap/indicator/english_7cee77aa-en (d

19. Germany: Guidance on research allowance granted as R&D tax incentive. *KPMG*. 2022. URL: https://kpmg.com/us/en/home/insights/2022/01/tnf-germany-guidance-on-research-allowance-granted-as-r-and-tax-incentive.html.

20. Global competitiveness report special edition 2020: how countries are performing on the road to recovery. *WEF*. 2020. URL: https://www.weforum.org/reports/the-global-competitiveness-report-2020/.

21. Global Innovation Index 2022. *WIPO*. URL: https://www.wipo.int/edocs/pubdocs/en/wipo-pub-2000-2022-en-main-report-global-innovation-index-2022-15th-edition.pdf.

22. Global R&D incentives guide. *KPMG*. 2022. URL: https://tax.kpmg.us/content/dam/tax/en/pdfs/2021/global-rd-incentives-guide.pdf.
23. Green E. Innovation: The History of a Buzzword. *The Atlantic*. 2013. URL: https://www.theatlantic.com/business/archive/2013/06/innovation-the-history-of-abuzzword/277067/.
24. Hlibka S. V., Heorhiievskoho Yu. V., Rozghon O. V. *Innovatsiine pravo: naukovo-praktychnyi posibnyk* (Kharkiv: Pravo, 2019), 246–247. URL: https://openarchive.nure.ua/server/api/core/bitstreams/1c12df97-cc65-43a6-bd78-ff89ea005ad2/content [In Ukrainian].
25. Inclusive innovation policies: Lessons from international case studies. *OECD Science, Technology and Industry Working Papers*. 2017. URL: https://read.oecd-ilibrary.org/science-and-technology/inclusive-innovation-policies_a09a3a5d-en#page1.
26. Innovation for inclusive green and digital transition. *European Investment Bank*. URL: https://www.eib.org/attachments/publications/innovation_for_inclusive_gree n_and_digital_transition_en.pdf
27. Innovation Policy Reform – The China Dashboard Winter 2021. *Asia Society Policy Institute*. URL: https://chinadashboard.gist.asiasociety.org/winter-2021/page/innovation.
28. Innovation policy. *BMWK*. URL: https://www.bmwk.de/Redaktion/EN/Dossier/innovation-policy.html.
29. Innovative parks: what is it and where do they start in Ukraine. *Slovo and Dilo*. 2021. URL: https://www.slovoidilo.ua/2021/04/16/infografika/suspilstvo/innovaczijni-parky-ce-vony-budut-stvoreni-ukrayini [In Ukrainian].
30. It's time to close the gender gap in research. *OECD*. URL: https://www.oecd.org/gender/data/it-is-time-to-close-the-gender-gap-in-research.htm.
31. Kawase K. Made in China 2025 plan thrives with subsidies for tech and EV makers. *Financial Times*. URL: https://www.ft.com/content/f7df0f64-25b5-4526-82fa-ca1b554b541b
32. Kushniruk V. *Innovatsiina polityka: opornyi konspekt lektsii* (Mykolaiv: MNAU, 2016), 70-71. URL: http://dspace.mnau.edu.ua/jspui/bitstream/123456789/2277/1/Kushniryk_Innov_polituka.pdf [In Ukrainian].
33. Lee K.-F. *AI Superpowers: China, Silicon Valley, and the New World Order*. Houghton Mifflin Harcourt Trade & Reference Publishers, 2019. 272 p
34. Liberto D. Who Was Joseph Schumpeter, and What Was He Known For? *Investopedia*. 2022. URL: https://www.investopedia.com/terms/j/josephschumpeter.asp.
35. M. Peters et al. The impact of technology-push and demand-pull policies on technical change – Does the locus of policies matter? *Research Policy*. 2012. Vol. 41, no. 8. P. 1296–1308. https://doi.org/10.1016/j.respol.2012.02.004
36. Main Science and Technology Indicators. Vol. 2022, iss. 1. 2022. *OECD*. https://www.oecd-ilibrary.org/deliver/4db08ff0-en.pdf?itemId= per cent2Fcontent per cent2Fpublication per cent2F4db08ff0-en&mimeType=pdf.
37. Military strength ranking. *Global Firepower*. 2023. URL: https://www.globalfirepower.com/countries-listing.php.

38. Mind Disrupt Innovation Index 2021: how Ukrainian app companies are the most innovative. *Mind*. URL: https://mind.ua/publications/20234607-mind-disrupt-innovation-index-2021-yaki-kompaniyi-ukrayinskogo-apk-gotovi-stati-innovacijnimi [In Ukrainian].

39. Mykytiuk P. P., Brych V. Ya., Shkilniak M. M., Mykytiuk Yu. I. *Innovatsiinyi menedzhment* (Ternopil: Ekon. Dumka TKEU, 2019), 518-519. URL: http://dspace.wunu.edu.ua/bitstream/316497/36441/3/ %D0 %9C %D0 %B8 %D0 %BA %D0 %B8 %D1 %82 %D1 %8E %D0 %BA %20 %281 %29.pdf [In Ukrainian].

40. N. Gaind et al. Seven ways the war in Ukraine is changing global science. *Nature*. 2022. Vol. 607, no. 7919. P. 440–443. https://doi.org/10.1038/d41586-022- 01960-0

41. OECD R&D tax incentives database. URL: https://data-explorer.oecd.org/vis?df[ds]=dsDisseminateFinalDMZ&df[id]=DSD_RDTAX %40 DF_RDTAX&df[ag]=OECD.STI.STP&df[vs]=1.0&pd=2015 %2C&dq=.A..PT_B1 GQ..&to[TIME_PERIOD]=false&ly[rw]=REF_AREA&ly[cl]=TIME_PERIOD&l y[rs]=MEASURE&lc=en&pg=0

42. OECD Reviews of Innovation Policy: Germany 2022. *OECD*. https://doi.org/10.1787/50b32331-en

43. OECD science, technology and innovation outlook 2023. *OECD*. https://doi.org/10.1787/0b55736e-en

44. Olcott E., Smith A., Cookson C. China's fake science industry: how 'paper mills' threaten progress. *Financial Times*. 2023. URL: https://www.ft.com/content/32440f74-7804-4637-a662-6cdc8f3fba86

45. On special regimes of innovation activity of technological parks: Zakon Ukrainy vid 16.07.1999 r. No. 991-XIV: stanom na 5 hrud. 2012 r. URL: https://zakon.rada.gov.ua/laws/show/991-14#Text [In Ukrainian].

46. On the development of the Strategy for the sphere of innovation for the period up to 2030: Research. Kab. Ministriv Ukrainy vid 10.07.2019 r. № 526-r. URL: https://zakon.rada.gov.ua/laws/show/526-2019-r#Text [In Ukrainian].

47. Oslo Manual 2018 – guidelines for collecting, reporting and using data on innovation. The measurement of scientific, technological and innovation activities. *OECD*. URL: https://www.oecd-ilibrary.org/deliver/9789264304604-en.pdf?itemId=/content/publication/9789264304604-en&mimeType=pdf.

48. Plan vidnovlennia Ukrainy. URL: https://recovery.gov.ua/en [In Ukrainian].

49. Prodanets V., Kurinna I. Stratehii innovatsiinoho rozvytku dlia Ukrainy. *Economics and management 2017: perspectives of innovation and development.* 2017. Vol. 3, 100 pp. URL: http://confcontact.com/2017-ekonomika-i-menedzhment/EIM_2017_tom3.pdf [In Ukrainian].

50. Public procurement for innovation. *OECD*, 2017. https://doi.org/10.1787/9789264265820-en

51. R&D personnel by sector of performance, professional position and sex. *Eurostat*. URL: https://ec.europa.eu/eurostat/databrowser/view/rd_p_persocc/default/table?lang=en.

52. Research and development expenditure (% of GDP) – Germany. *World Bank Open Data*. URL: https://data.worldbank.org/indicator/GB.XPD.RSDV.GD.ZS?locations=DE&view=chart.

53. Research and development expenditure (% of GDP) – Ukraine. *World Bank Open Data*. URL: https://data.worldbank.org/indicator/GB.XPD.RSDV.GD.ZS?locations=UA.
54. Researchers (in full-time equivalent) per million inhabitants. *UIS Statistics*. URL: http://data.uis.unesco.org/index.aspx?queryid=3685.
55. SBIR/STTR Annual Report. *SBIR*. 2019. URL: https://www.sbir.gov/annual-reports-files.
56. Shvaika, L. A. *Derzhavne rehuliuvannia ekonomiki: navch. posib*. Znannia, 2006. 435 p. URL: http://politics.ellib.org.ua/pages-cat-82.html [In Ukrainian].
57. State of the U.S. semiconductor industry. *Semiconductor Industry Association*. 2022. URL: https://www.semiconductors.org/wp-content/uploads/2022/11/SIA_State-of-Industry-Report_Nov-2022.pdf.
58. Survey of business owners in terms of innovation and actual problems in R&D. *Ministry of Education and Science of Ukraine.* 2020. URL: https://mon.gov.ua/storage/app/media/innovatsii- transfer- tehnologiy/2020/08/28. 08/opituvannya-28-08-2020.pdf [In Ukrainian].
59. Technological parks. *Ministry of Education and Science of Ukraine*. URL: https://mon.gov.ua/ua/nauka/innovacijna-diyalnist-ta-transfer-tehnologij/tehnologichni-parki [In Ukrainian].
60. Technology and innovation report. *UNCTAD*. 2021. URL: https://unctad.org/system/files/official-document/tir2020_en.pdf.
61. The 17 goals. *UN Sustainable Development*. URL: https://sdgs.un.org/goals.
62. Ukraine Deal Review 2021. *Kreston Ukraine*. URL: https://kreston.ua/wp-content/uploads/2022/05/Ukraine-Deal-review.pdf.
63. UNESCO Institute for Statistics. URL: http://data.uis.unesco.org/.
64. World intellectual property indicators 2022. *WIPO*. URL: https://www.wipo.int/edocs/pubdocs/en/wipo-pub-941-2022-en-world-intellectual-property-indicators-2022.pd.

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