RESEARCH AND INNOVATION POLICY AT WARTIME: CASE OF UKRAINE

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Summary

The war started by Russia in Ukraine has caused a lot of challenges for economic development. It is hardly imagined without the contribution of research and innovation. Rebuilding R&I became another challenge for Ukrainian policymakers. Thus, ***the purpose of the paper*** *is to analyse the R&I policy of Ukraine during the war caused by Russia and to develop policy recommendations for the post-war recovery. To achieve it, we used several methods, in particular expert opinion generalization, relevant scientific and policy literature analysis, and statistical analysis.*

The paper considers three approaches to innovation policy, that Ukraine could choose as a response to the war: produce; buy; repurpose. Currently, Ukraine uses mainly the second one, by buying and receiving modern armament and equipment. Meanwhile, there were some innovative developments in Ukraine, which are not produced in sufficient quantities. After the war, Ukraine couldn't buy armament due to fiscal constraints. Thus, in the short-run period, the government should reorient efforts using repurpose approach. However, such an approach is not sustainable in the long-run period, when the development of a broader S&T base is required to create a solid base for further repurposing in emergency cases. The war caused massive damage to Ukrainian R&I potential, which by now is not fully measured and quantified. There are two types of damage: physical loss of research and innovation infrastructure (e.g. research facilities, and high-tech enterprises) and «brain drain», which should be at the focus of R&I policymakers. Therefore, a set of policy measures is proposed to address the war-led challenges in R&I.

Keywords: *R&D and innovation policy, science, war, damage, recovering, economic development.*

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Introduction. The war started by Russia in Ukraine has caused a lot of challenges for economic development. It is hardly imagined without the contribution of research and innovation. Rebuilding R&I became another challenge for Ukrainian policymakers. Thus, **the purpose of the paper** is to analyze the R&I policy of

Ukraine during the war caused by Russia and to develop policy recommendations for the postwar recovery.

Literature review. Despite there being a bulk of war conflicts in the world during the last century, it is impossible to identify a proper benchmark for research and innovation policy for Ukraine. Thus, we have to analyse different experience and take key messages and approaches to rebuild our own R&I policy and design effective measures. There is an objective reason for that as wars took place in different time periods, conditions, size and economic structure of countries vary a lot, etc.

However, the common approach for R&I policy is the acknowledgment of the crucial role of science and technology in war and post-war recovery. Mobilizing science during WWII in the US "...had large effects on the direction and location of U.S. invention and high-tech industrial employment, setting in motion agglomeration forces which shaped the technology clusters of the post-war era" (Gross & Sampat, 2020). Duy Dung Thin stated that S&T output was considered by the Vietnamese government as a tool for hunger and poverty elimination within a short period of time and for economic restoration (Meske & Thin (eds), 2000).

Stimulation of innovation is a part R&I policy, development of which is not a trivial task during wartime. There was a paper by Leadbeater C. (2020), a NESTA expert, where he analysed three approaches to R&I policy at crisis: produce, purchase and repurpose. Each approach has pros and cons, but none of them is sustainable for a longer period of time. Policymakers should activate purchase and repurpose as an immediate crisis response.

Ukrainian scholars didn't pay a lot of attention to R&I policy-making during crisis times. Whereas most of studies on R&I policy were focused on the issue of intensification interaction between science and business, designing policy mix to stimulation innovations, rebuilding research system, etc.

Research methodology. To achieve the main purpose of the paper, we used several methods, in particular expert opinion generalization, relevant scientific and policy literature analysis, and statistical analysis.

Main results. Before the war in February 2022, Ukraine had 2nd rank by area and 9th rank by the population in Europe. However, its economic performance was rather poor. The GDP level is lower than it was before the independence in 1991, while the economic development is not sustainable. In 2021, GDP per capita was about 4100 Euro, and real GDP growth was 3.4%. It makes Ukraine a low-middle-income country.

The unsuccessful economic development of Ukraine was accompanied by transformation of research and innovation systems. There were a number of attempts to use innovation policy tools and incentives, but their outcomes were not quite good as overall business conditions were rather bad.

The war exacerbated existing problems in the economy and brought massive damage to economic process. According to a number of studies and forecasts, fall of real GDP of Ukraine is expected in between 35 and 50% (Korablin S., 2022). Such a wide range of estimation is associated with high uncertainty in war duration and damages to infrastructure, including industrial as well as different methodological approaches.

It is obvious that simple rebuilding of the economy will not be enough for sustainable development. Moreover, as Ukraine became a candidate for the EU membership, it forces Ukraine to accelerate processes of integration into the EU value-added chains, digital and green transformation within the tremendous changes in human resources and limited access to capital.

It should be noted that Ukraine has not got a successful experience in directed structural transformations and innovation-based growth support. In recent pre-war, there was a demand for reforming R&I policy, as science and research are the main sources of innovations (Mazzucato & Dibb, 2020).

In 2015 the new law on S&T activity was adopted. But it did not lead to the expected results, as the law provisions were not properly addressed in the government activities, e.g. creation of the National Research Fund was very long and didn't support its activity with sufficient financing. Despite the Law, the research intensity of GDP dropped from 0.48 to 0.43% during 2016-2020 (Ukrstat, 2021a). It seriously limits researchers in their abilities to produce effective solutions to solve urgent problems during wartime and in post-war period.

On the side of innovations, the new law is still under development. However, the government developed so called the National Innovation Strategy 2030. It was aimed at enabling and promoting scientific research and the transformation of innovative ideas into commercial solutions more broadly. The implementation of the strategy should address gaps in legal frameworks, improve education and fortify an entrepreneurial culture, and strengthen the national innovation infrastructure. Other objectives are to promote private R&D and boost demand for innovation (UNECE, 2020). However, Ukraine repeats the same mistake – good ideas with poor (or wrong) implementation. The Action plan for the Strategy was not developed in time and it was approved only more than 1 year after the Strategy adoption. One of the reasons is that the civil service has no specific training in drafting policy (UNECE, 2020). In other words, the ministry staff, even those who joined the Ministry within the public government reform, lacks of skills in policy drafting.

To summarize the weakest points of innovation policy, we used the UNECE experts' assessment. According to them, there are poor coordination and complementarities with SME development and industrial policies, inadequate institutional and legal frameworks, and miscoordination at the central government level (and we can add at regional level too). Also, in the context of innovation policy tools, there were any subdomains where Ukraine got higher scores, while the biggest challenge is supporting relations and linkages between science and industry. It should include clusters, business networks, innovation infrastructure, mobility, etc.

According to the latest data, the innovation activity of enterprises dropped to less than 10% in 2018-2020 (Ukrstat, 2021b). The main factor was the tremendous drop in reporting non-technology innovations, while implementation of technology innovations decreased slightly due to COVID-19 induced financial constraints. We also could assume that enterprise representatives who fill in statistical questionnaires are not fully aware of what innovation is.

In the 2022 Global Innovation Index, Ukraine ranked 57th out of 132 economies in terms of innovation performance (GII, 2022). The poor performance

was in the area of market sophistication, institutions, and infrastructure. So, the R&I policy making should be focused on (UNECE, 2020):

- Increase the share of high-tech and medium-high-tech goods in total manufacturing;
- Increase public and private investment in R&D, strengthen industry–science linkages, and encourage technology upgrading;
- Commercialize more innovative ideas by stimulating demand in the domestic market.

The war, obviously, did not only exacerbate existing problems, but created new challenges in the R&I area. It caused massive damage to Ukrainian R&I potential, which by now is not fully measured and quantified.

There are two types of damage: physical loss of research and innovation infrastructure (e.g. research facilities, and high-tech enterprises) and «brain drain», which should be in the focus of R&I policymakers.

The latter one is the most dangerous for post-war recovery. Unlike restoration of buildings and purchasing of new equipment, human resources could be simply substituted. It takes plenty of time to grow and educate a researcher. This is also a challenge for Ukraine as many pupils and students might not return to Ukraine, even after the end of the war.

The outflow of students, PhD students and researchers means that many R&D projects in Ukraine were interrupted or even cancelled, that despite the war may lead to some tensions between the Ministry of Finance and R&D performing organizations, funded from the state budget.

While "hosting" countries implement measures to integrate Ukrainian asylums. EU has launched the platforms, e.g. #ScienceForUkraine (https://scienceforukraine.eu), ERA4Ukraine, special call was announced in MSCA Horizon Europe, to support Ukrainian researchers at risk. National research foundation of Ukraine aggregates programs and grant calls for Ukrainian researchers as, while its direct task of R&D financing is suspended due to budget cut (KPI, 2022).

Thus, many researchers who got scholarships in foreign universities and research institutions might choose to stay there after the war as they get not only access to modern scientific equipment, but also different integrational support (e.g. language learning, etc)

By now, there were any official declarations on planned measures to retain researchers in Ukraine and to return those who left the country. Meanwhile, the Recovery plan for the economy is being developed, which may force the government to address the issue.

Speaking about the physical losses in R&I area, the representative of the Ministry of education and science of Ukraine reported that at least 68 research institutions were damaged, 2 destroyed completely, and 9 research facilities are under occupation. In general, around 15% of the research infrastructure in Ukraine was damaged (MES, 2022)[3]. It also includes unique research facilities, e.g. laboratories of the Institute for Safety Problems of Nuclear Power Plants and the nuclear subcritical

[3] https://mon.gov.ua/ua/news/nauka-u-voyennij-chas-vidbuvsya-onlajn-zahid-shodo-innovacijnogo-i-tehnologichnogo-rozvitku-dlya-zdobuttya-peremogi-ta-vidnovlennya-ukrayini

installation "Source of Neutrons" at the National Science Center Kharkiv Institute of Physics and Technology.

Regarding innovation activity, it should be noted that Ukraine was lagging the EU average. During 2016-2018 share of innovative enterprises was 50% in the EU, while only 28% in Ukraine with a descending trend in 2018-2020.

Since the war started, about 50% of enterprises terminated their activity either completely or nearly activity (Advanter, 2022). It was a short-term shock of the war, but after a few months, while the situation is becoming more stable, enterprises recover their activity. According to the latest data, in August 2022 share of enterprises that are not working or loaded less than 25% decreased to less than 10%. And the share of those who loaded more than 50% increased to 75%.

However, speaking of SMEs most of them (above 50%) don't have enough financial resources to survive in long term war and lack of capital is an obstacle to recovery activity (Advanter, 2022).

Thus, implementation of new technologies and innovations seems unclear given that 80% of innovation expenditures in pre-war time was own funds of enterprises (Ukrstat, 2021c). So the role of government in boosting innovation and technology upgrading the economy gains more importance.

The central and regional governments (e.g. Lviv regional military administration) launched programs and initiatives to support the relocation of enterprises into safe regions. After 6 months of the war about 750 enterprises were relocated and about 300 is in the process.[4]

The relocation process might have a positive impact on industrial park development, first in Western Ukraine, and later across the whole of Ukraine, when the war is over and industrial activities will be recovering. In addition, the relocation could force enterprises to implement innovations related to adaptation to new markets, raw materials and inputs, new logistics etc. In overall about half of enterprises are needed a business transformation, e.g. innovative approaches, of which up to 20% have already been transformed[5]. The demand for innovations will increase due to the implementation of the best available technologies and management practices. About half of enterprises are considering on the issue and 10% confirmed their plans to implement them (CID, 2022).

Given that financial constraints are a big problem for many SMEs, the government should develop and introduce a set of financial instruments to support enterprise recovery based on modern technologies.

So, now Ukraine should re-examine its R&I policy adding the challenge of recovery in the short-run period. One of the studies on R&I policy at crisis time suggests three approaches to innovation policy, that country could choose as a response to the crises and war: produce; buy; repurpose (Leadbeater C., 2020). Let's explore all of them in the Ukrainian context.

The first approach – **produce** – obviously require a broad base of basic and applied research empowered with effective mechanism and tools to turn scientific

[4] http://uaprom.info/news/185830-bezpechni-regioni-pereyihali-745-pidpriyemstv.html

[5] https://usp-ltd.org/23-biznesu-zaluchaiut-ponad-polovyny-spivrobitnykiv-opytuvannia/?fbclid=IwAR2O2WGzFcls-F4M09BmNlqU1SDGu6uLmnloyJdv8IxoQOX78LjrRhX3NLc

knowledge into a final product. Thus, it requires a lot of time and resources. Such an approach was used by leading states, e.g. US and UK, during WWII. It is important that private companies took an active part in R&D performed by government-funded laboratories.

As an indicator that shed some light on country's capacity to produce its own innovative products we use the ratio between basic and applied research and experimental developments. In Ukraine the ratio looks like 1:1:2 and R&D intensity is lower 0,5%, while in France it is about to 1:2:2, and in Austria, it is 1:2:3. And R&D intensity in France and Austria were 2,2% and 3,1% respectively (Eurostat, NA.). The data shows that Ukraine is lagging in applied research which is a crucial chain between scientific knowledge and product. Even in such conditions, Ukrainian companies and scientists were able to create competitive defence-oriented products (e.g UAV, antitank complex Stuhna, tactical rocket Neptune etc), but the scale of production was quite low and was not sufficient in wartime. The war forced the government to change its attitude towards military innovations and launched a call for military-tech startups. There was a call on dual purpose technology announced by the Lviv regional administration. Also, a group of businessmen organized Innovation Defense Initiative (https://idi.camp/) to select and support the best solutions for army needs. So, a defense hackathon was organized with the support of the Ukrainian startup Fund, Ministry of digital transformation, Ukroboronprom (Ukrainian defense industry company) and some IT companies.

The second approach is **purchasing of innovations**. It is a quite fast option to implement. This approach is common in many countries. It was clearly demonstrated by COVID19 response. However, there are some risks associated with purchasing of innovations. First of all, these are unclear (uncompetitive) purchasing tenders and lack of coordination as in short run there is no full information neither on needs nor all possible options to buy. Also, there are specific regimes in trade of military and defence-related innovations. Usually, the price for them is very high while many up-to-date innovations are not supplied to global markets due to political and security reasons.

Currently, Ukraine is heavily related on imported/purchased defence-related innovations as own innovations were not implemented into large scale producing. Moreover, many production sites were destroyed during the war, so purchasing is the only option for prompt response during the war.

After the war, probably Ukraine couldn't buy armament due to fiscal constraints. Thus, developing own defense-oriented product is a key for the future security of Ukraine. They can be turned to civil economy and put on commercial way.

The third approach is **repurpose**. According to Leadbeater C. (2020), it is the best option for innovation policy to response on crisis. The idea of this approach is to adjust current R&D to the emerged challenge. It is cheaper than to invent something from a scratch or to purchase on global markets. Repurposing cases are known also during WWII, when machinery plants mastered production of tanks and other military equipment.

Of course, in modern times the complexity of goods is much higher and repurposing requires a well-developed industry and highly qualified engineers to change production lines in short-time period.

A few cases of repurposing can be found in Ukraine as well. For example, the Ukrainian company Eleek is a manufacturer of e-bikes. It adjusted the existing model of the e-bike for the need of the Ukrainian Army[6]. Another company had been developing electric light commercial vehicles, but they pivoted activities and developed a buggy for the Army's needs. Meanwhile, we did not find examples of repurposing in R&D sector.

In long-term period repurpose will no longer be sustainable because industrial pivoting will be limited to existing science and technology bases. Therefore, the development of basic and applied science is crucial for producing of innovative solutions in response to unexpected shocks.

According to Leadbeater (2020), one of the key points for the implementation of repurposing as an innovation policy approach is that it requires proper institutions and persons who are able quickly to unite existing opportunities to solve emerging challenges. The ability for fast repurposing should be embedded into post-crisis economic and social strategies.

Despite the lack of government support, few institutions that tried to foster innovative development emerged in pre-war time in Ukraine. And since the war started the process has become more intensive. As an example, in March 2022, the Association of Industrial Automation of Ukraine initiated the establishment of the Ukrainian cluster alliance, a multi-industry nationwide union of enterprises, business associations, clusters and cluster organizations of Ukraine that strive to increase their competitiveness by implementing the principles of cluster cooperation, industrial, digital and green innovations, automation and effective interaction with the government. By now, it is the largest union of business clusters with 32 members (UCA, 2022a).

UCA started to implement many initiatives in order to support manufacturing and foster innovative activity and cooperation between enterprises and their internationalization. Among them free-membership in CSIA, cooperation with the European Cluster Alliance and European Cluster Cooperation Platform, manufacture of Medical kits for Ukrainian Army Forces, innovation matchmaking events etc. It worth to mention UCA's efforts on inclusion of Ukrainian enterprises in Innovation Communities of the European Institute of Innovation and Technologies. This work is quite successful as UCA became a partner of EIT Manufacturing and launch of "Pre-accelerator in Ukraine – powered by EIT Jumpstarter" program.

Such activity is oriented not only on the recovery of business activity in short term period, including export but rather on the creation basis for long-term sustainable development after the war, based on digitalization and other technology innovations.

Meanwhile, bottom up initiative is not enough to maintain recovery of economy on innovations. And government should take more responsibility on adjusting innovation policy to the war and post-war needs. It is also acknowledged by the UCA and it was the reason why UCA (2022b) develop a set of proposals for the government that include measures on:

- Buy Ukrainian.
- Integration into GVC.

[6] https://nashkiev.ua/news/ukrainska-kompaniya-eleek-rozrobila-elektrobaik-dlya-zsu

- Inno-Integration.
- Standardization.

Discussion and conclusions. In the paper, we shed light on how Ukrainian R&I sector responded to the war. The next steps should be done by the government to ensure sustainable after war recovery and economic development. As is known, at the end of April 2022, the President of Ukraine created the National Council for the Recovery of Ukraine from the Consequences of the War, which includes 23 working groups. The result of the work of the National Council was the Plan of measures for the post-war recovery and development of Ukraine, which was publicly presented at a special conference in Lugano on July 4-5, 2022.

At first glance, the Recovery Plan has a comprehensive nature and ambitious goals, and is seen by the government as a unique chance not only to compensate for the damage caused by the war, but also to accelerate economic growth and improve the quality of life in Ukraine. The plan consists of 17 national programs, 850 projects and financing volume of 750 billion dollars (more detail at https://recovery.gov.ua/). But according to foreign specialists and experts (URC, 2022) responsible for certain areas, at the moment, the document cannot be considered finalized yet. And indeed, there is poor coordination between different programs and low consistency of measures. R&I is underestimated. The increase in innovative activity is mentioned only in the context of the development of mechanical engineering, while R&D are considered as a part of Education. All this leads to the disappointing conclusion that science and innovation are once again at risk of not becoming a decisive factor in the development of Ukraine. Instead, world experience proves that science and technology are not only one of the key factors of economic and social development of the country in the long term, but also the most important factor for overcoming the consequences of crises and wars. Those countries that managed to turn science into a source of development were able to achieve significant economic results and high living standards.

But, when it comes to real actions, the government's approach to economic development, including a drastic cut of R&D financing and a lack of support of an innovative activity, is not sustainable in the long-run period, when the development of a broader S&T base is required to create a solid base for further repurposing in emergency cases.

A set of policy measures was proposed by businesses and researchers to address the war-led challenges in R&I. However, they are not taken seriously by the government as the government does not demonstrate a long-term strategic vision of the post war recovery. It rather shifts some important activity to international donors and the EU, who do a lot of support in many areas, and business itself.

REFERENCES

Advanter (2022). Study of SME in Ukraine. 6 wave, July, 2022. URL: https://drive.google.com/file/d/1SpJwNwG8-TvB8NRCZWmt4MLcNxBr994w/view (in Ukrainian)

Bobukh I. (2022). Assessment of losses and prospects for the development of human capital as a component of Ukraine's national wealth as a result of military

aggression / in Geopolitical and geoeconomic changes triggered by the Russian aggression and renewal of Ukraine's place in the world / Yurchyshyn V. (ed). — Kyiv: Razumkov Center. P.75-81 (in Ukrainian)

CID (2022). The state and needs of business for environmental post-war recovery: survey results. URL: https://cid.center/the-state-and-needs-of-businesses-for-post-recovery-ecological-recovery-survey-results/ (in Ukrainian)

Eurostat (NA). GERD by sector of performance and type of R&D. URL: https://ec.europa.eu/eurostat/databrowser/view/RD_E_GERDACT/default/table?lang=en&category=scitech.rd.rd_e

GII (2022) GII 2022 results. URL: https://www.globalinnovationindex.org/userfiles/file/reportpdf/GII-2022/GII_2022_results.pdf

Gross D., Sampat B. (2020). Inventing the endless frontier: the effects of the World War II research effort on post-war innovation. *NBER Working Paper 27375*. URL: https://www.nber.org/system/files/working_papers/w27375/w27375.pdf

Korablin S. (2022). Ukraine: financial dimension of the war. Herald of the National academy of sciences of Ukraine, (7), 39–41. URL: http://visnyk-nanu.org.ua/ojs/index.php/v/article/view/1104 (in Ukrainian)

KPI (2022). National Research Foundation: 2022 grant season suspended until final victory over Russian occupiers. URL: http://svit.kpi.ua/2022/03/17

Leadbeater C. (2020). Innovation and crisis: comparing wartime strategy to our COVID-19 response. NESTA blogs. URL : https://www.nesta.org.uk/blog/innovation-and-crisis-comparing-wartime-strategy-our-covid-19-response/

Mazzucato M. & Dibb G. (2020). Innovation policy and industrial strategy for post-Covid economic recovery. UCL Institute for Innovation and Public Purpose, Policy Brief series (IIPP PB 10). URL: https://www.ucl.ac.uk/bartlett/public-purpose/sites/public-purpose/files/iipp_policy_brief_10_innovation_policy_and_industrial_strategy_for_post-covid_economic_recovery-final.pdf

Meske, Werner and Thinh, Dang Duy (Eds) (2000). Vietnam's research and development system in the 1990s: Structural and functional change. Research report, *WZB Discussion Paper*, No. P 00-401, Wissenschaftszentrum Berlin für Sozialforschung (WZB), Berlin

UCA (2022a). Ukrainian cluster association. URL. https://www.clusters.org.ua/

UCA (2022b). The program “Export and Internationalization of Industrial SMEs”: 7 proposals of the UKA for the Government. URL: https://www.clusters.org.ua/en/blog-about-clusters/export-and-internationalization-7-proposals-for-the-government/

Ukrinform (2022). URL:https://www.ukrinform.ua/rubric-society/3475112-za-kordon-viihali-bils-ak-23-tisaci-vciteliv-ta-ponad-600-tisac-ucniv.html

Ukrstat (2021a). Research and development expenditure by R&D type for 2010-2020. URL: http://ukrstat.gov.ua/operativ/operativ2021/ni/rik/vvndrvr_10_20ue.xlsx

Ukrstat (2021b). Number of innovation active of industrial enterprises by areas of innovation by type of economic activity. URL: http://ukrstat.gov.ua/operativ/operativ2021/ni/rik/kiap_ved_20_ue.xlsx

Ukrstat (2021c). Financing sources of innovation activities of industrial enterprises. URL: http://ukrstat.gov.ua/operativ/operativ2021/ni/dj_fin_igpp/dj_fin_idpp_20ue.xlsx

UNECE (2020). Sub-regional Innovation Policy Outlook 2020: Eastern Europe and the South Caucasus URL: https://unece.org/sites/default/files/2021-06/UNECE_Sub-regional_IPO_2020_Publication.pdf

URC (2022). Outcome Document of the Ukraine Recovery Conference URC2022 'Lugano Declaration'. Cabinet ministry of Ukraine. URL: https://www.kmu.gov.ua/storage/app/sites/1/18%20-%20Department/18%20-%20PDF/2022/05.07/Lugano%20Declaration%20URC2022.pdf