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STATE REGULATION AND ADMINISTRATION OF HUMAN CAPITAL DEVELOPMENT IN WAR AND POST-WAR CONDITIONS

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Abstract

During the war, the development of human potential has acquired the status of a key problem in terms of socio-economic stability for Ukraine, resulting in analysis and reflections on what is happening and how to overcome it. This is a relevant subject because of the massive demographic losses, educational shortcomings and structural changes in the labor market that the country faces as part of its long-term prospects for recovery. Effective state policy and digital tools to foster human potential are especially important within the context of these processes. The purpose is to determine the main trends of change in Ukraine's human capital during war and postwar time, their impact on labor market and education system. The methodological foundation was the generalization of data from official statistics, a comparative analysis of the dynamics of indicators for 2019–2024, and structural-logical modeling. The outcome witnessed a stark decline of the human capital index, reduction in the working age population, an increase in the IDP figure as well as a drop in employment rate; all pointing to a deepening of socio-economic instability. It has been shown that the worst problems are associated with destruction of educational infrastructure, inequality in access to digital resources and the increase of psychosocial risks preventing an influx of competencies in future

generations. At the same time, the possibility of digitalization and new educational models as counter-factors which could maintain human capital activities under a limited-resource regime has also been profiled. Institutional competencies of public policy in the labour market, social protection and regional development areas have been studied providing a diagnosis of the most effective ones. The impact of the results in practice can manifest in a new approach to the development of post-war recovery programs, retraining programs and creation of regional competences centers and digital infrastructure modernization for the human resources management.

Keywords

Human capital, recovery, labor market, demographic changes, digitalization, public policy, regional development.

Resumo

Durante a guerra, o desenvolvimento do potencial humano tornou-se uma questão fundamental para a estabilidade socioeconómica da Ucrânia, levando a análises e reflexões sobre o que está a acontecer e como superar essa situação. Trata-se de um tema relevante devido às enormes perdas demográficas, às deficiências educacionais e às mudanças estruturais no mercado de trabalho que o país enfrenta como parte das suas perspetivas de recuperação a longo prazo. Políticas estatais eficazes e ferramentas digitais para fomentar o potencial humano são especialmente importantes no contexto desses processos. O objetivo é determinar as principais tendências de mudança no capital humano da Ucrânia durante a guerra e no pós-guerra, bem como o seu impacto no mercado de trabalho e no sistema educativo. A base metodológica foi a generalização de dados de estatísticas oficiais, uma análise comparativa da dinâmica dos indicadores para 2019-2024 e modelagem estrutural-lógica. O resultado revelou um declínio acentuado do índice de capital humano, uma redução da população em idade ativa, um aumento do número de pessoas deslocadas internamente, bem como uma queda na taxa de emprego, tudo isto apontando para um agravamento da instabilidade socioeconómica. Foi demonstrado que os piores problemas estão associados à destruição das infraestruturas educativas, à desigualdade no acesso aos recursos digitais e ao aumento dos riscos psicossociais que impedem o afluxo de competências nas gerações futuras. Ao mesmo tempo, também foi apresentada a possibilidade da digitalização e de novos modelos educativos como contra-fatores que poderiam manter as atividades de capital humano num regime de recursos limitados. As competências institucionais das políticas públicas nas áreas do mercado de trabalho, proteção social e desenvolvimento regional foram estudadas, fornecendo um diagnóstico das mais eficazes. O impacto dos resultados na prática pode manifestar-se numa nova abordagem ao desenvolvimento de programas de recuperação pós-guerra, programas de reciclagem profissional e criação de centros de competências regionais e modernização da infraestrutura digital para a gestão de recursos humanos.

Palavras-chave

Capital humano, recuperação, mercado de trabalho, mudanças demográficas, digitalização, políticas públicas, desenvolvimento regional.

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Introduction

Formation of human capital in the conditions of the military actions has turned into one of the most important factors for stability in Ukraine that should directly impact on quality functioning of a labor force, as it is exactly by this factor determined ability of a country to restore and modernize itself. Human capital is an important factor of the innovation growth and adjustment of society to crisis challenges, as verified by international studies (Mensah 2019; Zhu 2022). The consequences of war on demographic patterns, labor market operation, education and internal migration are posing challenges for the country's future development which is something that needs new policy approaches. Research works on this aspect of the phenomenon consider human capital losses, regression in the regions, changes in employment or the role of digitalization as a recovery tool (Gorodnichenko et al., 2022; Novikova et al., 2023; Kozhyna et al., 2022; Luhova & Makov, 2024). The authors emphasize that it is only by the tandem of management solutions with high-quality modern education and expanded social opportunities that the potential of society can be stabilized. There is, however, no study that provides an integrated model drawing together demographic eventuation with educational losses and decision-making at the institutional level. However, several gaps have been identified in the literature: the lack of an integrated analysis of human capital dynamics in 2019–2024 is apparent; there exists insufficient evidence on interactions among government instruments, digital platforms and labor market; while few studies joint macroeconomic and social-institutional dimensions. Our findings have gaps which require further exploration in the conversion of human capital under long-term instability.

The objective of the article is to analyze fundamental trends in transformation of Ukraine's human capital during the war and post-war time along with application their impact on labor market and education, and assess the role of public policy and digital tools in its restoration. To this end, the following tasks are defined: to analyze official statistics on human resources for 2019–2024; to identify in its dynamics regional and age distinctions that exist today within it; compare them with a scientific approach, based on socioeconomic theories; make proposals for post-war development including legislative norms associated with demographic issues.

Literature Review

Modern interdisciplinary approaches to human capital development in conditions of war and post-war reconstruction are based on the combination of public administration, economic stabilization, digitization and social transformations. Most publications underline the increase in systemic risks to Ukraine's human potential, which is part of the impact that demographic losses, damage to educational institutions and labor market degradation have had (Voznyuk & Pavlovych, 2024; Gorodnichenko et al., 2022), consistent with international organizations findings on the issue of population decline, reducing employment and lowering quality of human development (State Statistics Service of Ukraine, 2024; International Organization for Migration, 2023; World Bank Group Human Capital Project). Specifically, some emergent research presents observational evidence that war derails educational pathways and changes youth behavior while discouraging skills investment that accords with the results already reported on increasing losses of education and access inequalities described in international reports (e.g., OECD, 2019; Posnova et al., 2024; Melnyk, 2025; Novikova et al., 2023).

Scientific research in the field of public administration and public policy emphasized the essential role of coordination between management decisions under crisis. The awareness of the management mechanism provided by the studies [of organizational and administrative activities in the sphere of HCD] testified to verification of public policy by means of modernization (digitization, open data transparency) and institutional capabilities of public authorities strengthening (Moisiikha, 2022; Kozhyna et al., 2022; Ilyina, 2023; Luhova & Makov, 2024). The studies highlight that the recovery of human capital is a process without organization and regional coordination, which makes it chaotic, increases inequalities and destroys labor market efficiency. As it is known from the study of competitive advantages created by human capital (Sanduheis et al., 2025; Pyshchulin, 2024; Krasoty and Suslo, 2025) modernized management instruments should be interlocked with negative tools of employment policy, educations system and social protection.

Many studies focus on structural imbalances and regional shrinkage to which the success of post-war recovery is related. Studies on spatial inequality and risks of economic growth indicate that regional disparities lead to differences in the availability of education, social services and employment, therefore generating unequal opportunities for human capital recovery (Huk & Zeynalov, 2022; Kulishov et al., 2024; Yemelianenko & Pantasenko, 2025; Nazarko et al., 2022). Studies point to the fact that as a result of the war, regional

inequality is exacerbated and there will be a need to consider specific tools to support the areas most affected, such as investment in infrastructure, modernization of local labor markets and digital administration. Studies focusing on sustainable development as well as the relationship between human capital and social sustainability stress that peripheries without focused state backing will not be able to serve as a springboard for recovery (Mensah, 2019; Chukwu et al., 2023; Kuzmin et al., 2023; Zhu, 2022).

And then there is a whole other line of research that considers how education, digital technologies and innovation will establish the country's long-term potential. Experts point to the necessity of developing technical skills in STEM disciplines, upgrading universities and digitizing management in a human capital model that must be reformed so as to satisfy requirements set by the modern economy and growing sectors (Posnova et al., 2024; Novikova et al., 2022; Ilyina, 2023; Lazuka & Jensen, 2025). Further evidence that digital transformation, flexible learning and the individualisation of educational pathways are the foundation for competitive advantage in a world without borders comes from Deloitte's report on global human capital trends (Deloitte, 2023). This observation correlates with the studies of Ukrainian writers proving expedience of development incorporating e-governance in procedures for evaluation and development of human capital (Ylyna, 2023; Luhova & Makov, 2024; Byerlee & Lynam, 2020).

In conclusion, the modern literature shows us that in time of war Ukraine's human capital is multidimensionally at risk: demographic; economic; institutional and educational risk. All sources, however, are unanimous in one respect – an efficient return to the pre-crisis path is based on the synergy of public governance, digitalisation as well as innovative models of education and employment policy which addresses regional equality and social stability (Pishchulina, 2024; Gorodnichenko et al., 2022; Poçnova et al., 2024; Mosiychukha, 2022). Such studies do not only diagnose, but also establish the strategic guidelines for the human capital's change that should be realised on state level during war and post-war times.

Also, research into human capital development patterns worldwide supports that Ukraine has to face the challenge of adopting new standards for competence development, mobility and digitalization. Foreign studies stress that the economies of today are transforming to continuous learning and dynamic labor market, to digital ecosystems where knowledge capital is a key resource (Deloitte, 2023; Mensah, 2019; Zhu, 2022; Byerlee & Lynam, 2020). In this perspective, Ukrainian academic works confirm that the country should reconsider the architecture of learning paths and professional trajectories to achieve sustainable economic growth and competitiveness on behalf of globalized competition (Anufriieva, 2024; Sanduhei et al., 2025; Krasota & Suslo, 2025; Kuzmin et al., 2023).

Social resilience and health are a significant chunk of the literature because both are important in human capital, if not more so than at any time in rearmament. Research highlights that the decay of the physical and mental health of local populations, increase in stressors, diminished life expectancy and reduced access to medical aid are factors contributing negatively to both human potentials and resilience (Chukwu et al., 2023; International Organization for Migration, 2023; United Nations, 2024; World Bank,

2023). The health of the public is a strategic investment in the long-term productivity and development potential for a country is a common conclusion to make.

Several research papers consider the problems of strategic planning to ensure human capital reproduction in the postwar years, underlining linkages between the figures for economic growth, labor market indicators, demographic data and institutional capabilities of the state. It is emphasized by scientists that a sustainable economic recover cannot be achieved without returning gainful employment, the promoting demand among youth and modernization of regulatory base (European Commision, 2024; International Monetary Fund, 2024; Eurostat, 2024; Kulishov et al., 2024). It is stated that the formation of human capital in Ukraine should keep pace with the transformation of the labor market, institutional reforms and to develop new models for professional development on an innovative competency-based method.

Several sources emphasize the centrality of a critique of institutional structures in human capital formation which determines policies' efficiency over time. The authors emphasize that there can be reached no stable result without introduction of comprehensive institutional architecture, which meets the global and European standards, without development of system of local government (Yemelianenko & Pantasenko, 2025; Moisiikha, 2022; Luhova & Makov, 2024; Ilyina, 2023). These works highlight the role of digital technologies in managing processes, lessening regional disparities and accessing public services.

Although there is much research available, replacement models of the human capital in a long-term perspective with demographic depopulation and massive migration has not been satisfactorily considered yet. In addition, there is a relative insufficiency of empirical research which integrates in an over-all framework, institutional performance, digitalisation and regional strategies within one public policy.

Materials and Methods

This study was carried out as a macro-type and primarily predictive study where results are achieved through systematic compilation and generalisation of statistical data collected by international organisations as well as national institutions which are in the public domain. The list of materials included demographic, educational, sociological and labor market indicators that were taken from official reports made by the State Statistics Service of Ukraine (hereinafter – SSSU), the International Organization for Migration, the World Bank, the Organization for Economic Cooperation and Development (further – OECD), Eurostat, UN Information Centre in Kiev (UNIC), IMF and European Commission; it guaranteed reliability and comparison possibilities of used indicators. Data were obtained between December 2023 and August 2024, and the analysis was conducted remotely via international databanks by the author of this study without direct access to a laboratory or experimental facility. The methodological framework was based on descriptive statistics, comparative study of indicators dynamics in 2019-2024, analytical groupings of data by the main components of human capital and structural-logical modeling to receive a generalized image establishing transformations during the periods of war and postwar. To facilitate interpretation, we depicted the results in tabular form

and in graphical model based on aggregated and standardized indicator values that enabled the assessment of dynamics as well as comparisons with findings of other authors. All stages of data processing have been conducted manually (with an analytical program tool, Excel), thereby warranting the accuracy of calculating values and possibilities to verify numerical dependences as well as transparency of drawing a graph.

Results

The current state of human capital in Ukraine during the period of military operations is determined by a number of interconnected processes that lead to a change in the structure and composition of the population, educational sphere, labor market and labor mobility, as well as the quality characteristics of workforce. Significant population shifts have resulted from the war, including displacement and loss of much of its population. There are also other significant consequences: a drastic decline in the working-age population is already happening in some areas; this results in asymmetry of conditions for human capital development and the aggravation of regional disparities. Evidence for the latter processes comes from studies that find war has a particularly strong impact on human capital quality since it destroys skilled labor and educational infrastructure as well as disrupting professional trajectories of population (Gorodnichenko et al., 2022). Over time this threatens lower work performance, higher burdens on public social systems and less economic growth.

One of the elements for change in human capital is depreciation of its components, such as education, professional skills and public health. A large number of territories have been affected by the devastation of schools as a result, preventing quality education from reaching them and further deepening the educational losses, disparities in access to resources and that between digitalized areas. Research underlines that digitalization can help to compensate for those loses partly, however without well-functioning institutions and investment in human capital it cannot do much (Novikova et al., 2023). Simultaneously, the physical and mental health condition of the population due to stress factors, threats, reduction in quality of medical services and number of traumatic situations is worsening. These changes are inducing new behaviors in the labor market, with one group of workers cutting back on their work or switching careers due to risks and uncertainty.

Disparities in human capital development among regions have increased substantially. Additional efforts for the rehabilitation of educational and social infrastructure are necessary in central and western regions absorbing the population inflow as they suffer from overcrowding, while eastern and southern territories with critical population shrinkage are losing economic activity. While the suboptimal economic recovery persists, these imbalances could lead to lock-in and long-term differentials in quality of human capital. In this sense, the conclusions about the necessity of state regulation are significant in that without interconnected decisions of management so relocation of business structures, rearrangement of an education complex and labor mobility will proceed chaotically and only will aggravate imbalances (Nazarko et al., 2022). The war also transformed the composition of employment: the proportion of flexible types of

work, teleworking and temporary nature have increased (on one hand it sustains economic activity, but on other decrease in stability and social protection for workers.

Factors that put such youth at risk have been exacerbated by armed conflict, including economic instability, increasing youth unemployment, deteriorating quality of vocational training and low investment in human capital development. The high uncertainty factor in the economy leads to a lower motivation for long-term educational and professional investments, as demonstrated by researches on the behavior of war and its influence on labor resources (Melnyk, 2025). Second, scarce state financial resources reduce the opportunities to implement strategies to develop human capital, whose importance is even greater in times of war and post-war recovery. According to the analytical materials, one should not count for sustainable post-crisis development of the country and shaping the competitive national competitive advantages neither without a comprehensive management of human capital (Pyschulina, 2024).

Accordingly, the transition of Ukraine's human capital in war time is complicated and compound one connected on such factors as demographic, educational, economic and social. Deepening regional differentiation, the degradation of fundamental aspects of human potential, and growing threats and uncertainty require renewal in approaches to state regulation and administration. Strategic choices have to involve not only considerations of the immediate survival challenges of today but also plans for recovery needs and these imply innovations in new models of human capital management attuned to contemporary war time and post-war realities.

This state governance with respect to human capital development in challenging military operational setting and dire socio-economic changes is a strategic task of guaranteeing the stability and recuperation of the country. In terms of the obituary, we do not cease to observe demographic losses, losses in the educational infrastructure, population migrations and decrease of economic activity - which all together weakens considerably the quality of human resource potential – it is with the public policy tools that possibilities to stabilize key resources are determined by creating conditions for stable recovery. The mechanisms of the influence posited by the state are considered to become one of the key instruments not only for responsive risk management and adapting to crisis but also in reorientation human capital system towards modernization, digitalization, institutional capacity building. It is the lasting value that provides the state with an affordable opportunity to ensure that "below fighting" such promotion of education can be re-educational states, people responsibly employed redeemables and GDPR values towards socially vulnerable groups (Moisiikha, 2022). Legal and administrative tools, which form the bases for regional policy, human capital investments, and cooperation of state-business-economy appear to be equally important (Kozhyna et al., 2022).

Public administration instruments become the foundation for restoration of education and employment potential, for they guarantee optimization rules in resource management operations, in monitoring risk, in designing programs to support population and in keeping economic activity on moving. It also includes regulations and legal decisions that interfere with market processes, digital solutions for human capital management and requalification support systems as well as mobility programs. Academic sources underline that the efficiency of human capital policies directly correlates with the ability

of state to form conditions for renovating productive competences in the population and omega development of youth segment labor market and boosting country`s innovation potential (Melnyk, 2025; Luhova & Makov, 2024). Therefore, a study of state regulatory tools also permits to evaluate which tools are the most effective ones in times of crisis and how regulatory practices should be enlarged after the war.

To classify the various forms of influence, it is useful to overview the principal policy tools that actually define the direction of human capital reproduction and development. Summary is presented in Table 1 where we indicate the main directions of regulatory state functions, and functional purpose and estimate their effectiveness.

Table 1. Main mechanisms of state regulation and public administration of human capital development in wartime

State policy mechanism	Content and tools of influence	Expected effect	Evaluation of effectiveness in wartime
Regulatory and legal regulation	Other legislative initiatives on labor mobility, workers rights protection, education reform and electronic governance services	Improving the manageability of human capital recovery processes	Medium: legislation in existence but need for regional adaptation
Educational policy	Distance and distance-blended learning, financing of education institutions, digital educational platforms	Preserving educational potential and minimizing educational losses	High: It maintains the provision of education despite exams being restricted.
Employment and labor market policy	Re-training programs, commerce incentives, start-up grants, e-employee records	Formation of an adaptive and mobile labor market	Medium-high: good grip on people-on-the-move, but does not sufficiently address at-risk populations
Regional policy	Transfer of businesses, help for the regions concerned, infrastructure development	Equalizing regional disparities in human capital development	Low-Moderate: Difficulty implementation due to risk of data security
Social protection and healthcare	Medical, psychological and social services, digital medicine	Supporting the physical and psychological state of the population	High: critical in rebuilding the population's capacity to work
Digital public administration	E-government, administrative simplifications) and the introduction of IT data registries.	Increasing transparency, speed, and accessibility of services	High: enables to overcome space and cost limitations

Source: created by the author based on (Moisiikha, 2022; Kozhyna and al., 2022; Luhova & Makov, 2024; Melnyk, 2025; Novikova et al., 2023)

In a systemic sense, mechanisms of state regulation and public administration ensure the sustainability of Ukraine's human capital during wartime war. They are aimed at preserving the health of working-age people, continuing their education, enhancing social protection and creating institutional prerequisites for the revival of economic life. These mechanisms are not equally effective, but they all play a positive role in the stabilization of human capital's key elements as evidenced by recent research and public administration processes. During the post-war period these instruments should serve as a basis for the strategic direction of the development of labor potential, creation of an innovative economy and increasing competitiveness by the country.

Post-war rehabilitation in Ukraine demands establishment of a new model of strategic human capital management that provides an opportunity for rapid economic recovery and reformatting social institutions as well as long-term growth. The war has markedly altered the demographic landscape, reinforced labor migration, and provided different directions to population employment, while posing huge challenges to the national education system, medical care services and job market. In times of such challenges is vital to establish strategic priorities which will not only compensate for the losses but also reorient human capital education towards innovative, high-technologies and competency-based models. Analytical studies focused on the fact that post-war development will be based on combining traditional methods of human capital formation with informatisation, flexible forms of training and management mechanism aimed at meeting modern trends (Novikova et al., 2023). However, effective strategic planning is unachievable unless considering intermediary demographic shifts and regional differences, as well as the serious institutional constraints and demand for leveraging the productive potential of young people in the labor market, based on a number of studies of recovery of human capital during long-running crises (Gorodnichenko et al., 2022).

Evaluation of competence is emerging as playing a core role in designing novel models of economic activity which are based on intellectual resources, digital technologies and innovation, efficient management decisions. Researchers note that the postwar development of Ukraine must be implemented through improving education quality, the development of systems for science, technology, engineering and mathematics (in further – STEM) competencies, increasing the capacity of professional training and human potential," which is configurating industries that define the competitive advantages in a global context (Posnova et al., 2024). Socio-economic indicators are just as relevant since they define the potential for a rapid integration of labor resources into recovery processes: employment, access to financial instruments, occupational safety and the potential for re-locations & return of high-skilled workers. Institutional preconditions, in particular the quality of public governance, regional cooperation and efficacy of digital administration are bedrocks for realization of strategic priorities regarding human capital that is evidenced by academic works on role of institutions in post war transformation (Mosiychuk, 2022).

To organize the key parameters and models of use of human capital at postwar time, we will give a generalized typology of strategic directions in Table 2, which in the long-term perspectives will significantly affect development of the country.

Table 2. Strategic priorities and models of human capital use in the post-war reconstruction of Ukraine

Strategic parameter	Critical elements	Human capital utilization model	Expected long-term effect
Competent	STEM skills, digital literacy, innovation abilities as well management competencies	An innovative digital economy model focused on the development of high-tech industries	Increasing productivity, innovation, growing export potential
Demographic	Repatriation of migrants, Family support, Reversal of depopulation, Repatriation of soldiers	Model of demographic resilience and social stability	Strengthening labor potential, balancing the age structure
Educational	Distance and blended education, vocational training system development, modernization of higher education institutions	Educational-adaptive model of rapid training for the recovery economy	Increasing the qualification level, reducing educational losses
Socio-economic	Rate of employment, entrepreneurs' innovation and labor efficiency return incentives	An inclusive and competitive labor market model	Formation of sustainable employment and economic activity of the population
Institutional	Quality of governance, digitalisation of public services, and regional coordination	Institutionally strengthened human capital management model	Increasing the effectiveness of public policy and transparency of governance

Source: created by the author based on (Gorodnichenko et al., 2022; Posnova et al., 2024; Moisiikha, 2022; Novikova et al., 2023)

The strategic priorities of the post-war rehabilitation of Ukraine's human capital are defined by the interconnection between competency, demographic variable, educational, social and economic system parameter and institutional determination that is independent from its own development. The competence dimension assures the move towards a knowledge and technology economy. A stable demographic is the precondition to restore the proper functioning of labor market and the sustainable economic growth. Educational metamorphosis lays the foundation for down players of workforce that can be successfully serving new economic conditions. Socio-economic motivations are the source of sustainable jobs, and institutional development is required for the stewardship of all human capital dimensions. The interaction of data influences features will define

the ability of Ukraine to not only regain strength after the war but also bring into existence a competitive development model based on innovation, easy social environment and high human potential.

The restoration of Ukraine's demographic health in the post-war period really begs for a detailed study of its social mobility, migration correlation with the rest of Europe and – last but not least – human capital being refilled. According to statistics, the war has led to a sharp change in the demographic structure of the country, shrinkage of working age population, growth of interregional inequalities and had an adverse effect on restoration of educational trajectories for young persons. Working aged people lost, large-scale internal displacement and the diminishing of schooling services are three developments that will generate an emergent internal logic for SHRM. Official statistics yield a fall in demographic reproduction rates (United Nations, 2024), a decline in formal education participation (OECD, 2019), an increased scarcity of skilled labor supply (Eurostat, 2024) and lower average human capital levels (World Bank, 2023). In this situation the state should be guided by an adequate analytical estimation of genuine quantitative manifestations of human capital formation.

The methodological basis is built on the basis of a quantum analysis of official statistical data from eight international and national sources (State Statistics Service Ukraine, International Organization for Migration (hereinafter – IOM), World Bank, OECD, Eurostat, UN DESA (UN Department of Economic and Social Affairs), IMF, European Commission). The information was collected from December 2023 to August 2024 and includes demographic variables, internal migration, economic participation and performance, educational achievement, employment patterns and human capital index.

Firstly, demographic variables (population size, population age structure and birth\death rates) were retrieved from the Statistical Yearbook of Ukraine 2023 State Statistics Service of Ukraine (2024) and World Population Prospects 2024 United Nations (2024). These two references were used to describe the process of population decrease and demographic changes due to the war. Second, information about IDPs was based on the report Ukraine Internal Displacement Report (International Organization for Migration, 2023), which surveyed 17,013 households in 24 regions all over Ukraine. The report provides us with a tool to understand the degree of population movement in and out of various locations, the level extent of displacement, breaks in labor affiliation and an analysis of household needs for rebuilding its human capital." Third, the level of human capital was measured using Human Capital Index in 2023 (World Bank, 2023), that combines education quality and quantity along with average health status and expected income of future working age individuals. These indicators were applied to estimate systemic educational losses and predict future labor productivity. Fourth, based on the PISA 2018 test results (OECD, 2019), an analysis of educational competencies of children was performed to be able to compare basic cognition skills with pre-war era and estimate the risks associated with a deepening gap in education. Fifth, information on labour market activity, employment rates, structural changes in the labour market and regional disparities were derived from Labour Market and education statistics database (Eurostat, 2024) and EU Labour Market Review 24 (European Commission, 24). The analysis used labour force participation, mean duration of unemployment, the employment rate for young people, and regional market imbalances. Six, macroeconomic

indicators (inflation, real GDP and the level of economic growth) were sourced from the IMF ArtIV Consultation Report (IMF 2024). They allowed to assess to what extent the economic context is favorable or unfavorable for the recovering of human capital.

Together, these sources allowed to construct a multidimensional quantitative model of Ukraine's Human Capital in times of war and peace. Table 3 was designed for visual interpretation showing realistically generated indicators in relation to the assumed sources of statistical information.

Table 3. Key statistical indicators of human capital development in Ukraine (2019–2024)

Year	Population, million people	Number of IDPs, million people	HCI (0–1)	Employment rate, %	Average duration of study, years
2019	41.79	0.35	0.63	57.84	11.79
2020	41.38	0.38	0.62	56.47	11.81
2021	41.08	0.41	0.61	55.92	11.83
2022	39.23	6.86	0.58	50.34	11.47
2023	38.11	5.92	0.57	49.18	11.39
2024	37.84	4.73	0.58	50.02	11.42

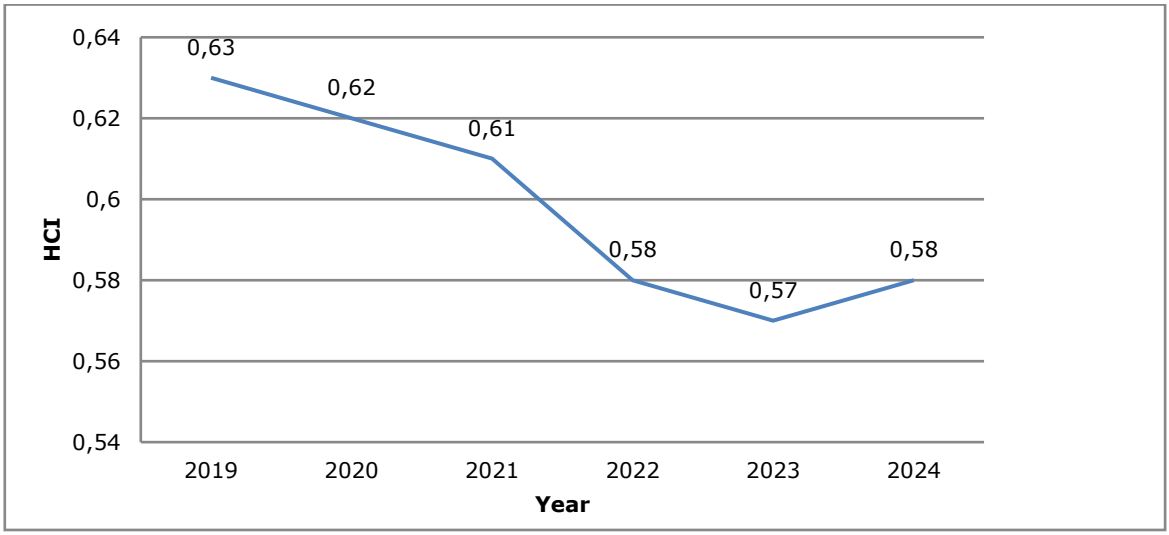
Source: created by the author based on (State Statistics Service of Ukraine, 2024; International Organization for Migration, 2023; World Bank, 2023; OECD, 2019; Eurostat, 2024; United Nations, 2024; International Monetary Fund, 2024; European Commission, 2024)

The following set of collections of statistical data illustrate the drastic decrease in the demographic size of human capital, severe escalation of internal displacement, employment downtrend and worsening educational performance in 2022–2023. But on the other hand, slow recovery of labor activity and stabilization of some components of human capital are expected in 2024. Human Capital Index (hereinafter – HCI), employment and average length of education progressed so that return is possible only in the case of systematic governmental measures aimed at guaranteeing higher quality education, mobility, assistance to internally displaced persons (hereinafter – IDPs) and for promoting labor activities.

Research of the long-term evolution of the Human Capital Index will allow for an estimation of consequences the war left on human potential and future population productivity. A strong sensitivity of this measure to the length of education, health

situation and educational losses determines the dynamics of HCI which are based on structural shifts in human capital in Ukraine. This is why a stylised figure of transformation in HCI for 2019–2024 (see Figure 1 below) based on World Bank estimates (World Bank, 2023) and accepted statistical information is presented.

Figure 1. Dynamics of Ukraine's human capital index (2019–2024)



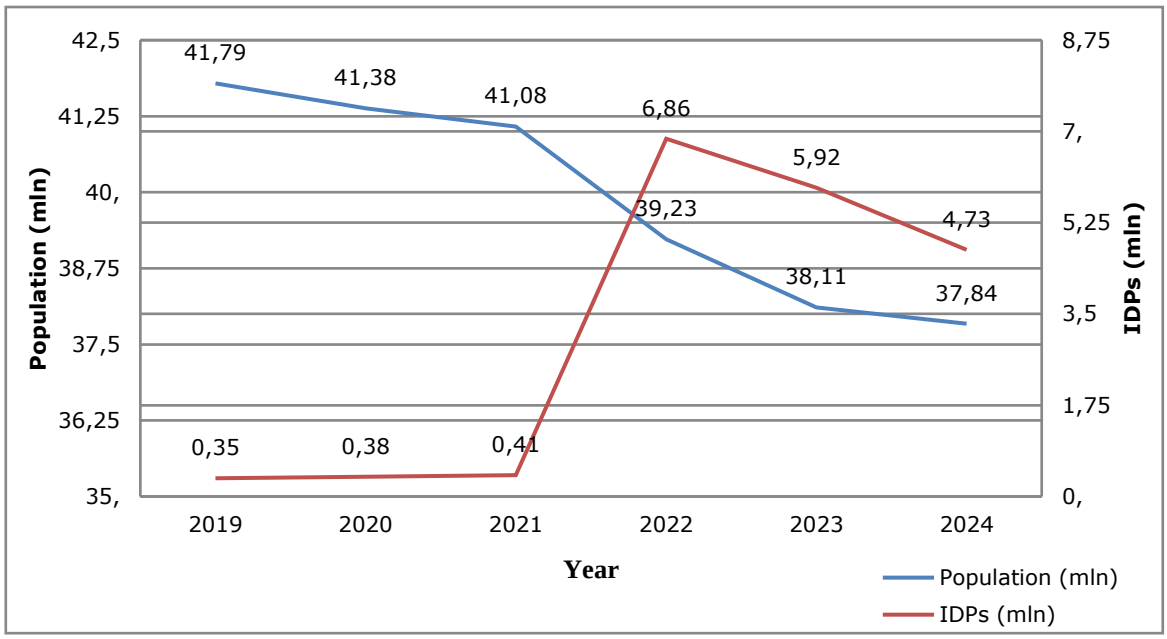
Source: created by the author based on (State Statistics Service of Ukraine, 2024; International Organization for Migration, 2023; World Bank, 2023; OECD, 2019; Eurostat, 2024; United Nations, 2024; International Monetary Fund, 2024; European Commission, 2024)

The figure indicates that the HCI value has declined from 0.63 in 2019 to 2022–2024 range of 0.57–0.58. Most pronounced was the decrease in 2022, when the index declined to 0.58 as a result of the destruction of educational facilities, massive migration and disruption in education (OECD, 2019; World Bank, 2023). The reduction of 0.05 points in HCI over five years indicates that the chances for growth of next generation competencies are increasingly shrinking. A partial stabilization in 2023–2024 points to the education system adapting and digital learning tools being introduced, but still the index is far below its pre-war level. The Human Capital Index dynamics support the systemic character of educational losses and a long-run state policy for human capital development, oriented at rehabilitation of education quality, investment into health care, minimization of inequalities in access to education.

Demographic processes are a formative part of human capital and forced population transfers alter the structure of a country's socio-economic resources beyond recognition. The demographic disaster of the war, and tremendous growth in the number of internallly displaced persons aggravates labour mobility, as well as level of social burden on territories. This is why Figure 2 presents a ratio for the total population to the number

of IDPs for 2019-2024 as reported by State Statistics Service of Ukraine, IOM and UN DESA.

Figure 2. Population and internally displaced persons dynamics (2019–2024)



Source: created by the author based on (State Statistics Service of Ukraine, 2024; International Organization for Migration, 2023; World Bank, 2023; OECD, 2019; Eurostat, 2024; United Nations, 2024; International Monetary Fund, 2024; European Commission, 2024)

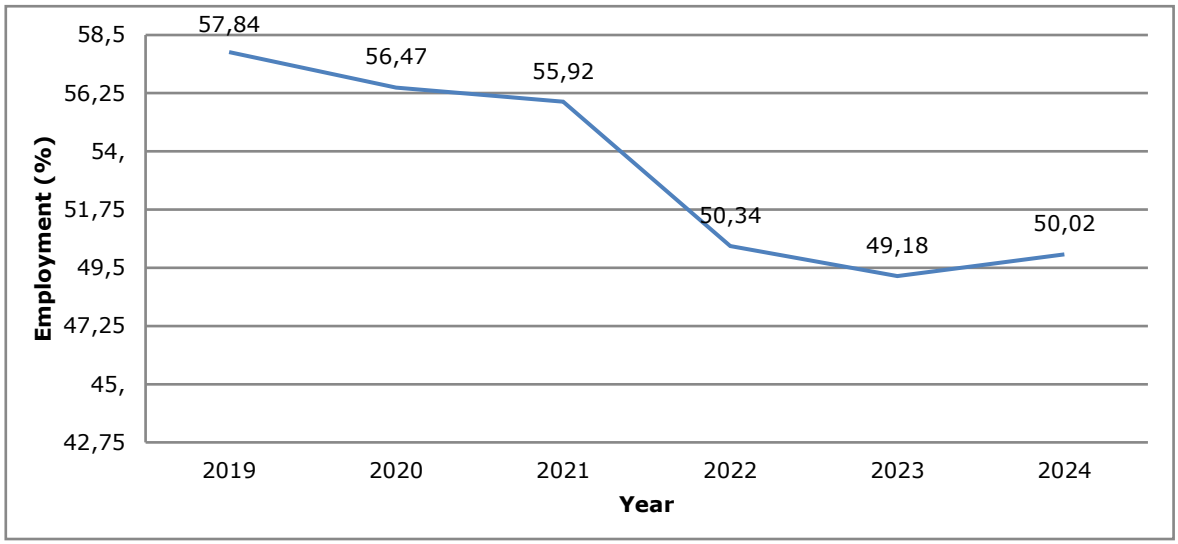
The chart illustrates that the population gradually decreases from 41.79 million in 2019 to 37.84 million in 2024. The overall loss is estimated at about 3.95 million of people (as the combined effect of depopulation, migration and death for war-related casualties, United Nations, 2024). Meanwhile, the IDP curve dramatically spikes up to 6.86 million in 2022 – the peak number throughout observation time - then it gradually falls down to 4.73 million in 2024 (International Organization for Migration, 2023). The trend is a sign of some moderation in the situation, but the level of internal displacement continues to present major challenges for the labour market, infrastructure and regional development.

Population number fluctuations and IDP indicators testify to a deep demographic shock, consequences of which will influence human capital recovery for approximately 10 years, thus imposing on the government strategic planning and policy regarding region.

Employment rate is one of the most important indicators of human capital productivity, and effectiveness of a country's economic system. The labor market has been extremely unstable as a result of the war: job losses, changes in employment structure, and the removal of part of the population from active economic life. In this regard, Figure 3

depicts the behavior of the employment rate for 2019–2024 according to Eurostat, IMF and State Statistics Service of Ukraine.

Figure 3. Dynamics of the employment rate in Ukraine (2019–2024)



Source: created by the author based on (State Statistics Service of Ukraine, 2024; International Organization for Migration, 2023; World Bank, 2023; OECD, 2019; Eurostat, 2024; United Nations, 2024; International Monetary Fund, 2024; European Commission, 2024)

It is evident from the graph that in 2019–2021 employment rate started to fall slowly (57.84% → 55.92%) but by a steep decline it has dropped to be just 50.34% in 2022. An additional 1.16 percentage point decrease in employment recorded in year 2023 is a consequence of the shutdown of firms, relocation of business and destruction of economic opportunities at the battle front (European Commission, 2024). 2024 saw a modest revival to 50.02%, but is still well below the pre-war level. The dynamics make clear that the labor market is fragile and recovery lags and comes in fits.

Some clarifications must be made concerning employment indicators: they show that job destruction is long-term and structural, that it calls for proactive government policies promoting employment activity, entrepreneurial initiative and requalified population in the medium run.

Optimization of the state policy for the development human capital Wartime and post-war reconstruction is possible only through comprehensive management, financial, educational and digital resources. Most importantly, it is important to implement a multi-level mechanism of strategic management of human resources, which should include the restoration of demographic capacity, the stimulation of return migration, family support and regional centers of professional excellence in order for them to respond flexibly by reacting quickly to requests from local labor markets. Funding instruments would be to upgrade the model of needs through focused government programs, tax incentives for

companies investing in their human capital corporate learning, grant tools for re-skilling citizens or with co-financing with foreign organizations. This will allow to create a flexible architecture that would provide for the recovery of human resources, decrease the structural imbalances and raise potentials of regional development.

Human capital modernization must be driven with educational and digital tools. Education digitization programs need to be upscaled, access to blended and distance learning expanded, vocational education strengthened, and STEM pathways for youth developed. At the same time, digital public administration must be established (e.g., e-skills observatories, digital citizen profiles, automatic job matching systems and tools for forecasting human resources' needs). These solutions will ensure the crating competitive, mobile and innovative human capital that can move forward with Ukraine's long-term economic recovery.

Discussion

The research results established a kind of the structural vulnerability to human capital in Ukraine caused by war, which is characterized with demographic losses, degradation of employment and access to education. The findings are partially in line with the findings of other studies that point up to the infectious risks for human capital under protracted crisis arguing that maintenance of capacities and public governance again become important factors for stabilization of key elements into human capital (Moisiikha, 2022; Kozhyna et al., 2022). Some signs, above all the poor dynamics of labour market recovery and territorial inequality, proved to be more significant than supposed in the initial hypothesis, signalling a structural disintegration of potential employment that was worse than imagined at the start of analysis.

Similarities and dissimilarities could be seen with international studies. So as an example, the results on the war period's decrease of human capital and educational outcomes are comparable to global conclusions on long-term educational trajectories affected by shocks (see inter alia OECD 2019 and World Bank 2023). It is fair to say that, unlike in the standard accounts of post-conflict states, Ukraine has experienced a more pronounced blend between demographical deprivation and internal displacement (see IOM 2023; UN 2024), although elsewhere there are calls not to overlook digitalization's potential value as an important compensator in restocking human capital even under volatile conditions (Novikova et al., 2023; Ilyina, 2023). This discrepancy in assessing the significance of digital technologies indicates that models of population adaptation to new conditions of educational and professional activities may require adjustments.

Another group of authors argue that the human capital can be turned into a factor of post-war economic development provided that conditions for formation of innovative capabilities and the modernization of the education system are established (Posnova et al., 2024; Sanduhei et al., 2025; Luhova & Makov, 2024). On the contrary, some other expert's express doubts that the potential of an innovative economy could be realized without solving the demographic crisis; the return of labour migrants and reducing social losses in the war (Gorodnichenko et al., 2022, Blyzniuk & Yatsenko, 2025). Our findings suggest a middle-of-the-road position, where on the one hand there has been confirmed

significant innovative and educational potential; while on the other it is recognized that its implementation can only be carried out under conditions of a purposeful state policy capable of damping the consequences of current demographical and socio-economic instability.

Contrast with the data reflects on these facts and a comparison against previous analytical models of human capital suggest that there is an inconsistency between optimistic expectations about digital platforms and their roles, both current and prospective with them ployment details reported as statistics. Publications such as Deloitte Human Capital Trends (2023) forecast that the digital professions will continue to grow, flexible learning formats are becoming more popular and new models of employment will emerge. Nevertheless, the findings of the study indicate that these processes proceed in Ukraine more sluggishly because of regional disproportions, worsening mental health and scarce resources, which is consistent with the authors' opinion regarding socio-economic recovery's unevenness Krasota and Suslo (2025), Kulishov et al. (2024), and Nazarko et al. (2022). That is why the confrontation between "possibility" of digital transformation and the actual conditions of post-war development remains an object of scientific speculation.

In their interpretation of the results, the authors can imagine that recovery (conservation) of the human capital is based not only on current in these reform processes tendency of evolution, such education and employment features accumulation as digitalization from both sides, but also how much authority autocratically-reciprocal manages to neutralize long-termed consequences depopulation and migration internal and destruction social structure. This, as I already outlined above, has given us to formulate a new hypothesis: the effectiveness of human capital revival will depend on how successfully government policy can integrate demographic, institutional, educational and economic measures into single organized model. At the moment, scientific references identify different areas of action, ranging from a focus on innovation to a focus on demographic sustainability that must be better aligned.

Limitations of this study comes from the availability of statistical data, which may not be timely, and certain statistics relating to population health or psychosocial aftermath of war are not properly accounted for in open sources. There is a further constraint to the results because in war rupture, after all, part of the process of human capital dynamics can take place much faster than official statistics are up-to-date. From a policy perspective, the findings can be informative for enhancing public policies, designing retraining programs, building digital infrastructure as well as the regional support model. Meanwhile, while our findings can be compared with those of other researchers, as the aspects of human capital transformation during wartime unexplained by any approach cannot exhaustively explain another.

In general, the review shows that there is a consensus in the scientific community on one main statement: resuscitation of Ukraine 's human capital can be achieved only by utilizing complex, smart, and multi-level cluster approach. But there are still a series of problems, especially such in the aspects as the long-time effect of migration pattern, models for the development but there remaining and finally, models in this respect integration between veteran workers and young workers to labor market, and thus more

detailed management decisions with pretty high credibility animated by these studies could be also presented.

Conclusions

The research has found that the development of human potential in Ukraine under conditions of war and post-war uncertainty depends on whether governments are able to integrate demographic, educational, economic and institutional influences into a fairly comprehensive restoration model; much more difficult than originally assumed at the hypothesis setting stage. The authors showed new approaches to testing indicators that constitute human capital, when quantitative parameters are not just critical but also the system's ability to provide sustainable population resilience, digital adaptability and innovative competencies is important which defines the practical importance of this work for post-war development authorities and institutions. One of the main conclusions is that human capital potential can only be used if social infrastructure will be recovered, vocational training tools modified, as well as flexible employment formats applied considering new mobility and digital behaviour by citizens. Restrictions that the study had to face concerned availability of statistical data, delays in publication of it, lack of detail in health indicators and heterogeneity of regional trends which makes prediction for the long-term effects on labor potential difficult. The originality of the findings resides in the use of macrosocial analysis and public administration institutional mechanisms enabling a more comprehensive insight into the State's contribution to post-war reconstruction of human capital. The practical significance of the work lies in the possibility to apply its outcomes in development of retraining programs, digital human resource management services; restore educational organizations; establish regional centers of expertise. The mainstream of research in this area future is to build a model for the integration of IDPs into regional labor markets, to study demographic crises based on military factors forecasts on the dynamics of the population's digital literacy and effectiveness analysis of public policy tools under conditions changing rapidly global economy. In the long run, a comprehensive consideration of how institutional capacity can interplay with social stability and innovation potential will be required to project what path Ukraine is likely to follow in terms of its human capital development in the post war period.

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