



**The Effect of the War on Human Capital in Ukraine
and the Path for Rebuilding***

Yuriy Gorodnichenko[†] Marianna Kudlyak[‡] Ayşegül Şahin[§]

Economics Working Paper 22122

HOOVER INSTITUTION
434 GALVEZ MALL
STANFORD UNIVERSITY
STANFORD, CA 94305-6010

June 9, 2022

In February 2022, Russia launched a full-scale invasion of Ukraine. The ensuing war has a devastating destructing impact in Ukraine. This article focuses on the humanitarian cost of war. The article develops a framework for the analysis of the effect of a war on country's human capital. We then identify the following key directions for rebuilding and further developing human capital in Ukraine: quantity and quality of schooling for children, quality of higher education, training and retraining programs for adults, assistance for people with disabilities, post-deployment re-integration into civilian sector, population growth and fertility, and promotion of self-motivating mechanisms.

Keywords: Human capital, growth, schooling, skills of the future, health, war, displacement
JEL Codes: I2, J24, O4

The Hoover Institution Economics Working Paper Series allows authors to distribute research for discussion and comment among other researchers. Working papers reflect the views of the authors and not the views of the Hoover Institution.

* Any opinions expressed are those of the authors and do not reflect those of the Federal Reserve Bank of San Francisco, the Federal Reserve System or any other organization with which authors are affiliated. The authors thank, without implicating, Bob Hall, Eric Hanushek, Viktor Tsyrennikov and Vitaliia Yaremko for useful comments.

[†] Department of Economics, University of California, Berkeley; NBER, CEPR, IZA. ygorodni@econ.berkeley.edu

[‡] Federal Reserve Bank of San Francisco; Hoover Institution, CEPR, IZA.

[§] Department of Economics, the University of Texas at Austin; NBER. aysegul.sahin@austin.utexas.edu

Contents

1	Introduction	3
2	Theoretical Framework for the Effect of War on Human Capital	3
2.1	Model of human capital	4
2.2	Channels of the effect of war on human capital	5
3	Humanitarian Situation in Ukraine	6
4	The Effect of the War on Human Capital in Ukraine	7
4.1	Schooling of children	8
4.2	Human capital of adults	9
4.3	Reallocation from civilian to military sector	10
5	Directions for Rebuilding of Human Capital	10
5.1	Schooling	10
5.2	Quality of higher education	11
5.3	Training and retraining programs for adults	11
5.4	Assistance for people with disabilities	11
5.5	Re-integration into civilian sector	12
5.6	Population growth and fertility	12
5.7	Encouragement of self-motivating mechanisms	12
6	Conclusion	13

1 Introduction

In February 2022, Russia launched a full-scale invasion of Ukraine, which has already caused a major destruction and loss of human life in the country. The war continues to have profound effects on the Ukrainian population. Rebuilding the Ukrainian economy and planning to revive the economic and social livelihood of Ukraine are of foremost importance. The economic growth literature (e.g., Christensen, Cummings, and Jorgenson (1980) and Gilchrist and Williams (2004)) has extensively analyzed the economic performances of various countries following World War II and identified accumulation of physical capital, human capital accumulation and technological catch-up as important factors for economic and social recovery. This article focuses on the effect of the war on country's human capital and identifies key directions for rebuilding human capital in Ukraine.

We develop a simple framework to identify the key channels of the human capital consequences of the war. The war has direct and immediate effects on the size of the workforce because of the increase in deaths, military mobilization, and increased migration out of the country. In addition to these immediate adverse effects, there are various other channels that likely have long-lasting consequences. The disruption of schooling of younger cohorts, the decline in fertility and human capital depreciation due to loss of potential work experience and deterioration of health—all contribute negatively and persistently to the human capital stock of the country. Identifying these persistent effects is important since recovery critically relies on addressing them. Although our analysis is qualitative, we can combine our theoretical framework, findings from the existing literature and empirical evidence on the humanitarian impact of the war in Ukraine to develop directions for rebuilding human capital in Ukraine.

The rest of the article is structured as follows. Section 2 outlines a simple model of country's human capital and describes channels through which war impacts human capital. Section 3 describes the humanitarian situation in Ukraine. Section 4 qualitatively summarizes human capital losses using the framework outlined in Section 2. Section 5 outlines key directions for rebuilding of human capital. Section 6 concludes.

2 Theoretical Framework for the Effect of War on Human Capital

Human capital is the skills, knowledge, and experience possessed by an individual or population, viewed in terms of their value or cost to an organization or country. Human capital encompasses education, technical or job-related skills, health, mental and emotional well-

being, and other qualities. The concept was developed in the 1950s and early 1960s in Becker (1964), Schultz (1961), and Mincer (1958). In this section, we lay out a parsimonious model of human capital to understand the possible channels of the impact of a war on country's human capital and, subsequently, the country's economic growth.

2.1 Model of human capital

Consider an economy that produces output using two inputs—physical and human capital. We can write the economy's production technology as

$$Y_t = A_t K_t^\alpha H_t^{1-\alpha}, \quad (1)$$

where Y_t is the output in period t , K_t is the stock of capital in t , H_t is the stock of human capital in t , A_t is a technology index, and $0 < \alpha < 1$.

The stock of country's human capital is the sum of the human capital stocks of working cohorts in the economy,¹ i.e.,

$$H_t = \sum_{a=0}^T h_t(a) L_t(a), \quad (2)$$

where a captures cohort's age at time t , $L_t(a)$ is the number of workers in cohort a at time t , $h_t(a)$ is their level of human capital, and T is some high terminal age number after which most cohorts are not productive. A cohort is uniquely identified by its age a at time t .

The number of workers in a cohort evolves according to the following law of motion

$$L_t(a) = (1 - d_t(a)) L_{t-1}(a - 1), \text{ for } a > 1 \text{ and given } L_t(0) > 0, \quad (3)$$

where $d_t(a)$ is the outflow rate of cohort a in t and $L_t(0)$ is the size of the newborn cohort in t . A war causes an increase in $d_t(a)$ not only through an increase in the death rate but also through military mobilization.²

Human capital of each cohort evolves as follows

$$h_t(a) = 0, \text{ for } a < s(t, a) \text{ and } a \geq T(t, a) \quad (4)$$

$$h_t(a) = f(t, a), \text{ for } a = s(t, a) \quad (5)$$

$$h_t(a) = (1 - \delta_t(a)) h_{t-1}(a - 1) + i_t(a), \text{ for } a > s(t, a), \quad (6)$$

¹The cohort approach is used by, for example, Bils and Klenow (2000).

²The model does not incorporate migration out of the country and a return of people from abroad. Such migration can be incorporated in the model. Those who emigrate do not lose their human capital so those losses might be treated differently. Moreover, there could well be direct returns to the country-of-origin through remittances of these emigrants.

where $\delta_t(a)$ is the depreciation rate of human capital of cohort a in t , $i_t(a)$ is the investment in human capital of cohort a in t , $f(t, a)$ is the human capital from schooling, $s(t, a)$ is the years of schooling, and $T(t, a)$ is the retirement age of the cohort defined by a in t . Note that $s(t, a)$, $f(t, a)$, and $T(t, a)$ remain fixed throughout the life of the cohort uniquely defined by (t, a) .

Eq. (4)-(6) show that prior to completion of schooling, a cohort's contribution to the aggregate human capital is zero. Once schooling is complete, at the cohort-specific age $s(t, a)$, each member of the cohort contributes $f(t, a)$ units of human capital. $f(t, a)$ captures the quantity and quality of schooling that cohorts receive. The quality of schooling might depend on the quality of teachers, curriculum, resources devoted to schooling and other factors.

Cohort's human capital depreciates at an annual rate $\delta_t(a)$. The depreciation captures both deterioration of skills and deterioration of the cohort's health. Deterioration of skills can be due to, for example, the emergence of new technologies that require new skills and render the existing skills obsolete.

Human capital building does not stop with schooling though, cohort a can continue building its capital by investing in it, which is captured by term $i_t(a)$. Investment in human capital can take a form of higher education, job training, investment in physical and mental health.

Finally, after some age $T(t, a)$, a cohort retires and no longer contributes to country's aggregate human capital. The model can be extended to allow the retired cohorts contribute to schooling of the newborn cohorts (see, for example, Bils and Klenow (2000)).

2.2 Channels of the effect of war on human capital

A war affects country's human capital through two main channels: the size of country's population and the productivity (quality) of its human capital:

- Size of workforce:
 - cohort outflow rate, $d_t(a)$, which encompasses the cohort death rate,
 - size of the birth cohort, $L_t(0)$,
 - age at which cohorts retire, $T(t, a)$
- Productivity:
 - years of schooling, $s(t, a)$,
 - quantity and quality of schooling, $f(t, a)$,
 - investment in human capital, $i_t(a)$,

- depreciation rate of human capital, $\delta_t(a)$, which captures loss of skills as well as deterioration of physical and mental health

All the effects of the war are negative. Given the dynamic nature of human capital, any impact in period t has long-lasting consequences for future human capital and, consequently, output.

In this article, we focus primarily on the impact of the war on the human capital. The war impacts human capital as well as physical capital and the country’s technology index (see eq. (1)). For a parsimonious measurement framework for valuing output losses from the lost potential growth, see, for example, Tsyrennikov (2022). Blinov and Djankov (2022) discusses that rebuilding the economy will require large investments in both human and physical capital, with support from international institutions, as well as upgrading the institutional environment conducive to economic growth. KSE (2022) provides calculations of the direct damage caused to Ukraine’s infrastructure during the war.³

3 Humanitarian Situation in Ukraine

Since the start of the war, a large number of people have been killed or wounded. The Office of the UN High Commissioner for Human Rights (OHCHR) reports that the actual figures are considerably higher than the official statistics because the receipt of information from some locations where intense hostilities have been going on has been delayed and many reports are still pending corroboration. As of May 27, OHCHR recorded more than 8.7 thousands civilian casualties in Ukraine — 4,031 killed and 4,735 injured (see Table 1 for the data sources in this section). Among those killed, 261 are children.

The civilian casualties and destruction of civilian infrastructure forced people to flee their homes seeking safety. Since the start of the war, more than 6.74 million refugees has fled Ukraine (as of May 27th). The ILO estimates that of the total refugee population, two-thirds have an advanced (tertiary) level of education and 49 percent were employed in high-skilled occupations (ILO (2022)). As of May 27th, as Ukrainian army has liberated some of the occupied territories, 2.2 million of refugees returned.

A further 7.7 million people have been displaced internally within Ukraine. And 13 million people in Ukraine are estimated to be stranded in affected areas or unable to leave due to heightened security risks, destruction of bridges and roads, as well as lack of resources or information on where to find safety and accommodation.

³For the analysis of the effect of the Russian invasion from 2014 to February 2022, see Aslund (2018), Melnyk, Pavlyuk, Petrov, and Glushko (2019), Havlik, Kochnev, and Pindyuk (2020), Kharitonov (2020).

Table 1: Humanitarian Situation in Ukraine

	Number (1)	Period (2)	Source (3)
Total population	43,467,000	2021	1
Killed	4,031	02/24-05/26 2022	2
Injured	4,735	02/24-05/26 2022	2
Refugees, left the country	6,737,208	02/24-05/27 2022	3
Refugees, returned back	2,229,500	02/28-05/27 2022	3
Internally displaced	7.7 million	02/24-04/29 2022	4
Stranded in affected areas	13 million	02/24-04/29 2022	4
Forcefully evacuated to the invading country	1.2 million	02/24-05/09 2022	5

Notes: Sources

1. <https://data.un.org/en/iso/ua.html>
2. <https://ukraine.un.org/en/183647-ukraine-civilian-casualties-26-may-2022>
3. <https://data2.unhcr.org/en/situations/ukraine>
4. <https://data2.unhcr.org/en/documents/download/92353>
5. Jewers (2022).

Additionally, more than 1.2 million individuals were forcefully evacuated to the invading country against their will (Jewers (2022)).

Summing up all the displaced populations (as of May 27th)—6.7 million, 7.7 million, 13 million, and 1.2 million, brings the total count to of displaced individuals to at least 28.6 million individuals, not counting those killed and injured. This constitutes more than 2/3 of the entire population of Ukraine.

4 The Effect of the War on Human Capital in Ukraine

In this section, we qualitatively summarize human capital losses described in Section 3 using the framework outlined in Section 2. This qualitative analysis will help us lay out key directions for rebuilding, which we discuss at the end of the article. We leave the quantitative analysis for future work.

We identify the following channels via which the war in Ukraine affects human capital:

1. Quantity—loss of human life
2. Quality—impact on productivity of human capital through
 - (a) Schooling of children

- (b) Adults' skills
 - (c) Physical and emotional health
3. Growth—impact on accumulation of human capital
 4. Reallocation from civilian to military sector

Below, we describe a few of these channels in some detail.

4.1 Schooling of children

During the war, children experience a disruption of schooling from being stranded in war-affected areas, from being displaced—either internally or to other countries, or from disruptions to schooling without displacement. A long-standing literature documents that even small disruptions to schooling have large negative effects on learning.

The loss of schooling has an impact on an individual and on the aggregate level (Hanushek and Woessmann (2020)). On an individual level, a loss of schooling decreases life-time earnings. Hanushek and Woessmann (2020), summarising research on the economics of education, find that each additional year of schooling increases life income by an average of 7.5-10%. On an aggregate level, a loss of schooling lowers accumulation of aggregate human capital, thereby lowering aggregate output growth.

Justino (2011) describes how the level and access to education of civilian and combatant populations affected by violence has the long-term human capital consequences. Ichino and Winter-Ebmer (2004) study the loss of human capital suffered by school-age children who receive less education during the World War II. They find that Austrian and German individuals who were 10 years old during the conflict, or were more directly involved through their parents, received less education than comparable individuals from non-war countries. They also show that these individuals experienced a sizable earnings loss some 40 years after the war, which can be attributed to the educational loss caused by the conflict. Akbulut-Yuksel (2022) presents evidence from WWII and the Vietnam War of how childhood war exposure had detrimental effects on education, physical and mental health, and labour market outcomes, even decades after the conflicts. Akbulut-Yuksel suggests that resources available during wartime are essential to reduce the enduring effects of war. Bruck, Maio, and Miaari (2022) discuss negative effect of a war on academic achievement, concluding that governments of war-affected countries should focus on maintaining as much as possible appropriate social infrastructures and by trying to counteract the psychological burden of experiencing violent events on children.

Furthermore, the impact of the war on schooling is layering on the impact of the pandemic on schooling. Hanushek and Woessmann (2020) find that a loss of one-third of a year in effective learning for just the students affected by the closures of early 2020 of the pandemic will, by historical data, lower a country's GDP by an average of 1.5% over the remainder of the century.

4.2 Human capital of adults

Massive internal displacements, reallocation of refugees to other countries, and civilians being stranded in the zones of active war actions cause adults to lose their jobs.

Pindyuk (2022) reports that according to a representative survey conducted in Ukraine by Info Sapiens during March 24-28, 2022 unemployment in Ukraine reached 29%. Of those who have not lost their jobs, only 37% received their March salary in full, while 26% did not receive any salary at all. Astrov, Ghodsi, Grieveson, Holzner, Kochnev, Landesmann, Pindyuk, Stehrer, and Tverdostup (2022) reports that economic activity has practically ceased in the regions that have come under attack, apart from the maintenance of public utilities, basic retail trade and medical services, where possible. Astrov et al. (2022) report that Finance Minister of Ukraine estimates that by mid-March 2022, the war had forced 30% of the economy to stop working, and that according to the Ministry of Economy, the losses from the war so far could amount to between a third and a half of the country's GDP in 2022.

International Labor Organization estimates that as of May 2022 4.8 million jobs have been lost with respect to the pre-war situation, equal to 30 per cent of pre-war employment in Ukraine (ILO (2022)).

There are at least two ways in which human capital of the adults who lose their jobs deteriorates. First, human capital might deteriorate when people are not working. Although there is some variation in the estimates of how quickly human capital depreciates, Blundell, Dias, Meghir, and Shaw (2016) and Dinerstein, Megalokonomou, and Yannelis (2020) suggest that a year without work reduces human capital by 4 to 8 percent. Hence, a year of war can result in large decreases in human capital. Second, the post-war economy might require different set of skills.⁴ The evidence from the China shock in the U.S. and other countries suggest that labor adjustment may be slow and costly (see Autor, Dorn, and Hanson (2016) for a survey).

⁴For example, because coal mines in Ukraine may not be operational after the war, miners will need to re-skill for another jobs.

4.3 Reallocation from civilian to military sector

The number of deaths and injuries reported in Section 3 refer to civilian population. However, the war has led to a large reallocation of civilians to the military sector. The losses reported in Section 3 do not take into account losses and injuries of the military as well as reallocation of production from the civilian to military sectors. This is an important part of the country's human capital and future human capital building strategy; we leave this direction for future research.

5 Directions for Rebuilding of Human Capital

The parsimonious model of human capital in Section 2 allows perfect substitution between the number of people in each cohort and their level of human capital as well as substitution of human capital from different cohorts. While in the data the substitution is not perfect, we outline directions for rebuilding both the quantity and quality of human capital.

We identify the following directions for rebuilding of human capital in Ukraine:

1. Quantity and quality of schooling for children
2. Quality of higher education
3. Training and retraining programs for adults
4. Assistance for people with disabilities
5. Re-integration into civilian sector
6. Population growth and fertility
7. Promotion of self-motivating mechanisms

5.1 Schooling

Quantity and quality of schooling are one of the key inputs into human capital growth. Quality includes the development of relevant curriculum and providing resources for teachers and schooling infrastructure.

Heckman (1998), summarizing a large body of the literature, concludes that economic theory demonstrates that the returns to human capital investment are greatest for the young because, first, younger people have longer horizon over which to recoup the return on their investments, and, second, because skill begets skill. Heckman (2006) summarizes evidence on the effects of early environments on child, adolescent, and adult achievement and concludes

that life cycle skill formation is a dynamic process in which early inputs strongly affect the productivity of later inputs.

Hanushek and Woessmann (2016) argue that the key determinant of GDP growth is not the years of schooling but the quality of schooling, e.g., the skills developed in schools. Specifically, their empirical model that includes years of schooling accounts for 25% of the variance in country growth rates, compared with 79% when test scores, which measure quality of schooling, are included.

Angrist, Djankov, Goldberg, and Patrinos (2022) list a number of policy implications for providing education for temporarily displaced children during the war in Ukraine: (1) opening classes for Ukrainian refugees in selected schools in neighbouring countries, as well as expanding schools in parts of Ukraine where many internally displaced families have moved; (2) online, by-phone, or in-person tutoring; (3) adapting curricula – including printing textbooks in Ukrainian – in countries receiving refugees so that a large number of refugee children can regain access to standard schooling.

5.2 Quality of higher education

Quality of higher education is one of the factors that help build country’s human capital. Special attention should be paid to the skills of the future (see, for example, Brynjolfsson and Mitchell (2017)).

5.3 Training and retraining programs for adults

The large-scale displacement suffered by the Ukrainian population as a result of the war (see Sections 3 and 4.2) led to loss of jobs. In the post-war economy, some jobs will return but some jobs will be replaced by new jobs.

The goal is to identify occupations and, more specifically, skills for the post-war economy and established training and retraining centers for the displaced adult population. Construction, civil engineering, health, information technology are the industries that will likely be the key industries in the post-war economy, as well as the pre-war agricultural export industries.

5.4 Assistance for people with disabilities

Health is one of the factors contributing to the quality of human capital. The number of people physically injured during the war continues to grow. Many of the injured lost their limbs.

The statistics on the emotional and mental impact of the war are scarce but a negative impact of war on overall health is large. Murthy and Lakshminarayana (2006), reviewing research findings on mental health consequences of war, find that among the consequences of war, the impact on the mental health of the civilian population is one of the most significant. They write that studies of the general population show a definite increase in the incidence and prevalence of mental disorders; women are more affected than men; other vulnerable groups are children, the elderly and the disabled.

Disability-inclusive infrastructure and workplace policies can empower and make it easier for people with disabilities to be part of societal rebuilding and development. ICED (2019) outlines key challenges and opportunities in legislating for, designing and financing disability inclusive infrastructure.

5.5 Re-integration into civilian sector

A separate focus should be devoted to re-integration of the individuals serving in the Armed Forces of Ukraine or participating in the Territorial Defence Forces (e.g., the military reserve component of the army) into civilian life after deployment or for those who choose to return to the civilian life. This re-integration requires tailoring occupational training and health programs to the specific needs of the individuals who participated in the combat activities (Angrist (1990)). See, for example, Dunigan, Gore, Kidder, Schwille, Cherney, and Sladden (2020) for a review and analysis of practices across U.S. federal agencies.

5.6 Population growth and fertility

The policies that focus on fertility can help boost human capital by increasing the size of new birth cohorts. Such policies can include lump-sum payments for having a child.

5.7 Encouragement of self-motivating mechanisms

The country can encourage human capital building by developing policies that motivate investment in human capital. These incentives can be fiscal as well as non-fiscal (see, for example, Heckman (1998)).

Becker, Grosfeld, Grosjean, Voigtlae, and Zhuravskaya (2020) study the long-run effects of forced migration on investment in education. After World War II, millions of Poles were forcibly uprooted from the Kresy territories of eastern Poland and resettled in the newly acquired Western Territories, from which the Germans were expelled. We combine historical censuses with newly collected survey data to show that, while there were no pre-WWII differences in educational attainment, Poles with a family history of forced migration are

significantly more educated today than other Poles. These results are driven by a shift in preferences away from material possessions toward investment in human capital.

Justino (2022) argues that evidence from other wars, the economic, social, and political recovery of Ukraine will be dependent not only on bringing refugees back and reconstructing markets and infrastructure, but also on ensuring that social cohesion and trust in institutions is rebuilt so that any Ukraine post-war government is able to succeed in maintaining a united population.

Self-incentives could be amplified by easier access to retraining, better labor markets and regulation, improved working conditions and other mechanisms that enhance quality of life.

6 Conclusion

The war in Ukraine has led to catastrophic economic and humanitarian losses—deaths, injuries, displacements, negative impact on physical and mental health. The country’s human capital has suffered substantial negative impact that has a potential to last for a long period of time. As the war continues, the losses will continue to mount.

We outline possible directions for human capital rebuilding and development. A work along these directions requires a strategic plan for the development of the post-war economy in Ukraine and a quantitative assessment. The plan requires an agenda for development of industries and occupations as well as for general institutional and regulatory environment. Some work has already started in the Blueprint for Reconstruction of Ukraine (Becker, Eichengreen, Gorodnichenko, Guriev, Johnson, Mylovanov, Rogoff, and di Mauro (2022)).

References

- Akbulut-Yuksel, Mevlude. 2022. “Unaccounted Long-Term Health Cost of Wars on Wartime Children.” *Vox EU* 10 May.
- Angrist, Joshua D. 1990. “Lifetime Earnings and the Vietnam Era Draft Lottery: Evidence from Social Security Administrative Records.” *The American Economic Review* 80 (3).
- Angrist, Noam, Simeon Djankov, Pinelopi Goldberg, and Harry Patrinos. 2022. “The Loss of Human Capital in Ukraine.” *Vox EU* 27 April.
- Aslund, Anders. 2018. “Kremlin Aggression in Ukraine: the Price Tag.” Report, <https://www.atlanticcouncil.org/in-depth-research-reports/report/kremlin-aggression-in-ukraine-the-price-tag/> March 19, 2018, wiiw.
- Astrov, Vasily, Mahdi Ghodsi, Richard Grieveson, Mario Holzner, Artem Kochnev, Michael Landesmann, Olga Pindyuk, Robert Stehrer, and Maryna Tverdostup. 2022. “Russia’s Invasion of Ukraine: Assessment of the Humanitarian, Economic and Financial Impact in the Short and Medium Term.” Policy Note/Policy Report 59, April, wiiw.
- Autor, David H., David Dorn, and Gordon H. Hanson. 2016. “The China Shock: Learning from Labor-Market Adjustment to Large Changes in Trade.” *Annual Review of Economics* 8 (1):205–240. URL <https://ideas.repec.org/a/anr/reveco/v8y2016p205-240.html>.
- Becker, Gary S. 1964. *Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education*. Columbia University Press, New York.
- Becker, Sascha O., Irena Grosfeld, Pauline Grosjean, Nico Voigtlae, and Ekaterina Zhuravskaya. 2020. “Forced Migration and Human Capital: Evidence from Post-WWII Population Transfers.” *American Economic Review* 110 (5):1430–63.
- Becker, Torbjorn, Barry Eichengreen, Yuriy Gorodnichenko, Sergei Guriev, Simon Johnson, Tymofiy Mylovanov, Kenneth Rogoff, and Beatrice Weder di Mauro. 2022. “A Blueprint for the Reconstruction of Ukraine.” *Vox EU* 7 April.
- Bils, Mark and Peter J. Klenow. 2000. “Does Schooling Cause Growth?” *American Economic Review* 90 (5):1160–1183.
- Blinov, Oleksiy and Simeon Djankov. 2022. “Ukraine’s Recovery Challenge.” *Vox EU* 31 May.

- Blundell, Richard, Monica Costa Dias, Costas Meghir, and Jonathan Shaw. 2016. “Female Labor Supply, Human Capital, and Welfare Reform.” *Econometrica* 84 (5):1705–1753. URL <https://ideas.repec.org/a/wly/emetrp/v84y2016ip1705-1753.html>.
- Bruck, Tilman, Michele Di Maio, and Sami Miaari. 2022. “Learning the Hard Way: The Effect of Conflict on Education.” *Vox EU* 19 April.
- Brynjolfsson, Erik and Tom Mitchell. 2017. “What Can Machine Learning Do? Workforce Implications.” *Science* 358 (6370):1530–1534.
- Christensen, Laurits R., Dianne Cummings, and Dale Jorgenson. 1980. “Economic Growth, 1947-1973: An International Comparison.” *New Developments in Productivity Measurement*, John W. Kendrick and Beatrice N. Vaccara, eds., University of Chicago Press 41:595 – 698.
- Dinerstein, Michael, Rigissa Megalokonomou, and Constantine Yannelis. 2020. “Human Capital Depreciation.” Working Paper 8614, CESifo. URL https://ideas.repec.org/p/ces/ceswps/_8614.html.
- Dunigan, Molly, Kristie L. Gore, Katherine L. Kidder, Michael Schwille, Samantha Cherney, and James Sladden. 2020. “Civilian Post-Deployment Reintegration: A Review and Analysis of Practices Across U.S. Federal Agencies.” Tech. rep., Santa Monica, CA: RAND Corporation.
- Gilchrist, Simon and John C. Williams. 2004. “Transition Dynamics in Vintage Capital Models: Explaining the Postwar Catch-Up of Germany and Japan.” Working Paper 2004-14, Federal Reserve Bank of San Francisco.
- Hanushek, Eric A. and Ludger Woessmann. 2016. “Knowledge Capital, Growth, and the East Asian Miracle.” *Science* 351 (6271):344–345.
- . 2020. *The Economic Impacts of Learning Losses*. Paris: Organisation for Economic Co-operation and Development.
- Havlik, Peter, Artem Kochnev, and Olga Pindyuk. 2020. “Economic Challenges and Costs of Reintegrating the Donbas Region in Ukraine.” Research Report 447, wiiw.
- Heckman, James. 1998. “What Should Be Our Human Capital Investment Policy?” *Fiscal Studies* 19 (6271):103–119.
- . 2006. “Skill Formation and the Economics of Investing in Disadvantaged Children.” *Science* 312 (5782):1900–2.

- ICED. 2019. “Delivering Disability Inclusive Infrastructure in Low Income Countries.” Report, http://icedfacility.org/wp-content/uploads/2019/07/iced_dii_ics.pdf, *Infrastructure and Cities for Economic Development*.
- Ichino, Andrea and Rudolf Winter-Ebmer. 2004. “The Long-Run Educational Cost of World War II.” *Journal of Labor Economics* 22 (1):58–86.
- ILO, International Labor Organization. 2022. “The Impact of the Ukraine Crisis on the World of Work: Initial Assessments.” *ILO Brief*, <https://www.ilo.org/wcmsp5/groups/public/—europe/—ro-geneva/documents/briefingnote/wcms844295.pdf> May 11.
- Jewers, Chris. 2022. “Putin has forcibly deported 1.2MILLION Ukrainians to Russia and put them in ‘filtration camps’ – including mother of four-year-old girl who ‘was snatched off the street and separated from her daughter.” *Daily Mail*, <https://www.dailymail.co.uk/news/article-10798771/Putins-troops-forcibly-removed-nearly-1-2MILLION-Ukrainians-sent-Russia-officials-say.html> May 9.
- Justino, Patricia. 2011. “Violent Conflict and Human Capital Accumulation.” Working Paper 379, Institute of Development Studies.
- . 2022. “The War in Ukraine: Civilian Vulnerability, Resilience, and Resistance.” *Vox EU* 14 April.
- Kharitonov, Konstantin. 2020. “System of Estimation of Losses of the National Economy during the Armed Conflict (War).” *Journal of Scientific Papers “Social Development and Security”* 10 (6).
- KSE. 2022. “Direct Damage Caused to Ukraine’s Infrastructure during the War Has Reached over USD105.5 billion.” Report, accessed on may 29th 2022., Kyiv School of Economics, <https://kse.ua/about-the-school/news/direct-damage-caused-to-ukraine-s-infrastructure-during-the-war-has-reached-over-105-5-billion/>.
- Melnyk, Nataliia, Alina Pavlyuk, Maksim Petrov, and Olena Glushko. 2019. “Armed conflict in the East of Ukraine: the damage caused to the housing of the civilian population.” Report, Kharkiv: Ilb “Human Rights Publisher”, https://www.undp.org/sites/g/files/zskgke326/files/migration/ua/02-3_d_sos_Armed_conflict_in_eastern_Ukraine_english.pdf.
- Mincer, Jacob. 1958. “Investment in Human Capital and Personal Income Distribution.” *Journal of Political Economy* 66 (Aug.):281–302.

- Murthy, R. Srinivasa and Rashmi Lakshminarayana. 2006. "Mental health consequences of war: a brief review of research findings." *World Psychiatry* 5 (1):25–30.
- Pindyuk, Olga. 2022. "UKRAINE: Losses from the War Are Mounting." *in: Over-shadowed by War and Sanctions wiiw Forecast Report* Spring (April 2022):130–133, <https://wiiw.ac.at/ukraine-losses-from-the-war-are-mounting-p-6165.html>.
- Schultz, Theodore W. 1961. "Investment in Human Capital." *American Economic Review* 51 (1).
- Tsyrennikov, Viktor. 2022. "A Trillion-Dollar Question: What Russia Owes Ukraine." *Vox EU* 6 April.