



Ukraine: Post-War Economic & Workforce Development

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Abstract

As of June 2022, the cost to rebuild Ukraine's infrastructure destroyed by Russia likely exceeds \$1 trillion. With forecasted high poverty rates, social services will likely cost an additional \$1 trillion until Ukraine can financially self-sustain. Lastly, the cost to recapitalize and make Ukrainian companies operational following the war may cost an additional \$1 trillion.

Given the size of the financial challenge, Ukraine's future economic health and speed of recovery depend on Foreign Direct Investment. Ukraine's ongoing corruption challenges and increased geopolitical risk will make a material foreign investment into high-value manufactured goods export industries difficult. However, high-value service exports are risk tolerant.

The world is in the early stages of what will likely be the largest and most impactful skilled talent shortage in history. The world likely will experience a shortage of 85 million technology and tech-enabled workers by 2030. Given Ukraine's high Tertiary Education Rate, the country is uniquely positioned to become a primary destination economy for multinational corporations (MNCs) seeking an elite workforce. Ukraine should target an ICT Service Exports Per Capita rate of \$1,500 – up from \$163 in 2021. The target is achievable and would generate \$64 billion in high-value exports- up from \$7.11 billion in 2021.

Given changes in the world of work stemming from new technologies such as artificial intelligence, IoT, and automation, these same skills will be needed to help rebuild Ukraine following the war.

While the target is achievable, Ukraine's success will be primarily constrained by its ability to engage MNCs in collaborative workforce development and consumption programs. Fortunately, reference programs (such as the Center for Biostatistical Programming- created by Mr. Hatch) demonstrate MNC's enthusiasm for partnering with Ukraine in creating elite talent.

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I have worked with the people of Ukraine for many years. While the war is heartbreaking beyond comprehension, the hope and enthusiasm of the people in the face of such hardship are inspirational. I believe in the people of Ukraine!

The world is transitioning through a new industrial revolution that changes every aspect of business. The workforce needed within this new world will be far more technical than in any previous time. The world does not naturally produce enough of these new workers, creating significant challenges for companies. However, this shortage of workers also creates enormous opportunities for countries to emerge as leaders in the technology workforce world.

Ukraine has immense potential to become a leader in the future workforce space. However, Ukraine must take steps now to prepare for the growth of its technology workforce and industry following the war.

In 2013, Mr. Hatch (then a senior executive with ManpowerGroup-Experis) created a joint venture between the pharmaceutical industry and Ukrainian universities. The joint venture worked together to create high-value workers that the pharmaceutical industry needs.

Ukraine needs more of these programs. Specifically, Ukraine needs international employers to work with universities to create an elite workforce at scale. Ukraine needs these relationships now.

If these programs are approached using lessons learned from Mr. Hatch's efforts, Ukraine will likely gain significant support from multinational corporations in developing its greatest asset- the people of Ukraine.

I encourage President Zelensky to take moderate steps now to create such a collaborative workforce and technology industry development programs with active involvement from major international employers. The world is asking how to help Ukraine further. Give multinational companies a framework for helping Ukraine emerge stronger and better after the war.

-David Arkless
June 2nd, 2022



I first traveled to Ukraine almost twenty years ago after accepting a senior executive role with a US technology company with delivery centers in Kharkiv. For some reason, Ukraine resonated with me and became a major dynamic in my personal and professional life.

The war in Ukraine, for me, is not a news story. The Russian invasion of Ukraine is personal. I have many friends and former employees directly affected by this war. I must act.

Over the years, I have helped launch Ukrainian outsourcing firms and provided advisory services to the Ukrainian government. Starting with Vice Prime Minister Semynozhenko through various ruling regimes over the years, I have been extensively involved in the technology industry. I introduced companies such as Disney and Roche to the Ukrainian workforce.

As a senior executive with ManpowerGroup/Experis, I created a business group that partnered major international employers with public-sector agencies and academia to collaboratively create a scalable and modern workforce. In 2013, I launched a pilot program partnering with Roche, a local outsourcing firm, Experis, and V.N. Karazin Kharkiv National University that created biostatistical programmers the global pharmaceutical industry needed. This program thrived until the Russian invasion of Ukraine in February 2022. Ukraine became arguably the top workforce for elite biostatistical programming through this program.

Ukraine needs similar programs now. Given changes in the world of work and the scale of devastation, Ukraine needs multinational corporation involvement and investment in further developing the Ukrainian workforce. The timing and extent of such partnerships between Ukraine and global employers will likely dictate the speed of Ukraine's economic recovery following the end of the war.

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Executive Summary

The cost to rebuild Ukraine following the end of the war, combined with likely high social services costs until Ukraine can financially self-sustain and the need to recapitalize Ukrainian companies, may total between \$2 - \$3 trillion. Adjusted for inflation, the Marshall Plan totaled \$155.95 billion. Some form of reconstruction program like the Marshall Plan, extensively backed by Western nations combined with various financial instruments from IGOs such as IMF, will likely leave Ukraine with a shortfall well exceeding \$1 trillion. Ukraine will need to materially increase FDI to rebuild the nation following the war's end.

International corporations do not approach FDI as a grant. FDI, by nature, is an investment with involved parties expecting a return on their investment. Fortunately, Ukraine has an under-commercialized asset in great demand and is a proven opportunity for material FDI: The workforce.

By 2030, international employers may experience a shortage of skilled workers totaling 85 million people. This skilled talent shortage may cost global employers over \$8.5 trillion in revenues because they cannot find the talent they need. (Korn Ferry, 2018)

The risk to global employers stemming from the skilled talent shortage is significant enough that companies are making significant investments in collaborative workforce development programs. Microsoft launched a program in partnership with NASSCOM in India to create 1 million AI workers in 2021 alone. (Microsoft, 2020)

Ukraine has the raw components needed to become a globally recognized destination workforce for the technology industry with widespread involvement from MNCs in developing the workforce further. Ukraine has enormous potential for growth within the technology industry and can generate industry growth, jobs, and industry-related FDI.

Ukraine needs to begin engaging MNCs on various collaborative workforce development programs immediately. Doing so will help hedge the anticipated talent flight following the war, provide Ukraine with STEM workers needed to rebuild the country, seed a thriving technology industry, and generate material FDI.

Doing so will likely transform the country. With MNC involvement, Ukraine can likely grow its ICT industry from \$7.11 billion (2021) to over \$60 billion.

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Source Data and Considerations

Primary Data Sources

World Bank	World Development Indicators	https://databank.worldbank.org/
International Monetary Fund	Balance of Payments	https://data.imf.org/
International Labor Organization	ILOSTAT	https://ilostat.ilo.org/
UNESCO	UNESCO Institute for Statistics	http://data.uis.unesco.org/
United Nations	UN Comtrade Database	https://comtrade.un.org/
Transparency International	Corruption Perceptions Index	https://www.transparency.org/
glassdoor	Salaries	https://www.glassdoor.com
Korn Ferry	Global Talent Shortage	https://www.kornferry.com
World Bank	GovData360	https://govdata360.worldbank.org/

Considerations & Assumptions

1. Not all countries follow common recommendations for categorizing packaged software, software development, and technology hardware (goods) exports- such as the Handbook on Measuring Digital Trade. (OECD, WTO, & IMF, 2020) ICT Service Exports (indicator code BXSOTCM_BP6_USD) will be the primary indicator for all technology service exports.
2. Not all economies report using the IMF BoP BPM6 standard. Economies not in compliance with BPM6 are excluded from analysis.
3. As of the date of writing this report, not all countries have reported all data for 2021. For countries that have not reported a value for a specific indicator in 2021 used in a model, their 2020 value will be used.
4. If there is an omission for a country's indicator in a specific year, the value will be calculated by averaging the preceding and following year's indicator value.
5. Statistical outliers that report significantly high BoP or COMTRADE data due to various tax schemes (such as Luxembourg) are omitted from models.
6. Given the uncertainty in migration due to Russia's invasion of Ukraine in 2022, forward-looking calculations will use Ukraine's 2021 population.

Acronyms & Definitions

AI	Artificial Intelligence
BOP	Balance of Payments
COE	Center of Excellence
COMTRADE	UN Comtrade Database (official trade statistics)
CPI	Transparency International's Corruption Perceptions Index
FDI	Foreign Direct Investment
HS	Harmonized System export categorization.
HTP	High Technology Park. A tech-centric SEZ.
ICT	Information, Computer, and Technology
ILO	International Labor Organization
IMF	International Monetary Fund
IoT	Internet of Things
MNC	Multinational Corporations
SEZ	Special Economic Zones
STEM	Science, Technology, Engineering, and Math
TAM	Total Available Market
TI	Transparency International
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
WB	World Bank
WEF	World Economic Forum

An aerial night photograph of a city square. In the lower-left foreground, there is a large, circular, illuminated fountain with multiple water jets. The square is paved and surrounded by green trees and manicured lawns. To the right of the fountain, a wide, straight road or pedestrian walkway stretches into the distance, lined with parked cars and trees. On the left side of the square, there are modern buildings, including one with a prominent glass facade. On the right side, there are older, multi-story buildings with many windows, some of which are lit up. The background shows a dense urban landscape with numerous buildings and lights under a dark blue twilight sky.

Proof of Concept Program:

Center for Biostatistical Programing

In 2012, several global pharmaceutical companies engaged Mr. Hatch (while a senior executive with ManpowerGroup/Experis), asking for assistance in finding a reliable source of biostatistical programmers. Mr. Hatch proposed creating a collaborative workforce development program for the pharmaceutical executives after a study demonstrated no significant pools of talent with the right skills anywhere globally.

After some discussion, Mr. Hatch structured a joint venture between Experis, Intego Group (a local Ukrainian outsourcing firm), Roche, and V. N. Karazin Kharkiv National University in April 2013. Through this joint venture, all parties agreed to create a biostatistical programming and bioinformatics program at the university.

In fall 2013, [the Center for Biostatistical Programming](http://biostatcenter.com) (biostatcenter.com) officially launched with active involvement from all joint venture parties.

In the spring of 2014, students began graduating with a Master's Minor in Biostatistical Programming, with all graduates retained by Roche (through Intego-Group and Experis).

The program continued to expand and financially self-sustain until the Russian invasion of Ukraine in February 2022. Over twenty pharmaceutical or clinical trial companies have retained talent produced through this program. Graduates routinely received awards from various industry trade groups, and Ukraine was widely considered the reference workforce for elite biostatistical programming talent.

This program has been widely regarded as a success. Key findings from this proof-of-concept program include:

1. If the quality of talent produced through such a program is high, international companies will tolerate risk. Euromaidan and the following war in the Donbas region in Ukraine happened shortly after this program's launch. Although Ukraine had material geopolitical risk, it did not matter. International companies continued to be involved in this program until the outbreak of war in February 2022.
2. If programs are structured through a compelling commercial model, international employers will invest in covering program costs in full. This program was launched and continued to operate without any grants or donations from the Ukrainian government, NGOs, or IGOs.

3. The quality of talent Ukraine can produce is highly compelling. This program produced arguably the best biostatistical programming talent globally. More importantly, global employers quickly recognized the potential of Ukrainians and agreed to invest in developing this asset further.





War in Ukraine

Uncertainty

War is one of the most disruptive dynamics for any economy. It is impossible to accurately model the full impact of the war on Ukraine's economy or define detailed steps needed to rebuild post-war. Given uncertainties:

1. Modeling will factor 2021 Ukrainian economic and industrial performance.
2. Launch dates for any full-scale economic recovery program will not be known until closer to the war's end.

A colleague once stated, "We might not know where we are eating breakfast on the third day of our holiday, but we know we are going to Hawaii." We do not know specific details about an economic and workforce development program post-war, but we know the derivative. There are key themes that will continue to ring true and will be focused on in this document.

Given changes in the global economy stemming from the rise of the 4th Industrial Revolution, high-IP producing talent will dictate economic performance more frequently in the years ahead.

Ukraine's talent flight problem preceding the war has already been problematic and has been chiefly responsible for Ukraine's lower than the regional average in the tech industry. The war has greatly increased the net outflow of people from the country.

As of May 27, 2022, UNHCR estimates that 6.7 million people have left the country- or 16% of the Ukrainian population. (UNHCR, 2022)

In preparation for this paper, I conducted a poll of 100 Ukrainians that left the country due to the war. Employment following the war was the primary consideration for the repatriation of refugees.

1. The war has had a material effect on the financials of Ukrainians. 91% of respondents noted they needed a job in Ukraine before returning.
2. 70% of refugees with a spouse still in Ukraine stated they intend to return to Ukraine if they or their spouse had full employment in the country. Without full employment of the refugee or the spouse, intent to return to Ukraine dropped to 24.2%
3. Over 90% of respondents that had gained full employment with a company outside of Ukraine noted they are not likely to return to the country.
4. 50% of respondents noted they would not return to Ukraine if their homes were destroyed.
5. Although Zelensky is receiving praise for his leadership during the war, only 3% stated they believe the Ukrainian government could create a thriving business ecosystem (including a material reduction in corruption) following the war.

The consistent theme in repatriation is employment. The extent Ukraine can create Ukraine-related jobs now and the scale of a job creation program to be launched immediately following the war will dictate Ukraine's ability to keep (and bring) people home. Without such programs, Ukraine will likely experience one of the largest talent flight events in history.

Cost to Rebuild Ukraine

The war in Ukraine is incomprehensible. The damage to Ukraine's infrastructure has not been seen since WW2. By the end of April 2022, economists estimated that the damage to Ukraine's infrastructure and capital stock might exceed \$1 trillion. (VIVIENNE WALT, Fortune.com, 2022)

While this figure is alarming, it understates the cost of rebuilding and relaunching the Ukrainian economy.

1. UNDP estimated that up to 90% of Ukrainians are at risk of living in poverty post-war. (UNDP, 2022) Extensive social benefits programs will be needed at an unprecedented level. Further, the cost of providing social benefits will be materially higher. In many municipal areas, basic services such as healthcare no longer exist. Facilities were destroyed. (World Health Organization, 2022) The lack of such services in communities across the country will significantly increase the cost of delivery. If it takes a decade to achieve economic self-sustenance, Ukraine could theoretically need an additional \$500 billion - \$1 trillion to cover social benefits alone. (Phil Hatch, 2022)
2. There is a material activation cost (Frankenstein Cost- cost to bring the economy to life) once the infrastructure has been rebuilt. There are costs related to restarting education once a university has been rebuilt. Companies need working capital to restart commercial services once power, internet, and office space have been rebuilt. If the war were to end today, the activation cost (including needed working capital) of every aspect of the Ukrainian economy could theoretically cost between \$500 billion - \$1 trillion. (Phil Hatch, 2022)

The total cost to rebuild and relaunch the Ukrainian economy will be unprecedented, and the world is not prepared for such a financial need. European Bank for Reconstruction and Development (EBRD- the development bank created in 1991 to assist Eastern Bloc countries post-Soviet Union) had a total outstanding loan balance of \$28.62 billion in 2020. Adjusted to today's dollars, the Marshall Plan (\$13 billion in 1945) totaled \$155.95 billion.

Current thoughts regarding funding the rebuild of Ukraine include some form of a program like the Marshall Plan with active involvement from the IGOs and Western countries. Discussions about donating seized Russian assets to Ukraine to further offset the cost of rebuilding the country are ongoing.

If the war were to stop today, the combination of some new form of a Marshall Plan (including grants and secured loans) and donation of seized Russian assets likely would not be enough to rebuild the entire country.

Assuming a reconstruction program like the Marshall Plan (\$155.95 billion), and all frozen Russian assets were seized and then sold (\$300 billion), Ukraine likely will have an outstanding cost of reconstruction, economic development, and ongoing social services that exceed \$1 trillion over the first decade following the war.

The only viable option for Ukraine is to increase foreign direct investment (FDI). Over the past decade, FDI Net Outflows (indicator: BM.KLT.DINV.CD.WD) have averaged \$1.7 trillion per year, exceeding all grants and loans made by all IGOs, NGOs, and government development agencies combined. (Phil Hatch, 2022)



Key Global Dynamics

4th Industrial Revolution

New technologies such as artificial intelligence (AI), automation, 3-D printing, robotics, and 5G are pushing the entire world through a massive transformation that is widely described as the "4th Industrial Revolution." The transformation that will occur over the next two decades will be more significant than any previous moment in time.

While the world has much work to do before this transition is complete, the transition is happening faster than most realize. Some functional robots in agriculture and mining are already price-competitive with manual labor in Africa. (Phil Hatch, 2022)

A Complete Change in the World of Work

The 4th Industrial Revolution will bring about a complete transformation in every aspect of the business world. Changes will include:

1. AI-augmented leadership and management.
2. Every function. (I.e., AI-empowered automation in the entire supply chain.)
3. How companies interact with their customers, vendors, and partners.
4. Production.
5. The overall business value proposition.
6. Every job.
7. Skills needed per job.

The Workforce Value Proposition Will Change

The entire workforce value proposition will change. These technologies reduce labor costs as a component of the Cost of Goods Sold (COGs). (Aghion, Antonin, Bunel, & Jaravel, 2021) One worker using these advanced technologies can produce far more than a large team of manual labor. Further, the risk is amplified. One bad employee can negatively affect total production on a massive scale.

Given the amplification of a single worker and the reduction of labor costs as a component of COGs, global employers will seek elite talent over low-cost talent. This trend has also started.

There is a correlation between global purchasing patterns and the rise of these new technologies.

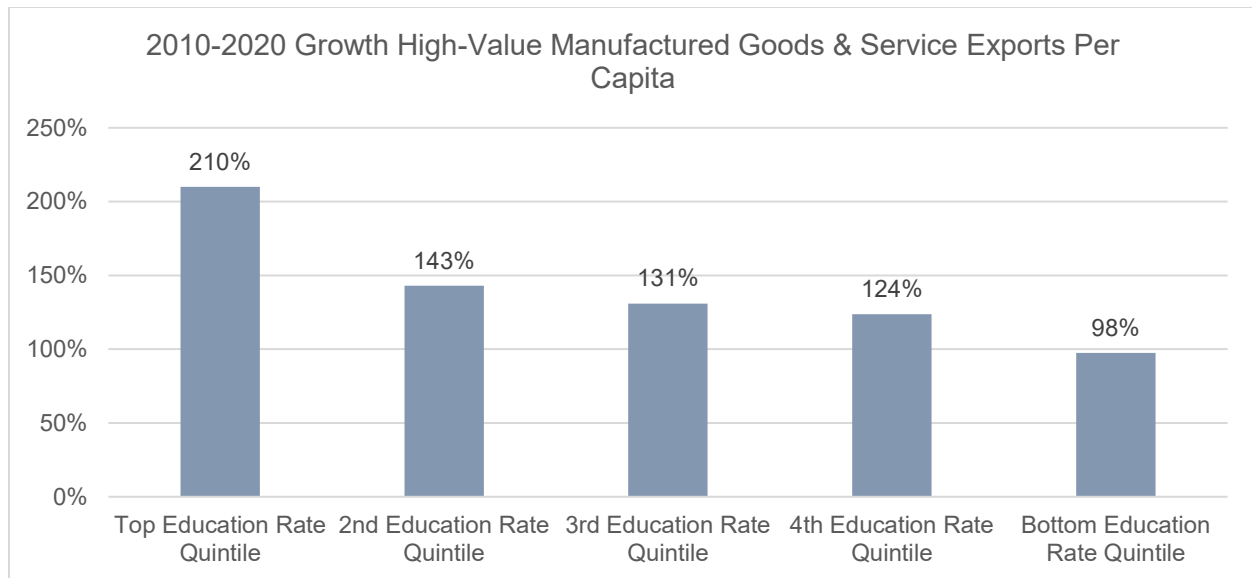


Figure 1: Growth High-Value Exports Per Capita (UN COMTRADE, IMF BOP, WB)

The world's top education rate and labor cost quintile has doubled high-value manufactured goods and service exports per capita from 2010 through 2020. The least educated quintile has declined by 2.5%.

The Point of Production Will Change

With labor costs becoming immaterial in COGs, companies will often shift production closer to the point of consumption to reduce shipping and handling costs.

Although early pioneers in moving production closer to the point of consumption (such as Adida's Speedfactory initiative) may have struggled, the model is sound and will become a material trend in the years ahead. (Supplychaindrive.com, 2020)

This movement of production from low labor cost markets closer to primary consumption points will materially affect existing manufacturing hubs globally.

Driven by direct job loss due to automation and global manufacturers moving production from China toward major consumer markets in the EU, US, and other wealthy countries, China may lose up to 100 million manufacturing jobs. (China Power, 2018)

Any country depending on labor cost arbitrage to generate material job growth likely will struggle in the years ahead.

Shift From Production to IP Generation

The rise of these technologies is also changing the fundamental value proposition for companies worldwide.

In 2015, Nike's then COO Eric Sprunk attended an industry event hosted by GeekWire. Sprunk was discussing the use of 3-D printing in Nike's manufacturing process when he was asked for his thoughts on the ability of end consumers to print shoes at home. (TAYLOR SOPER, 2015)

Sprunk noted, "Do I envision a future where [Nike] might still own the file, from an IP perspective—because it's a Nike product; you can't have just anybody make a Nike product—and you can manufacture that either in your home or we will do it for you at our store?... Oh yeah, that's not that far away."

These 4th Industrial Revolution technologies will shift many companies from a manufacturing and capacity-based value proposition toward a heavy IP production value proposition. Companies will gain market share based on their ability to provide top intellectual property. In many cases, their production (manufacturing) will become commoditized. In some cases, manufacturing may be omitted as 3-D printing gains traction.

Company success will shift more toward IP production in the years ahead.

Competing in a New Reality

The performance gap between companies that have successfully adopted 4th Industrial Revolution technologies over those companies yet to adopt these new technologies will be larger than in any previous Industrial Revolution. (Enno de Boer, 2019)

Likewise, countries that will experience the greatest growth in jobs over the coming decade will be those that provide elite 4th Industrial Revolution aligned workers, regardless of labor cost. The current global workforce consumption model will change. Many countries with thriving high-value manufactured goods and service exports industries will be left behind because they cannot modernize their workforce quickly. (UNCTAD, 2021)

While the threat of job displacement is enormous, there has never been a better time to create transformative job and economic growth. Countries that are most effective and fastest in aligning

their workforce to global demand can experience economic and job growth that far exceeds the growth in countries such as India in the early outsourcing boom.

Collaborative Industry Partnerships



Figure 2: Bayer - Microsoft Agriculture Partnership

"Today, Bayer announced a strategic partnership with Microsoft to build a new cloud-based set of digital tools and data science solutions for use in agriculture and adjacent industries, bringing new infrastructure and foundational capabilities to accelerate innovation, boost efficiency, and support sustainability across value chains" – Bayer, November 17, 2021

As much as analysts claim to know the full scope of changes in the world of work, there is a great deal of uncertainty. Leading MNCs are partnering together now to define the future role of technology in all industries.

Combining these collaborative industry development programs with tendencies that companies buy goods and services from entities they helped create, any country wanting to establish a

thriving high-value service export or packaged software industry must actively participate in such programs.

Ukraine must partner with programs such as the Bayer-Microsoft agriculture program focused on developing the talent these programs need.

Although there will likely be sympathy for Ukraine opening the door to such programs, Ukraine must demonstrate an ability to produce elite talent at scale. Ukraine must earn on merit the role of becoming the future workforce for such programs. Posturing for being the destination workforce for such programs has already started. Ukraine cannot wait until the end of the war to create a material position as a destination workforce within a 4th Industrial Revolution context.

Global Skilled Talent Shortage

The rise of 4th Industrial Revolution technologies creates the need for an entirely new workforce.

Job displacement in the coming years will be unprecedented. In February 2021, McKinsey & Company noted that up to 100 million people in G8 economies would likely need to change jobs due to the rise in automation. (McKinsey & Company, 2021) OECD further estimates that half of all jobs globally are at risk of displacement due to automation. (OECD, 2018)

While the number of jobs lost due to 4th Industrial Revolution technologies will be high, these same technologies create demand for an entirely new workforce that does not materially exist today.

Driven by a combination of changes in the world of work and demographics, the world is in the early stages of what will be the longest-lasting and most impactful skilled talent shortage in history. Korn Ferry estimates that by the year 2030, there may be as many as 85 million jobs unfulfilled because employers cannot find the talent they need. Further, Korn Ferry notes this skilled talent shortage will cost global employers \$85 trillion in revenues because they cannot find the workers needed to fulfill orders. (Korn Ferry, 2018)

The growing risk to global employers stemming from the skilled talent shortage pushes companies toward more strategic talent sourcing models. Companies are taking steps now to create "talent farms" in growing numbers and scale. (Similar to the Center for Biostatistical Programming created by Mr. Hatch as referenced earlier in this document.)

These strategic talent development programs are growing. Numerous programs now exceed total numbers and the strategic importance to the employer of any previous such program in history. In September 2020, Microsoft announced an initiative with NASSCOM to create 1 million AI workers in India by the end of 2021. (Microsoft, 2020)

Scaled to Ukraine's population, a single program like the Microsoft/NASSCOM program would create 32,000 AI workers in Ukraine each year.

4th Industrial Revolution Limiter: Talent

One specific aspect of the global skilled talent shortage is that a lack of workers with 4th Industrial Revolution skills limits adoption rates of the same technologies. (Joe McKendrick, Forbes, 2022)

The global lack of workers with new technical skills is both an opportunity and a threat.

Reconstruction of Ukraine following the war will depend on workers with 4th Industrial Revolution skills. Of specific importance to this document, Ukraine will need workers that:

1. Fully understand how these technologies can transform specific Ukrainian durable industries (such as agriculture) and can help craft an industry reconstruction program.
2. Can implement these same technologies during Ukraine's reconstruction.
3. Can train end workers in these newly reconstructed industries.
4. Can provide technical support long-term.

Reconstruction of Ukraine post-war will likely not be inhibited if Ukraine cannot provide a material percentage of the needed 4th Industrial Revolution type STEM workers. However, Ukraine will fail to leverage a highly valuable transition catalyst. MNCs involved in reconstruction following the war will use Ukraine to train and commercialize a workforce in other countries.

Evolution Skills Needed, & Education

The Rise of High-IP and Tech-Savvy Workforce

The rise of the 4th Industrial Revolution is creating the need for a more IP-centric skillset that is far more technical than any previous moment in time.

The skills needed in the future are rapidly changing as the world progresses through the 4th Industrial Revolution. World Economic Forum (Kate Whiting-WEF, 2020) noted material growth in demand for the following skills by 2025:

1. Analytical thinking and innovation.
2. Active learning and learning strategies.
3. Complex problem-solving.
4. Critical thinking and analysis.
5. Creativity, originality, and initiative.
6. Leadership and social influence.
7. Application and use of technology.
8. Technology design and programming.
9. Resilience, stress tolerance, and flexibility.
10. Reasoning, problem-solving, and ideation.

Each needed skill noted above either creates intellectual property or facilitates the use of intellectual property within the company.

Education Rate of Change (D1)

Excluding current geopolitical risk and the COVID-19 Pandemic, the world still is more volatile than ever before. The rate of development and application of best practices using these new technologies is unprecedented and will likely continue to increase well into the future.

Workers will need to reskill (in part or full) on a far more frequent basis. The global business community spends over \$370 billion on employee training. (Imed Bouchrika - Research.com, 2020). This amount will increase in the years ahead as employees need to refresh their skills more frequently.

Connecting Education to Jobs

There is a disconnect between traditional higher education and jobs. In 2021, Harvard's the Project on Workforce noted, "... America needs more pathways that bridge education and career." (Fuller, Lipson, Encinas, Forshaw, Gable, & Schramm, 2021)

Although Harvard referenced the United States, the challenges of connecting education to jobs are common in most countries.

Countries need to address two primary challenges:

1. Countries need to keep academia current with new business best practices and technologies. The gap between academia and the private sector is growing, and few universities can afford to keep current their technical infrastructure, curriculum, and instructors.
2. Companies prefer practical experience in hiring talent. In highly developed economies, students may have an opportunity to gain practical experience through various programs such as internships. However, most of the world cannot provide such opportunities to their students. Although regionally near highly developed economies such as Germany, Switzerland, France, and the UK, Ukraine has not traditionally provided enough opportunities for students to gain practical experience with major international MNCs.

The Future of Education: Collaborative Workforce Development Programs

Given:

1. The skilled talent shortage is a material business risk to all global employers,
2. Companies show a high preference for practical experience with all new hires (including recent college graduates),
3. The gap in technologies and business best practices is growing between the private sector and academia,
4. The rate of skills refresh for current employees will continue to accelerate,

Major global employers will turn toward collaborative workforce development programs more frequently.

The idea of public-private partnerships in education is not new. However, they will grow in importance, scale, and frequency in the years ahead.

Of special note:

1. MNCs will turn toward collaborative workforce development programs (MNCs partnering with academia and other public institutions to create high-demand talent together) more frequently to hedge the skilled talent shortage.
2. The scale of these collaborative workforce development programs will continue to rise. The Microsoft-NASSCOM AI program targeted the development of 1 million AI workers in India in a single year.
3. The level of involvement by MNCs in collaborative workforce development programs will increase. In addition to curriculum and infrastructure, MNCs will offer participating students additional learning opportunities such as internships and mentors.

Given the cost to reskill existing workers, there is an opportunity for traditional higher education institutions to grow in importance in corporate training if they are actively participating in a collaborative workforce development program with MNCs.

Ukrainian Durable Industries

Ukraine has numerous "durable industries" (those that will continue to have global demand post 4th Industrial Revolution transition). Although many will likely exceed pre-war production levels and generate material economic contribution, numerous industries (such as agriculture) will not create pre-war job numbers assuming industry redevelopment adopts 4th Industrial Revolution technologies.

Twenty-two out of Ukraine's top 25 exports are forecasted to experience high job displacement by 2030 due to the rise of automation and other technologies. Only 3 out of the 25 top exports (all high-IP service exports) are forecasted to have material job growth by 2030.

Goods Vs. Service Exports

Risk

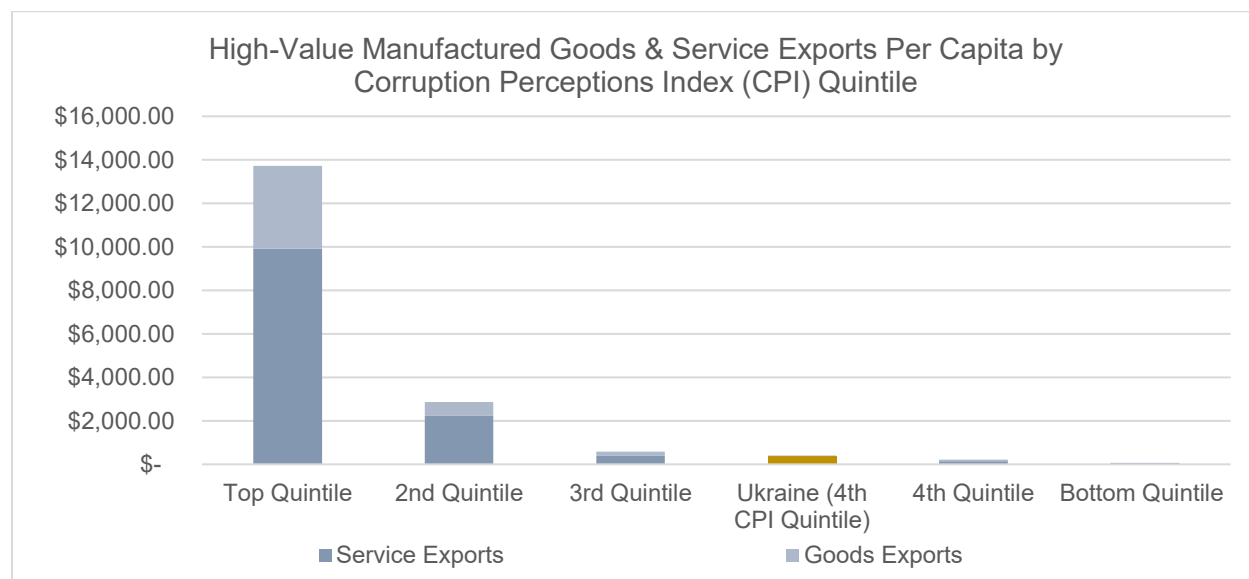


Figure 3: High-Value Exports by CPI Quintile (TI, UN COMTRADE, IMF BOP)

A country's risk profile has the greatest effect on exports of all variables. While risk affects all exports, high-value manufactured goods are specifically affected by high-risk levels.

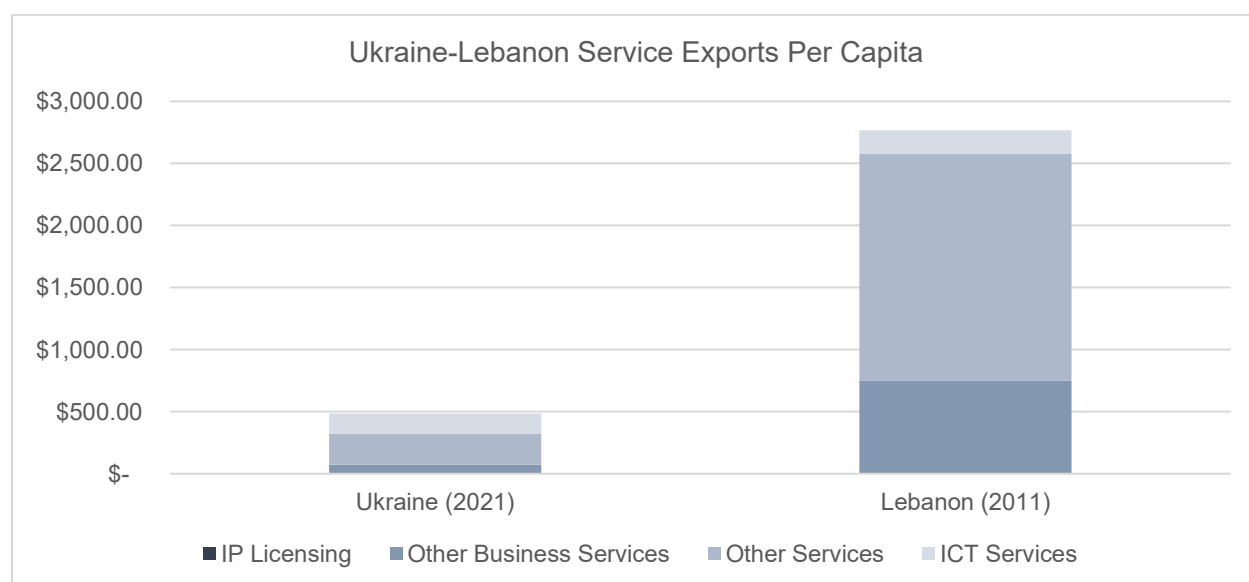


Figure 4: Lebanon - Ukraine Comparison (IMF, WB)

Some examples exist of high-risk markets achieving material success with high-value service exports. In 2011, Lebanon (with a lower CPI score and Tertiary Education rate than Ukraine) achieved \$2,766.45 in high-value service exports, exceeding Ukraine's best performance in 2021.

If Ukraine were to match Lebanon's performance, Ukraine would generate an additional \$115 billion in high-value and high IP exports- more than doubling Ukraine's GDP when considering secondary currency cycling. (Phil Hatch, 2022)

Of special note: Lebanon's ICT Service Exports Per Capita rate of \$187.23 in 2011 is higher than Ukraine's best score of \$163.50 in 2021.

There are no material exceptions or outliers with manufactured goods exports. Causality for lack of manufactured goods exports from high-risk markets is well understood:

1. The working capital needed to establish manufacturing is material. Few investors are willing to make such an investment in a high-risk market.
2. The infrastructure needed for high-value manufacturing is rigid and cannot be mobilized the same as high-value service export industries.
3. Customers (global buyers of manufactured goods) are concerned with delivery disruptions and heavily favor purchasing from low-risk markets.

The current war in Ukraine presents a significant risk. Ukraine has little chance of generating the needed investment to establish a high-value manufactured goods export industry until after the war.

The end of the conflict will not resolve significant risk concerns (i.e., corruption) endemic to the Ukrainian government to a level needed to drive material investment into establishing a thriving, high-value manufactured goods exports industry. (Phil Hatch, 2022)

However, given a reasonable level of risk tolerance with high-value service exports and proof of concept programs preceding the war (such as the Center for Biostatistical Programming), Ukraine can gain international investments needed to establish thriving high-value service exports industry well beyond Q4 2021 levels.

Ukraine should begin working now to seed these service export industries now.

Speed to Implement

The time required to implement a thriving high-value service exports industry is materially shorter than establishing high-value manufactured goods.

Transformative Power of Service Exports Industries

Although service exports may not be considered as prestigious as high-value goods exports, service exports can be economically transformative. The growth of the Indian economy over the past twenty years is a reference example of the potential of service exports to transform an economy.

Hyderabad, India, demonstrates the scale and speed of transformation when establishing a compelling service exports industry. Following a twenty-year transformation, Hyderabad has today:

1. Over 600k tech jobs.
2. Over 2 square kilometers of presold office space are waiting to be built in the tech industry.
3. Registered over 100k new companies and representative companies.
4. Achieved a base FDI level of over \$1.5 billion per year. Google committed over \$2 billion to develop the tech industry and workforce further.
5. Likely generates over \$2,000 ICT Service Exports Per Capita. (Compared to Ukraine's \$163.50 in 2021)

Scaling this by population size, Ukraine would have:

1. 2.37 million technology jobs across the country.
2. Over \$83 billion in ICT Service Exports per annum.

While these targets may seem unrealistic, consider that 2.37 million additional technology jobs represent less than 3% of the forecasted shortage of 85 million technology and tech-enabled workers (Korn Ferry, 2018) by the year 2030.

The Power of Multinational Corporations

Multinational corporations (MNCs) will be critical to Ukraine's recovery after the war.

Foreign Direct Investment

Ukraine will need a significant improvement in FDI inflows to rebuild the country (society, economy, and infrastructure). FDI is not a grant or charitable donation. FDI is an investment with the investors seeking a return on their investment. Material FDI is generated to develop further and facilitate the consumption of a proven asset.

Of Ukraine's top twenty-five exports, only service exports are forecasted to have material job growth. Fortunately, these high-value service export industries have a proven history of generating material FDI in other markets. India's ICT industry accounts for 74% of all FDI. (The Economic Times - India, 2021) India likely received well over \$200 billion in the past decade to develop further and facilitate the consumption of the Indian technology workforce. (Phil Hatch, 2022)

Ukraine does have a compelling history of elite-level STEM talent. The asset (the educated workforce) has likely been proven to the degree that global employers will invest in further developing and consuming this asset. (Phil Hatch, 2022) The Center for Biostatistical Programming is proof of the willingness of global employers to develop further and consume the Ukrainian workforce.

Intellectual Property & Education

Global employers also have the intellectual property needed to create a modern workforce. Without the active involvement of MNCs in education, Ukraine will struggle to implement current academic programs.

Keys to Ukraine's success, global employers will be needed to provide:

1. Current curriculum, technologies, and instructors.
2. Internship opportunities for Ukrainians allowing students to gain needed technical, functional, and industry expertise to be widely employable.

Business Assistance

Major international employers (especially the major technology companies) have extensive programs that help new companies thrive. As an example, Intel's Partner Alliance program offers companies access to new technologies, extensive training opportunities, subject matter experts, co-marketing funding, and lead generation.

Given the power of multinational corporations, companies attempting to go to market without the involvement of MNC partner programs face material challenges.

Ukraine must help facilitate the involvement of Ukrainian companies in such partnership programs. Without involvement in such programs, Ukrainian companies will compete against the spending and asset power of the major MNCs.

The Role of Special Economic Zones (SEZ) in Engaging MNCs

In 2017, Amazon issued a request for proposal (RFP) for a second headquarters (referred to as "H2"). By the end of October 2017, Amazon had received 238 proposals. Many of the received proposals were the length, scale, and sophistication of an Olympics or FIFA World Cup hosting proposal.

In the end, Amazon selected Northern Virginia as the winning proposal. After the fact, Amazon noted they selected Northern Virginia due to the workforce's size and quality combined with the region's ability to create talent in partnership with local academia collaboratively. (CNBC - Scott Cohn, 2019)

Although Northern Virginia offered Amazon material financial incentives (grants, tax credits, etc.), other cities that submitted proposals offered Amazon larger financial incentives. The core asset (the workforce) swayed Amazon's decision in the end.

Another material public-private partnership is Microsoft's partnership with NASSCOM to create over 1 million AI workers in 2021. This program was not limited to talent creation and consumption within the vast Indian SEZ infrastructure.

Specific to high-value workers, the world has reached a point where a special economic zone is widely considered the price to pay to enter the game. SEZs are not a guarantee a country will win the MNC partnership game. Referencing Amazon's H2 RFP, the workforce size, quality, and ability to collaboratively create talent are far more important.

As talent scarcity increases and labor costs further drop as a component of the Cost of Goods Sold, the ability of SEZs to sway MNCs on a cost basis will decrease further.

Diia City

Ukraine's announcement of Diia City in 2021 is compelling. (Ukrainian Presidential Office, 2022)
Diia City is critically important to Ukraine's future economic growth. However, Ukraine faces three specific challenges:

1. The world is saturated with various technology parks and special economic zones. As of 2022, there are likely well over 1,000 such programs globally. (Phil Hatch, 2022)
2. Many existing and planned technology parks offer similar or more competitive components. Some examples within the greater CEE/CIS greater region:
 - a. The Polish Investment Zone (Krakow Technology Park is a component) offers similar tax incentives and IP legal considerations. (Krakow Technology Park, n.d.)
 - b. Belarus's High-Tech Park offers a near total tax deferral until 2049. (HTP-Belarus, n.d.)
 - c. Kazakhstan's Astana Hub/AIFC offers a 0% tax rate and is also based on English Law. (Astana Hub, n.d.)
3. As noted earlier, major international corporation investment and participation in a specific market are becoming more tied to the quality of the workforce and ability to create talent over various financial incentives. Microsoft's NASSCOM AI program is not tied to SEZs in India. Amazon's H2 selection was primarily based on the quality of the workforce and the ability to create talent in the Northern Virginia region. (Phil Hatch, 2022)

Although current geopolitical dynamics will materially affect Belarus's technology industry, HTP Belarus is widely cited by countries in the CEE/CIS region as an example of a technology park program success. Excluding geopolitics, Belarus has traditionally performed reasonably well with its technology industry. That said, the role of HTP Belarus in the country's technology industry growth must be understood.

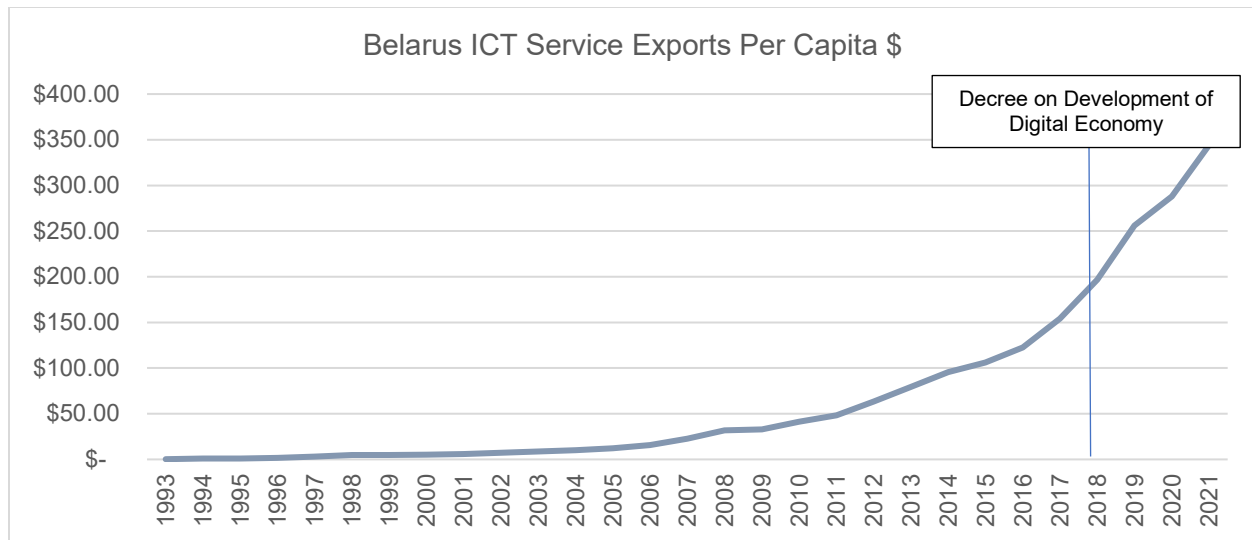


Figure 5: Belarus HTP Service Exports Per Capita (IMF BOP)

Although the Belarus HTP program's roots stretch back to 2007, the "Decree on the Development of the Digital Economy" signed in December 2017 forms much of what is considered to be HTP-Belarus's primary selling point. Belarus's technology industry was growing rapidly before the decree.

Technology Industry Trends

Business Vs. Consumer Technology Markets

TAM for the global business technology software and services industry far exceeds the consumer market. By year end of 2022, the business software and services market will likely exceed:

1. \$400 billion in software sales.
2. \$700 billion in technology services.

The global consumer software market will likely total \$200 billion.

Although the size of the consumer software market is material, targeting the business software market (and related service exports) provides the greatest opportunity for growth.

Service Exports Precede Packaged Software Exports

Packaged software tends to follow the establishment of a thriving software service export industry. Outsourcing services allows the economy to build a critical mass of technology workers needed for the organic growth of product companies.

Further, a thriving service export industry facilitates the building of industry knowledge needed for compelling business packaged software solutions. I.e., a team providing software development services for global pharmaceutical industries allows the greater workforce to gain key pain point knowledge specific to the pharmaceutical industry that can lead to a compelling software solution.

A group of people, including a man in a blue polo shirt and a woman in a black top, are looking intently at a laptop screen in a professional setting. The man is in the foreground, leaning over the woman, who is also looking at the screen. Other people are visible in the background, some looking at the same screen and others looking away. The scene appears to be a meeting or a presentation.

Ukraine Performance

Corruption

An ongoing corruption issue has plagued Ukraine since the country's formation in 1991. Out of every factor, corruption has the greatest effect on a country's ability to generate high-IP exports.

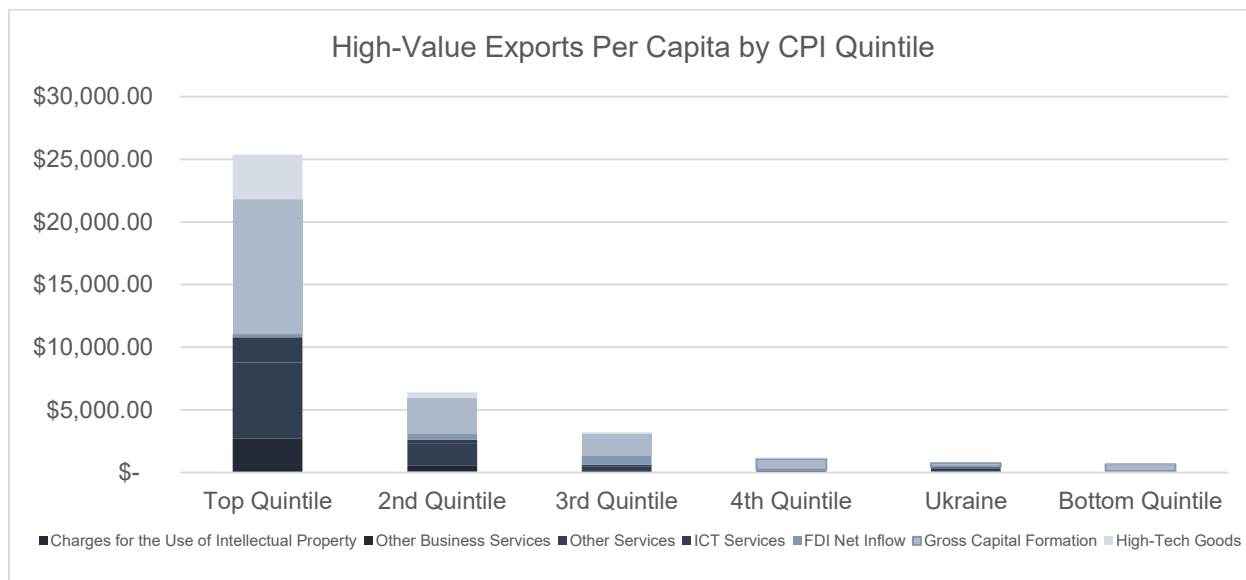


Figure 6: High-Value Exports Per Capita by CPI Quintile (TI, IMF, UN, WB)

Ukraine's 2021 CPI (Corruption Perceptions Index) score of 32 is problematic. Ukraine ranks within the 4th quintile globally.



Figure 7: High-Tech Goods Exports Per Capita by CPI Quintile (WB, IMF, UN, TI)

High-value manufactured goods are highly susceptible to CPI scores. High-value (especially high-tech) manufactured goods are almost exclusive to countries within the top CPI quintile.

While Ukraine's corruption score is problematic, it is not prohibitive in establishing high-value service exports. Several reference economies with a similar CPI score to Ukraine have achieved notable high-value service export success. Lebanon will be used again as a comparison.

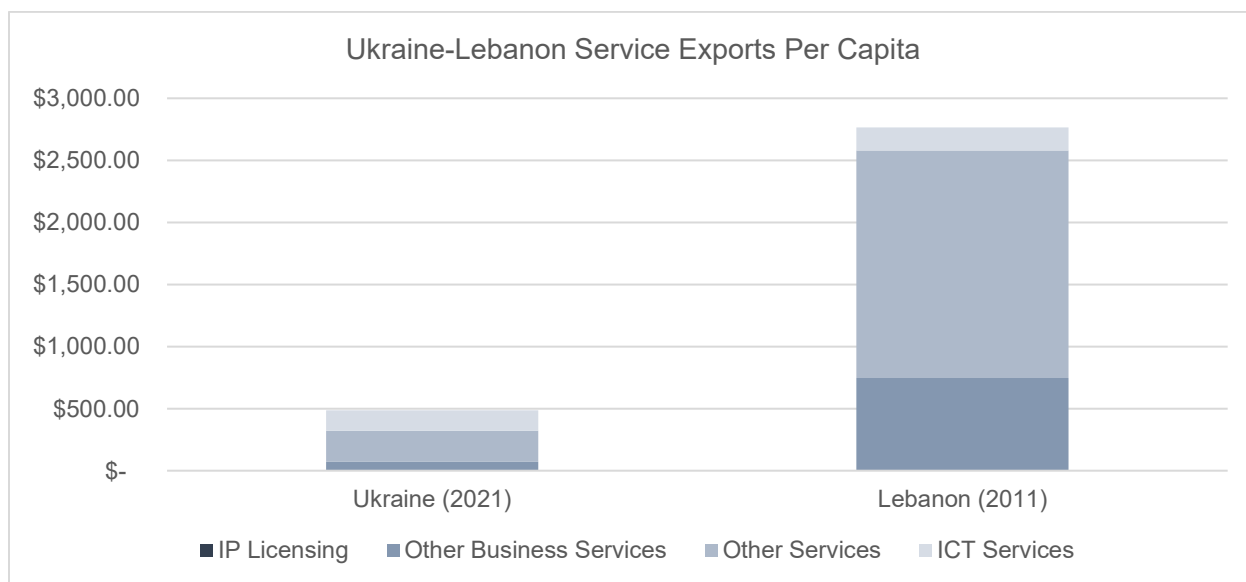


Figure 8: Lebanon - Ukraine Comparison (IMF, WB)

If Ukraine were to match Lebanon's performance, Ukraine would generate an additional \$115 billion in high-value and high IP exports- likely more than doubling Ukraine's GDP when considering secondary currency cycling. (Phil Hatch, 2022)

Academia, Research, and Innovation

Ukraine is a highly educated country with a Tertiary Education Participation Rate of 82.67%, placing the country above the median for the top Tertiary Education Rate quintile.

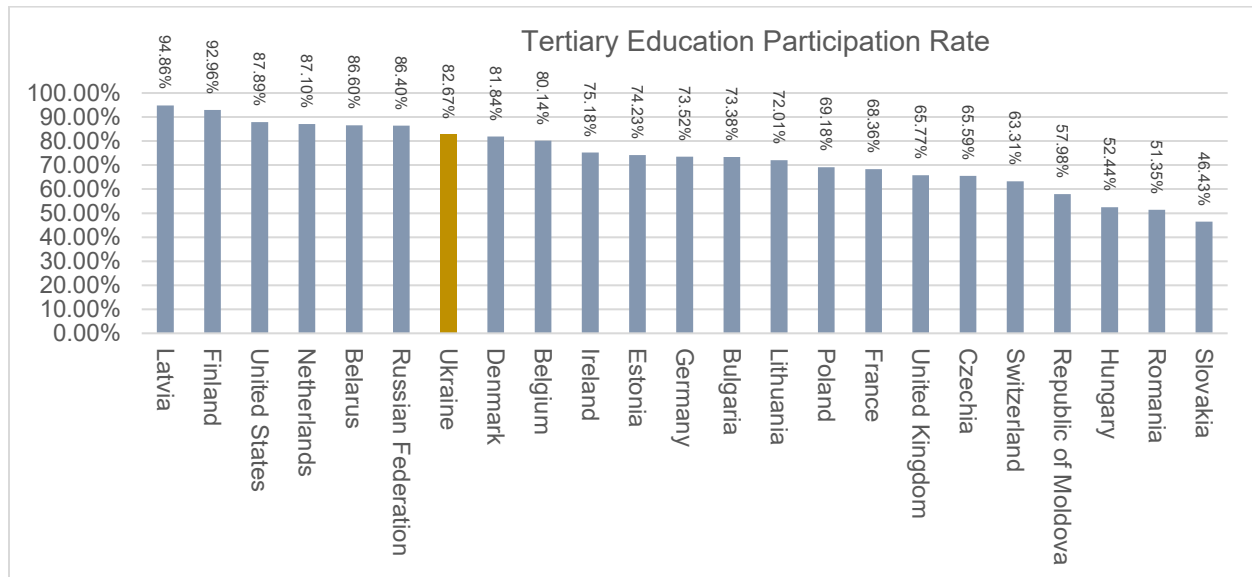


Figure 9: Tertiary Education Participation Rate (UNESCO)

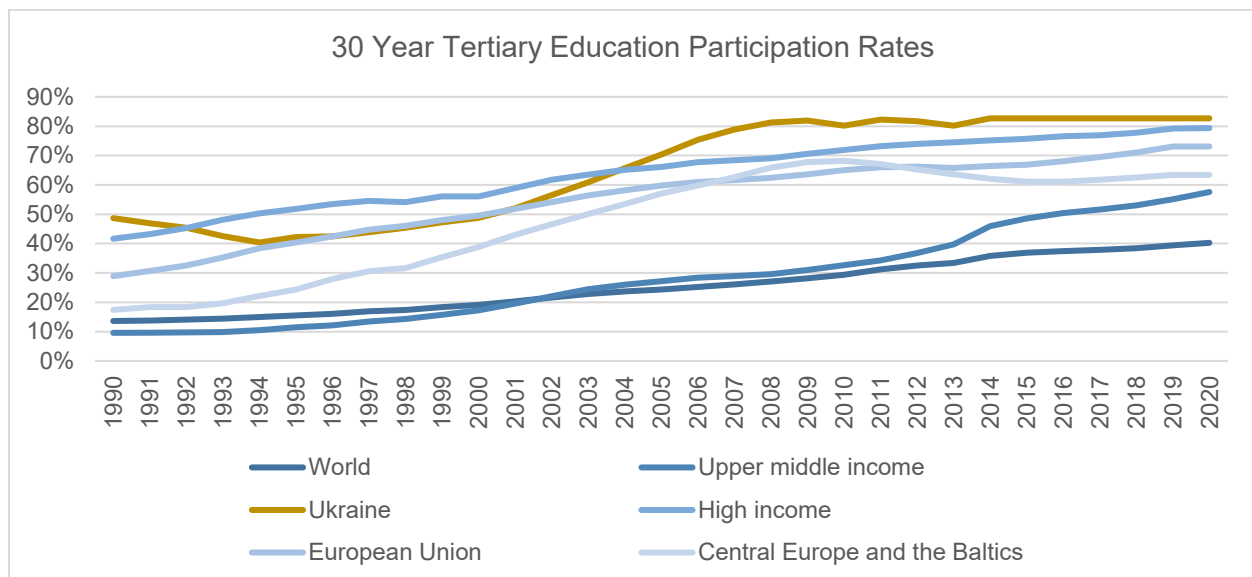


Figure 10: YOY Tertiary Education Participation Rate (UNESCO)

While Ukraine's Tertiary Education Rate is second highest in the CEE region, the STEM and ICT graduate percentage of total graduates is middle compared to CEE peers.

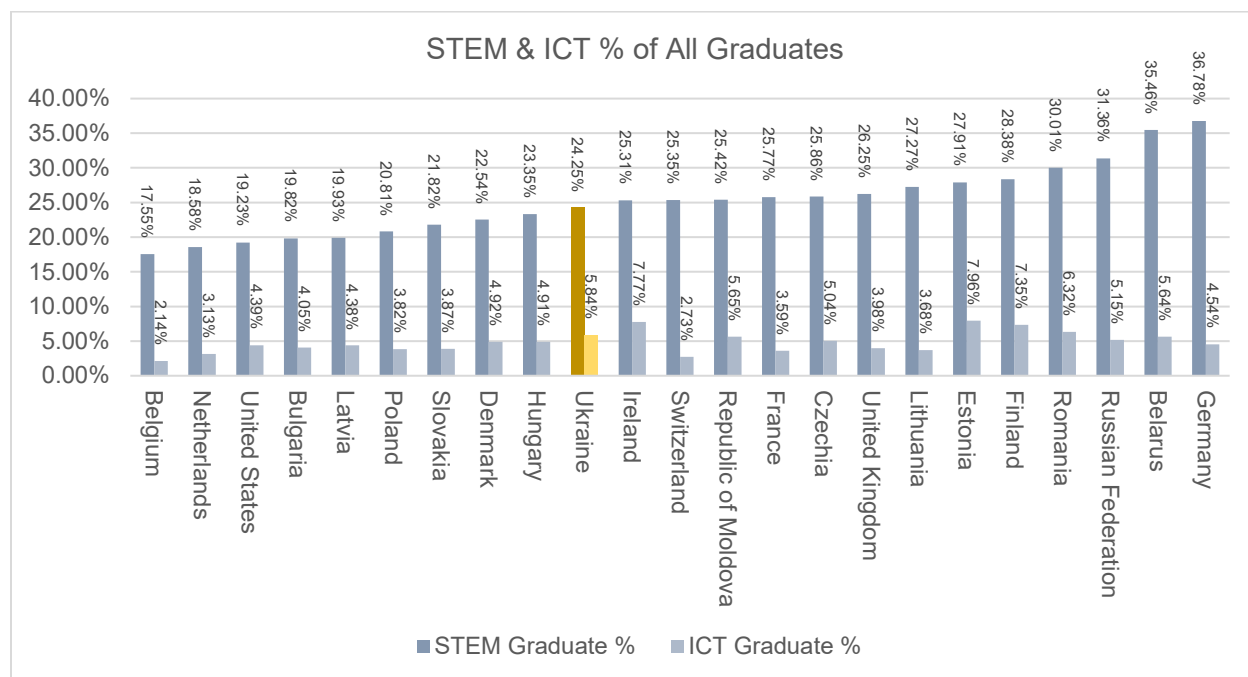


Figure 11: STEM & ICT Graduate % Rate (UNESCO)

Innovation

Ukraine has not translated high tertiary education rates, STEM graduate %, or ICT graduate % into a thriving innovation ecosystem. Although ICT service exports are materially growing, Ukraine trails peer nations in the region and others with similar education profiles.

Two examples demonstrate Ukraine's innovation ecosystem status.

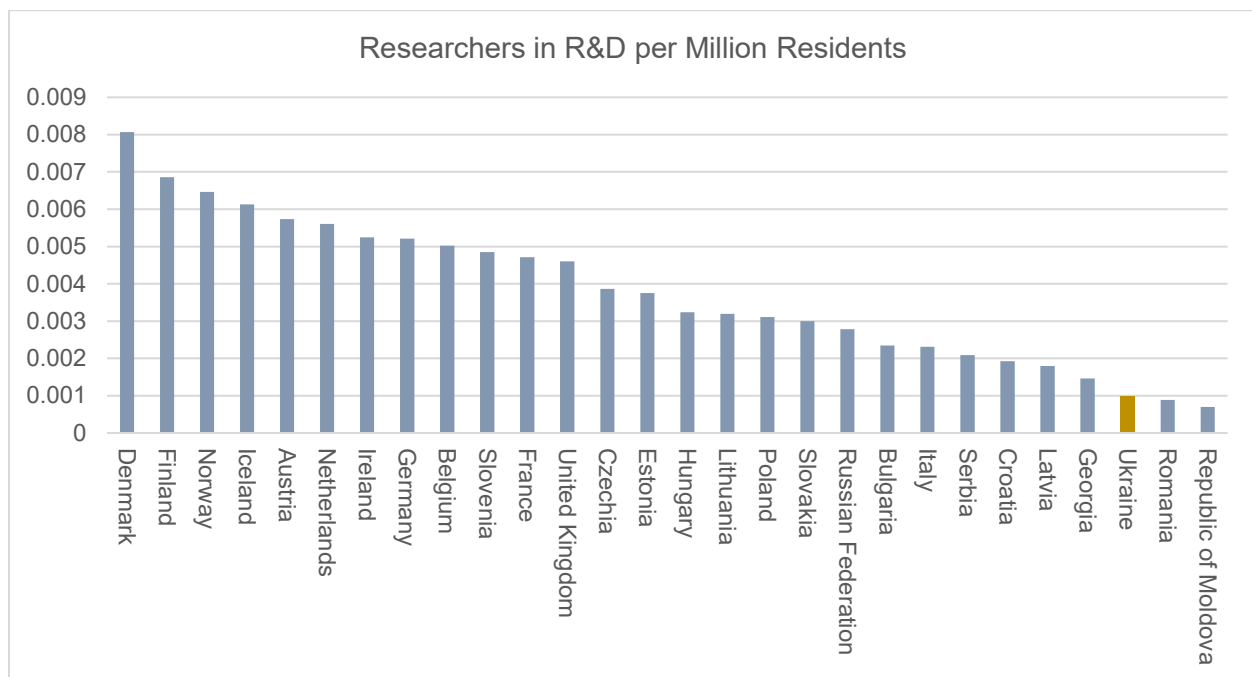


Figure 12: Researchers Per Million Residents (UNESCO)

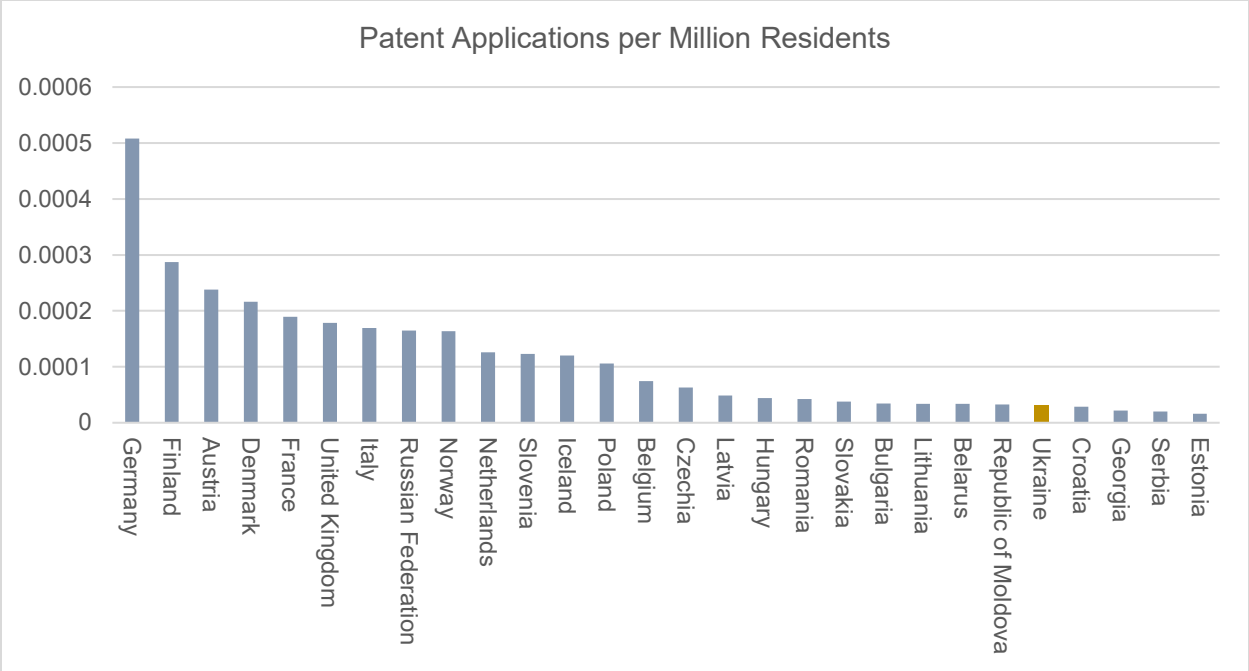


Figure 13: Patent Applications per Million Residents (UNESCO)

Demographics, Employment & the Workforce

Population

The primary demographic dynamic affecting Ukraine's economic performance is talent flight.



Figure 14: Ukrainian Population YOY (WB)

Ukraine has lost 4.66% of the total population from 2012 through 2021 (preceding the war). This loss of 2.13 million people ranks Ukraine only behind Syria in terms of total population decline from 2012 through 2021.

In 2019, Ukraine's then Foreign Minister Pavlo Klimkin stated that 100 thousand individuals were leaving Ukraine each month. (CNBC - Yuliya Talmazan, 2019)

Causality for Ukraine's population decline is important. For this paper, Mr. Hatch conducted a poll of 100 Ukrainian adults that left the country before the outbreak of war.

- 82% of respondents cited ongoing corruption and public leadership challenges preventing material high-value job growth as primary reasons for leaving the country.
- 84% of respondents noted they have some form of tertiary education (slightly above the Ukrainian national tertiary education participation rate of 82.6%)

Ukraine is losing the key asset the country needs for transformative economic Growth: The workforce.

Employment

Although slightly below comparative models, Ukraine's labor force participation and unemployment rates are not statistical outliers.

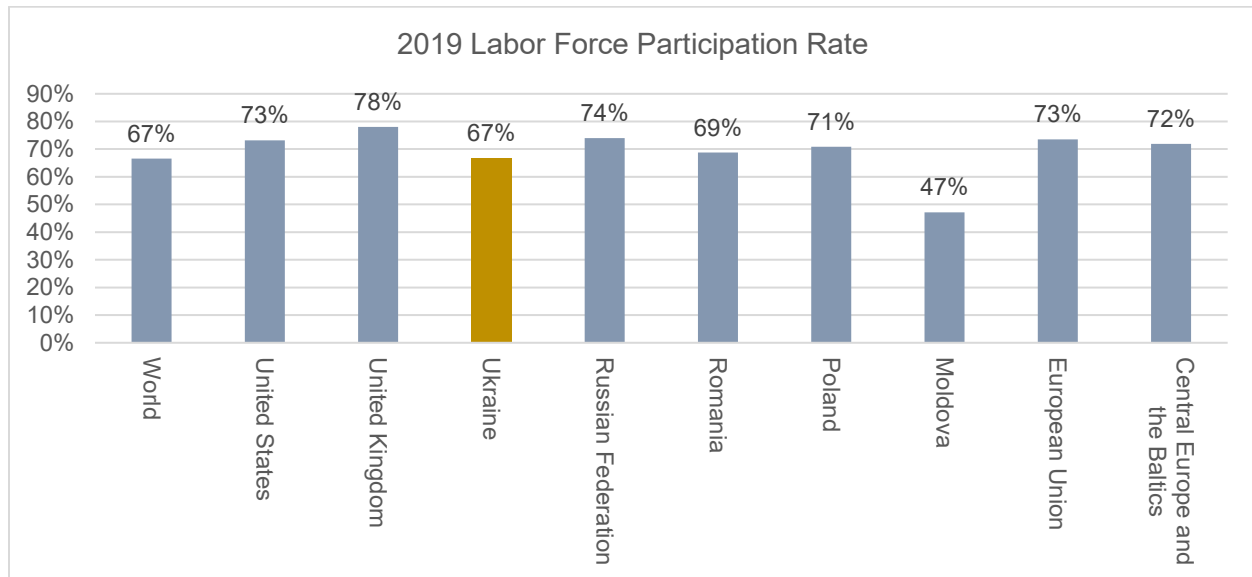


Figure 15: Labor Force Participation Rate (ILO)

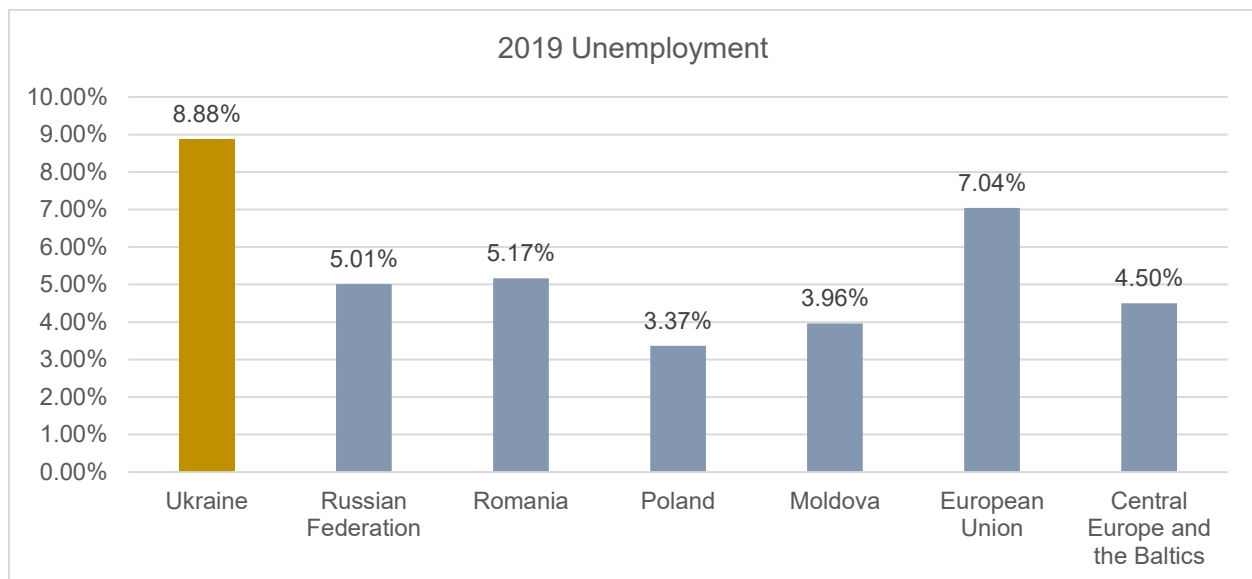


Figure 16: Unemployment Rate (ILO)

Using data preceding the COVID-19 Pandemic, Ukraine's 2019 unemployment and labor force participation rates have reasonably returned to levels predating Euromaidan and the following war in the Donbas region.

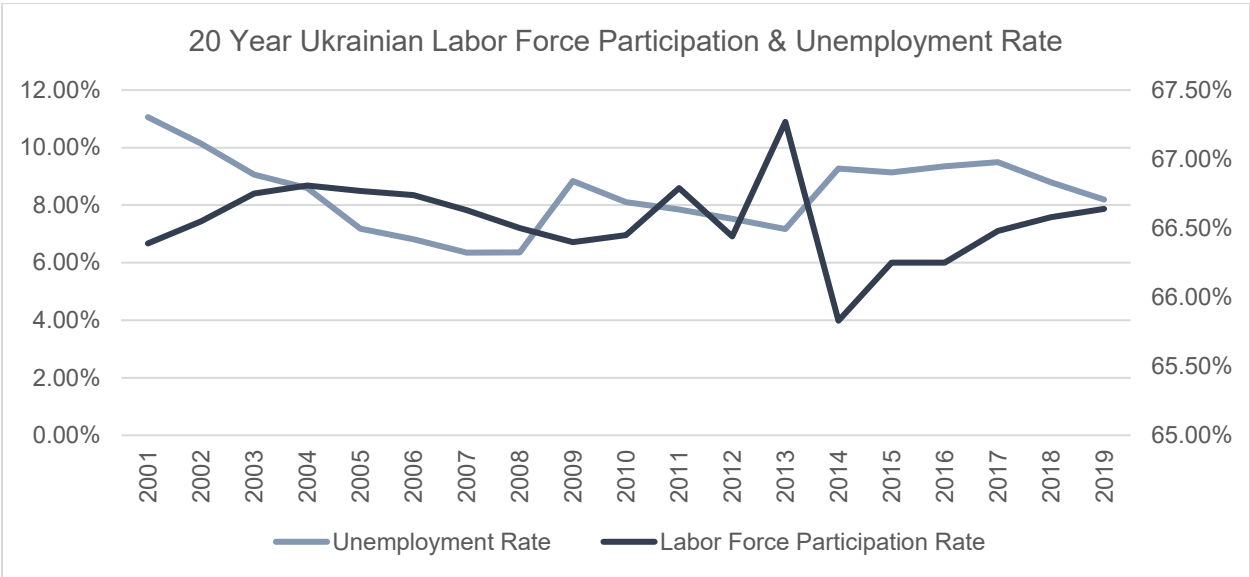


Figure 17: Ukrainian YOY Labor Force Participation Rate & Unemployment (ILO)

Labor Cost

Although Ukraine's workforce is lower-cost than major Western economies, Ukraine is not a low-cost labor market given a global context. Ukraine's average salaries for high-demand talent are materially higher than countries such as India.

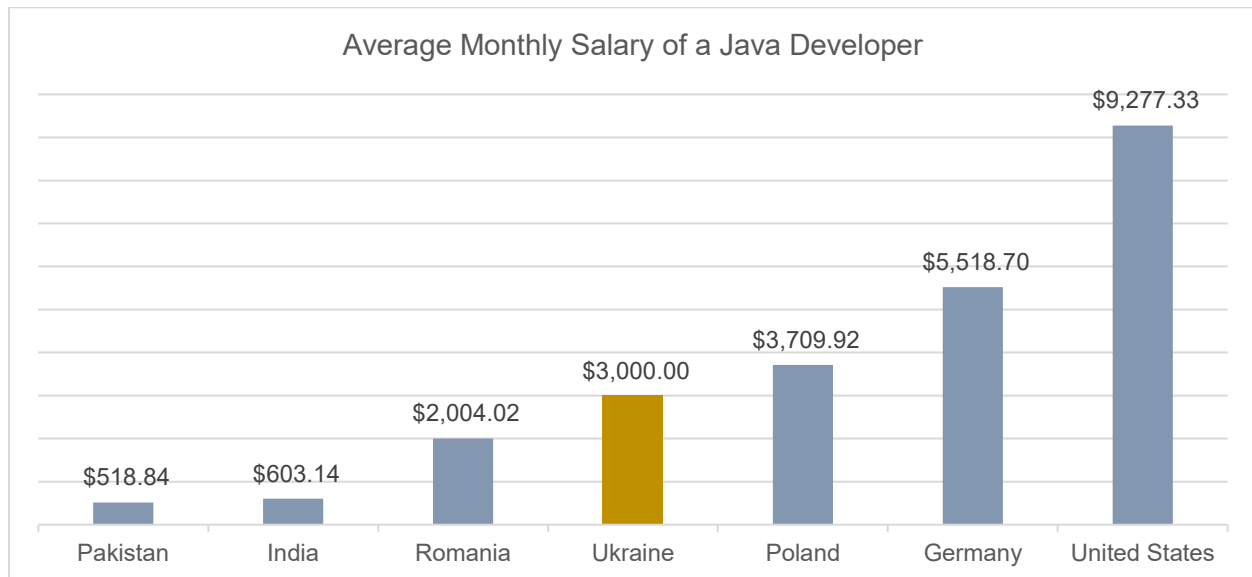


Figure 18: Java Developer Salaries (glassdoor.com 2022)

Labor costs in Ukraine for high-demand talent will affect how Ukraine commercializes the workforce. Ukraine cannot compete on a cost-basis value proposition. Ukraine must develop a higher value proposition to be competitive. Fortunately, changes in the workforce value proposition stemming from the rise of 4th Industrial Revolution technologies place lesser emphasis on labor costs.

Economy

GDP & GDP Per Capita

Limiting the analysis before the COVID-19 Pandemic, two primary events have heavily disrupted the Ukrainian economy.

1. The global financial crisis in 2008-2009 materially affected the Ukrainian economy in line with peer nations.
2. The Euromaidan protests and following war in the Donbas region had a larger negative effect on the Ukrainian economy than the global financial crisis.



Figure 19: Ukrainian YOY GDP & GDP Per Capita (IMF)

Ukraine's GDP Per Capita is low against all comparative economies.

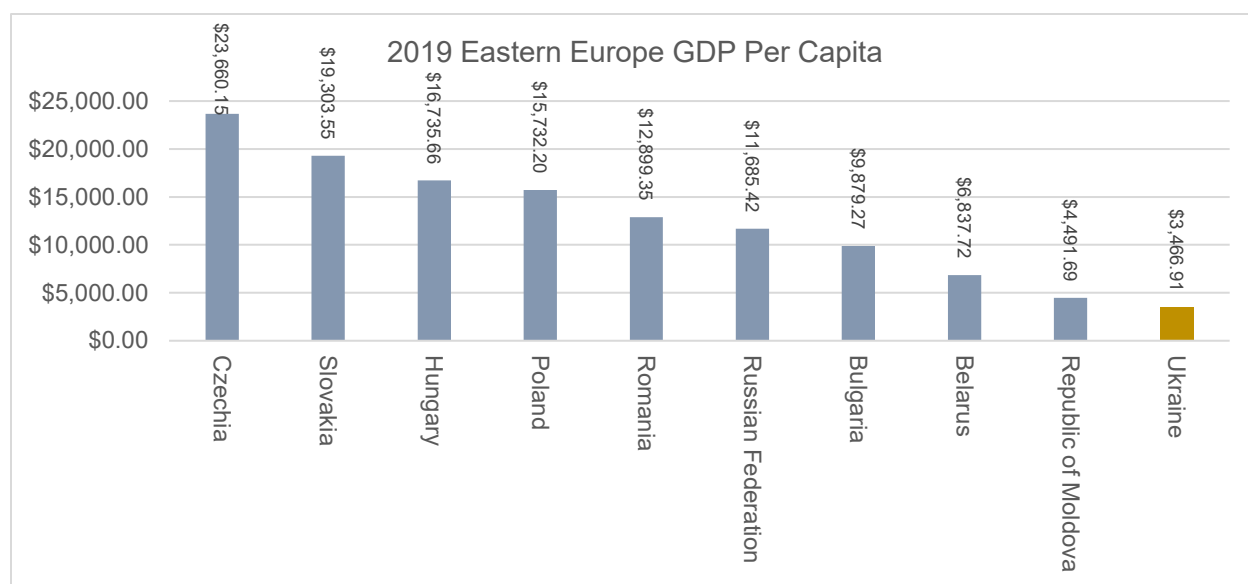


Figure 20: Ukrainian GDP Per Capita Regional Comparative (IMF)

Ukraine's 2019 GDP Per Capita rate of \$3,661.4 is the lowest in the region- almost \$20,000 less than the regional leader Czech Republic (\$23,660.15)

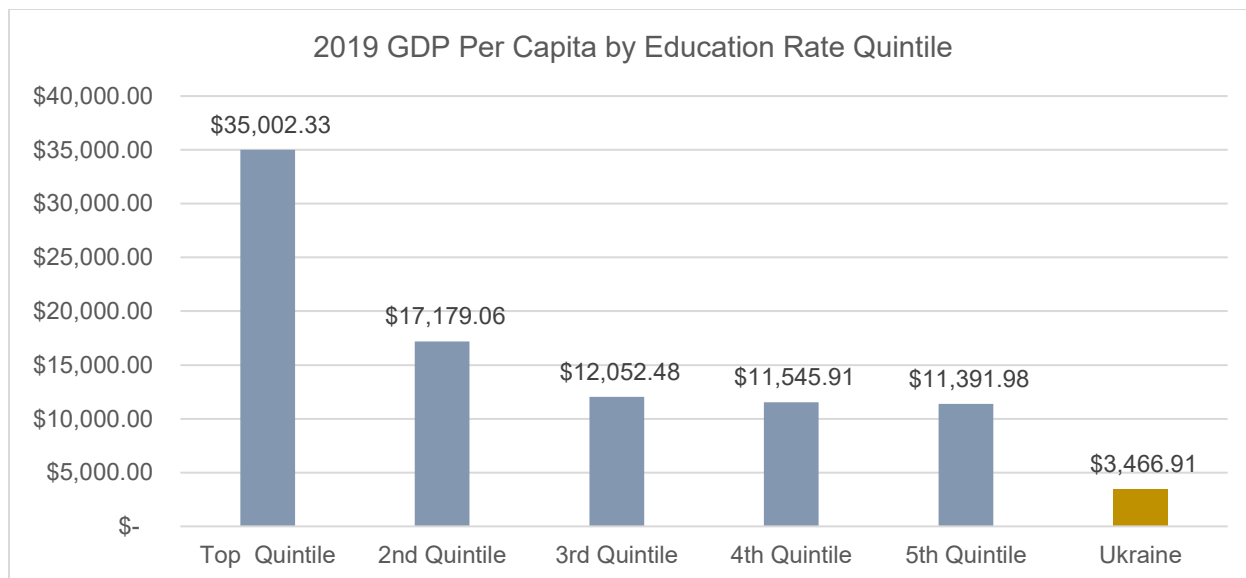


Figure 21: GDP Per Capita by Tertiary Education Rate Quintile (IMF, WB, UNESCO)

With a Tertiary Education Participation Rate of 82.7%, Ukraine ranks above the median for the top Tertiary Education Rate Quintile.

Ukraine is significantly underperforming against peer economies - almost \$31,000 less than the top Tertiary Education Rate Quintile average.

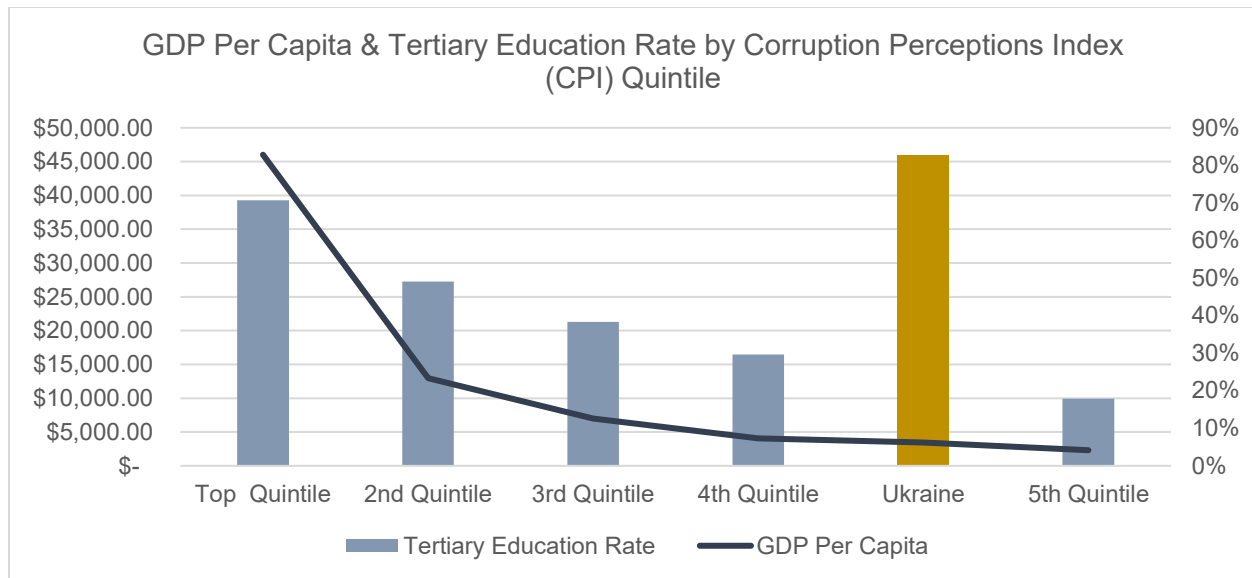


Figure 22: GDP Per Capita & Tertiary Education Rate by CPI Quintile (TI, IMF, UNESCO)

Ukraine falls within the 4th Corruption Perceptions Index (CPI). Against peer countries in the 4th quintile, Ukraine underperforms. Ukraine's GDP Per Capita is over \$400 below the quintile average of \$4,084. Of great concern, Ukraine's Tertiary Education Participation Rate of 82.6% is well above even the top CPI quintile.

Effect of the COVID-19 Pandemic on Ukraine's Economy

Although the global pandemic negatively affected the global economy (a loss of \$2.8 trillion from 2019 into 2020), Ukraine generated economic growth. Ukraine's GDP rose from \$153.9 billion in 2019 to \$155.5 billion in 2020- an increase of \$1.62 billion.

FDI & Access to Capital

Ukraine has not been able to translate its highly educated workforce into material domestic and foreign investment into the country. Total venture capital, private equity, corporate investment, etc., values trail peer economies on a per capita basis.

Working capital is highly risk-averse, having the strongest correlation to Corruption Perceptions Index than any other modeled indicator. Ukraine's ongoing challenges with corruption and growing geopolitical risk preceding Russia's invasion of Ukraine in 2022 are demonstrated in data.

An analysis demonstrating Ukraine's underperformance will be limited to Gross Capital Formation and Foreign Direct Investment Net Inflows, allowing competitive analysis against peer economies using validated and consistent data.

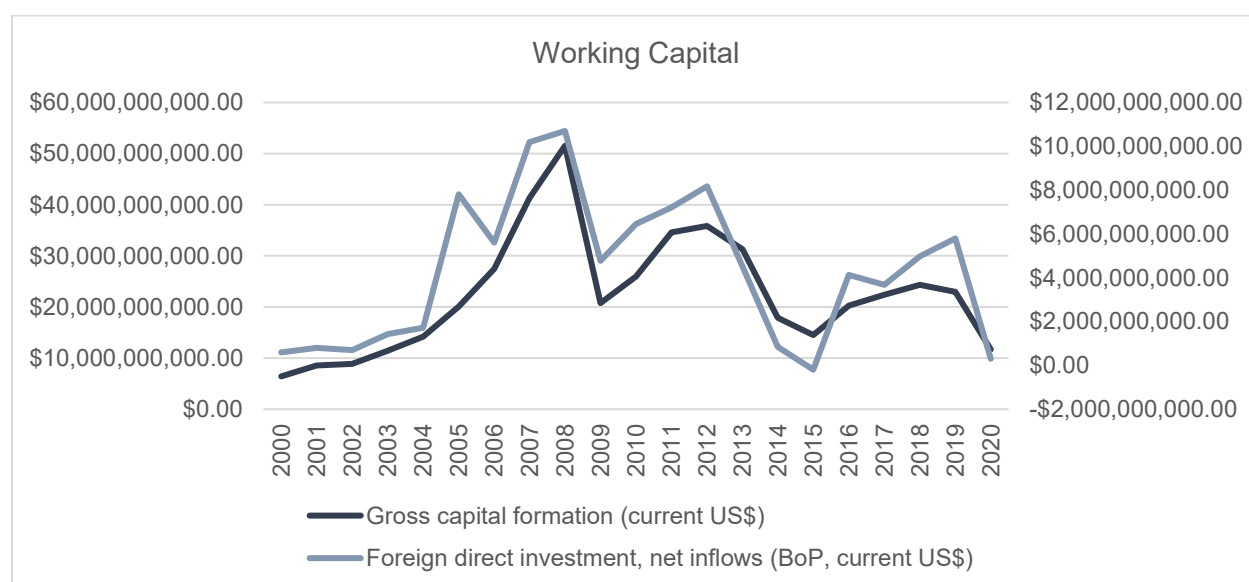


Figure 23: Ukrainian Gross Capital Formation & FDI Net Inflows (IMF)

1. Ukraine's peak Gross Capital Formation and Foreign Direct Investment Net Inflows peaked in 2008, preceding the global financial crisis.
2. Like most countries, the financial crisis in 2008-2009 materially affected Ukraine's access to working capital. Gross Capital Formation declined 60% YOY.
3. Ukraine's access to working capital plummeted following Euromaidan in 2013 and the outbreak of war in the Donbas region.

4. Lastly, the COVID-19 Pandemic further tightened Ukraine's working capital access (as with most countries).

Using pre-pandemic performance, Ukraine lags behind peer economies:

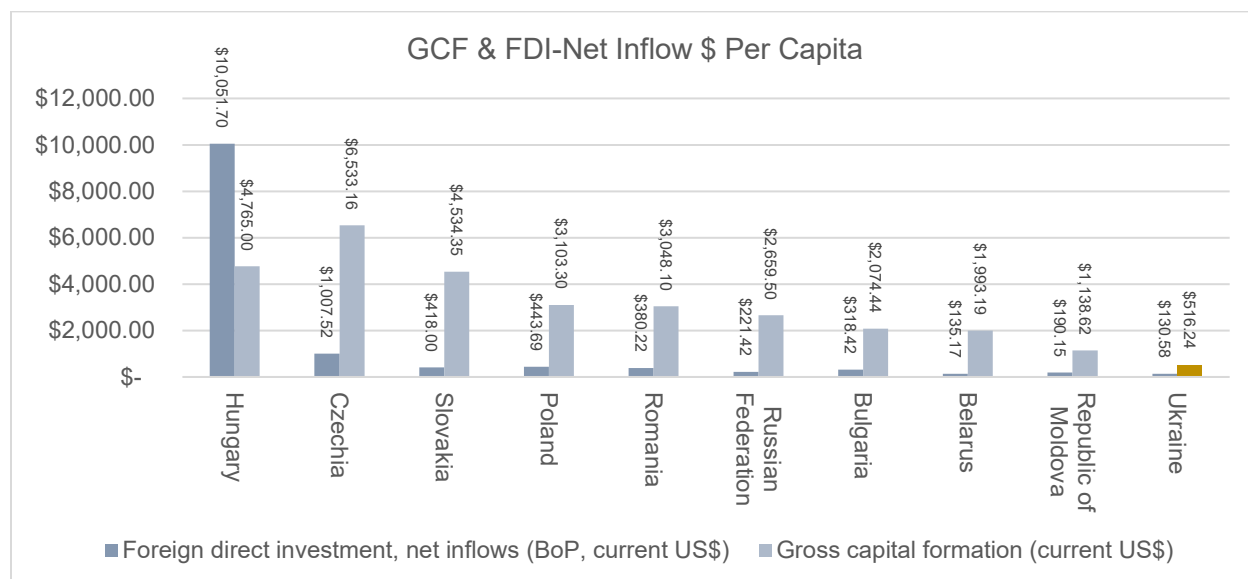


Figure 24: GFC & FDI Net Inflow Per Capita Regional Comparative (IMF, WB)

Ukraine's FDI net inflow and Gross Capital Formation rates are the lowest in the Central and Eastern European region.

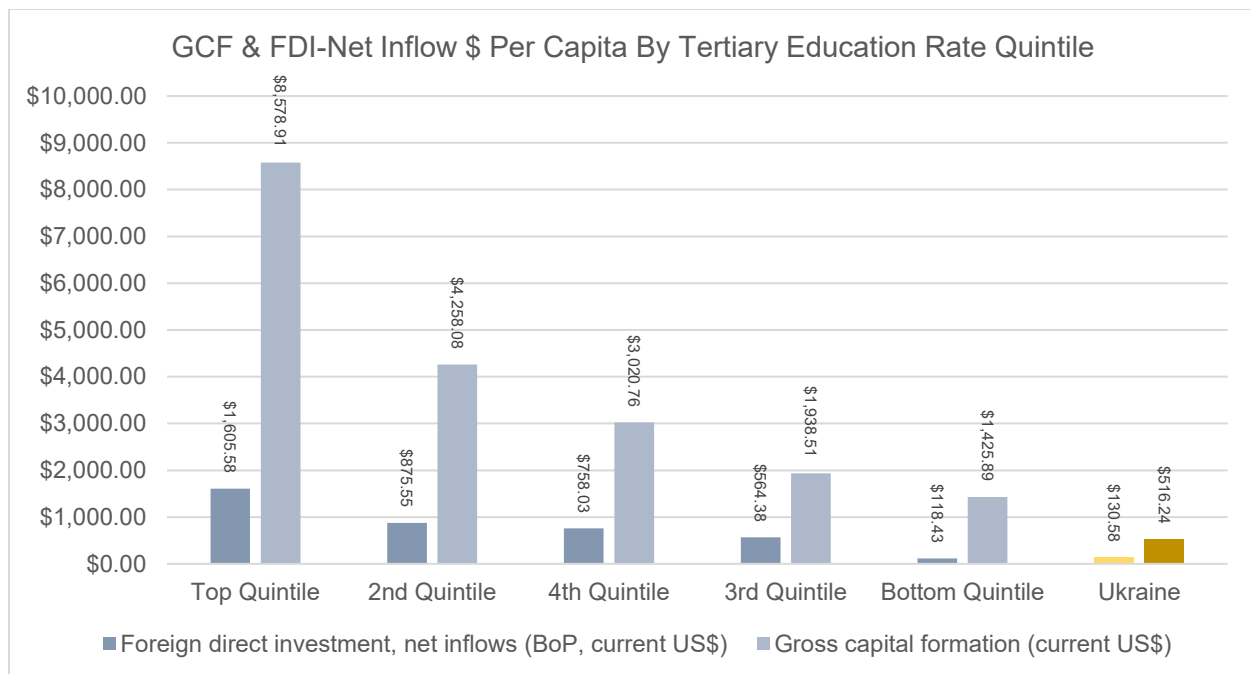


Figure 25: GFC & FDI Net Inflow Per Tertiary Education Rate Quintile (IMF, UNESCO)

Ukraine ranks below the lowest Tertiary Education Rate Quintile.

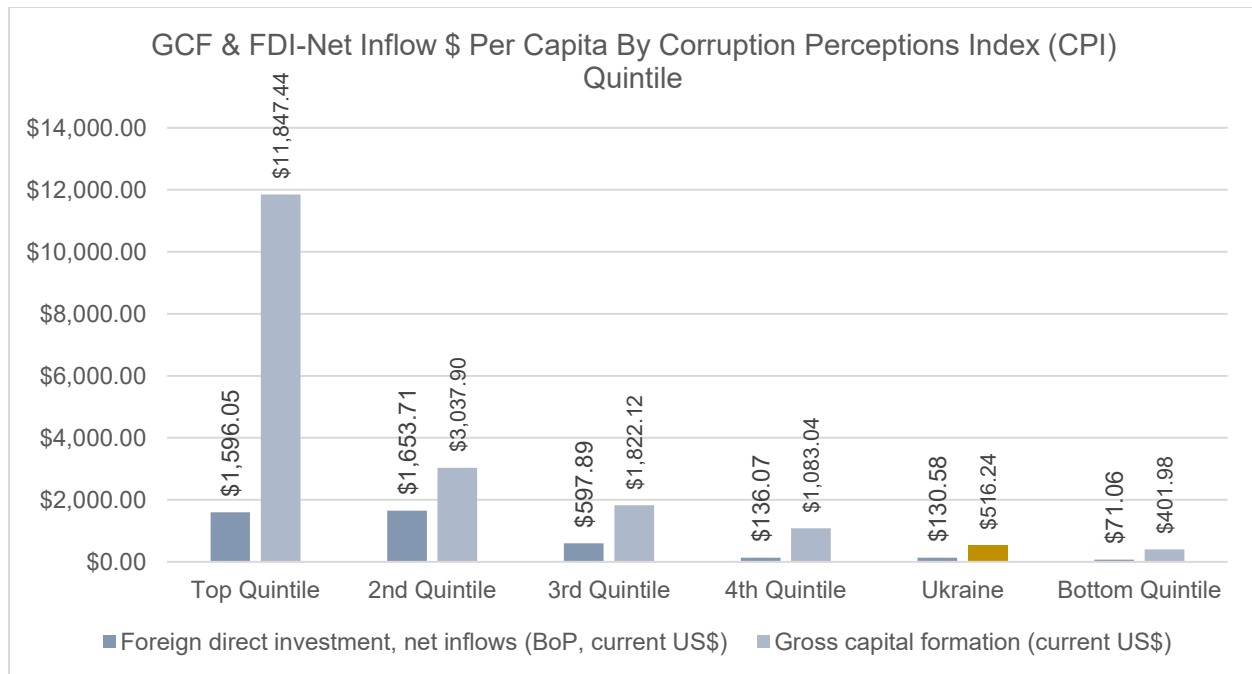


Figure 26: GFC & FDI Net Inflow Per Capita by CPI Quintile (IMF, TI)

The strongest correlation between a country's ability to generate foreign and domestic investment is the country's level of risk. Ukraine's low Corruption Perceptions Index (CPI) score stemming from ongoing corruption, public-sector efficiencies, and geopolitical risk preceding the invasion of Russia in 2022 places Ukraine within the 4th (second to bottom) CPI Quintile.

Of concern, Ukraine is performing below the average of peer economies in the 4th CPI Quintile.

Effect of Euromaidan and Resulting War in Donbas on Working Capital

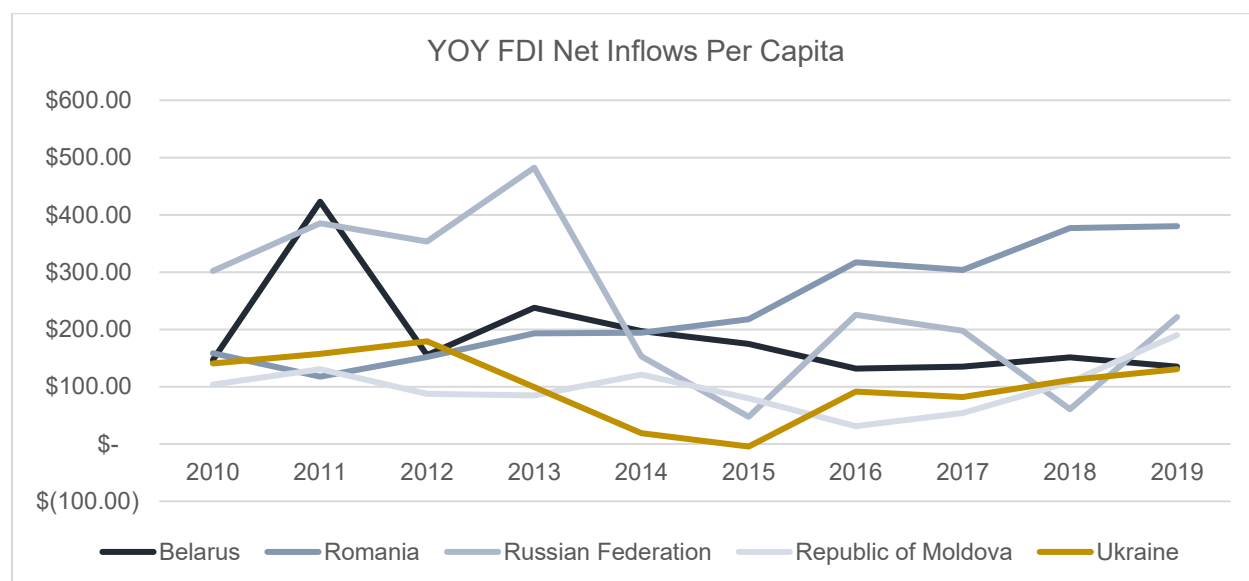


Figure 27: FDI Net Inflow Per Capita Regional Comparative (IMF, WB)

The outbreak of war in the Donbas region of Ukraine following Euromaidan in 2013 introduced material geopolitical risk that can be widely seen in econometrics. This conflict greatly reduced Ukraine's access to working capital. However, Ukraine was experiencing a decline in Gross Capital Formation and Foreign Direct Investment Net Inflows Per Capita starting in 2012 (preceding the Euromaidan protests).

The outbreak of war in Donbas following the Euromaidan protests negatively affected Ukraine's access to capital and global investment position. However, Ukraine's greatest challenge preceding the invasion of Russia in 2022 was Ukraine's ongoing CPI challenges.

For Ukraine to transition into a higher income category following the end of the Russian invasion, Ukraine will need to address ongoing corruption and public efficiency issues.

Exports

Like comparative economies with a similar sized population and within the CEE/CIS region, Ukraine relies heavily on exports for economic performance. Ukraine's total exports of \$81.76 billion in 2021 are slightly below half of Ukraine's GDP of \$164.52. Given the importance of exports in overall GDP, the overall economic growth strategy should be export-centric.



Figure 28: Ukraine YOY Exports (IMF BOP)

Ukraine's total export peak performance was reached in 2012. Euromaidan and the following war in Donbas negatively affected overall exports, although Ukraine has materially recovered in both goods and service exports in 2021. If Russia's current war in Ukraine had not happened, Ukraine would likely have generated more exports in 2022 than any previous year.



Figure 29: Ukrainian Exports Growth Rates (IMF)

Growth rates for goods exports exceeded service exports for the previous 15-years and from 2015 to 2021 (lowest export performance post-Euromaidan and the war in Donbas).

Table 1: Top Ukrainian Exports (IMF, UN COMTRADE, Hatch)

Export	2021 (\$B)	Growth from 2015	15 Year Growth	Job Displacement Risk
Iron and steel	\$13.14	63%	-21%	↑
Cereals	\$11.84	96%	1451%	↑
Other Services	\$10.84	127%	269%	↓
ICT Services	\$7.11	238%	1847%	↓
Ores, slag and ash	\$7.03	217%	536%	↑
Animal or Vegetable Fats	\$6.90	109%	302%	↑
Electric Machinery	\$3.17	60%	41%	↑
Other Business Services	\$3.07	70%	137%	↓
Nuclear Reactors, Parts, etc.	\$2.12	8%	-23%	?
Oil Seeds	\$2.12	43%	217%	↑
Wood and Wood Articles	\$1.94	75%	134%	↑
Food industries, residues and wastes thereof; prepared animal fodder	\$1.73	73%	410%	↑
Iron or steel articles	\$1.24	36%	-57%	↑
Furniture	\$1.03	159%	259%	↑
Plastics and articles thereof	\$0.95	178%	35%	↑
Inorganic chemicals	\$0.95	-2%	-18%	↑
Meat and edible meat offal	\$0.83	119%	687%	↑
Mineral fuels, mineral oils and products	\$0.74	52%	-72%	↑
Fertilizers	\$0.63	18%	-52%	↑
Salt; sulphur; earths, stone; plastering materials, lime and cement	\$0.50	27%	-7%	↑
Paper and paperboard; articles of paper pulp, of paper or paperboard	\$0.45	-15%	-35%	↑
Tobacco and manufactured tobacco substitutes	\$0.45	28%	145%	↑
Preparations of cereals, flour, starch or milk; pastrycooks' products	\$0.41	51%	143%	↑
Dairy	\$0.39	0%	-38%	↑
Fruit and nuts, edible; peel of citrus fruit or melons	\$0.34	118%	138%	↑

Out of Ukraine's top 25 exports (goods and services), only four are considered high-IP exports. Over the next decade, all exports but three (general services, business services, ICT services) have a high risk of job displacement due to the rise in adoption of 4th Industrial Revolution technologies.

ICT Service Exports, the 4th largest export accounting for \$7.11 billion in 2021, is Ukraine's fastest growing export with a 15-year growth rate of 1,847% and a 2015-2021 growth rate of 238%.

Export	2021 (\$B)	2015 - 2021 Growth	15 Year Growth
ICT Services	\$7.11	238%	1847%
Cereals	\$11.84	96%	1451%
Meat and edible meat	\$0.83	119%	687%
Ores, slag and ash	\$7.03	217%	536%
Food industries, residues and wastes thereof; prepared animal fodder	\$1.73	73%	410%

Table 2: Fastest Growing Ukrainian Exports (IMF BOP, UN COMTRADE)

High-IP Exports

Export	Indicator Code	Type	2021	2015 – 2021 Growth	15-Year Growth
Aircraft, spacecraft and parts thereof	HS88	Goods	\$0.07	-65%	-74%
Charges for the Use of Intellectual Property	BXSORL_BP6_USD	Services	\$0.07	-19%	30%
Other Business Services	BXSOOB_BP6_USD	Services	\$3.07	70%	137%
→ Other Business Services, Technical, Trade-related, and Other Business Services	BXSOOBTT_BP6_USD	Services	\$1.57	65%	230%
Other Services, Credit	BXSO_BP6_USD	Services	\$10.84	127%	269%
Telecommunications, Computer, and Information Services	BXSOTCM_BP6_USD	Services	\$7.11	238%	1847%
→ Telecommunications, Computer, and Information Services, Computer Services	BXSOTCMC_BP6_USD	Services	\$6.94	316%	3779%
Electrical machinery and equipment and parts thereof	HS85	Goods	\$3.17	60%	41%
High-technology goods exports (2020)	TX.VAL.TECH.CD	Goods	\$1.18	-21%	
→ ICT goods exports (2020)	TX.VAL.ICTG.ZS.UN	Goods	\$0.33	13%	-38%
Nuclear reactors, boilers, machinery and mechanical appliances; parts thereof	HS84	Goods	\$2.12	8%	-23%
Optical, photographic, cinematographic, measuring, checking, medical or surgical instruments and apparatus	HS90	Goods	\$0.17	7%	-17%
Pharmaceutical products	HS30	Goods	\$0.30	94%	133%
Photographic or cinematographic goods	HS37	Goods	\$0.00	-11%	-78%
Railway, tramway locomotives, rolling-stock and parts thereof; railway or tramway track fixtures	HS86	Goods	\$0.29	38%	-84%
Ships, boats and floating structures	HS89	Goods	\$0.16	56%	-25%
Toys, games and sports requisites; parts and accessories thereof	HS95	Goods	\$0.11	56%	60%
Vehicles; other than railway or tramway rolling stock, and parts and accessories thereof	HS87	Goods	\$0.16	-8%	-84%

Table 3: High-IP Ukrainian Exports (IMF BOP, UN COMTRADE)

Of special note, Ukraine's Computer Service Exports (a subcategory of ICT Service Exports) achieved a 3,779% 15-year growth rate with the highest YOY growth rate in Ukraine's history from 2020 to 2021.

High-Value Exports Per Capita Analysis

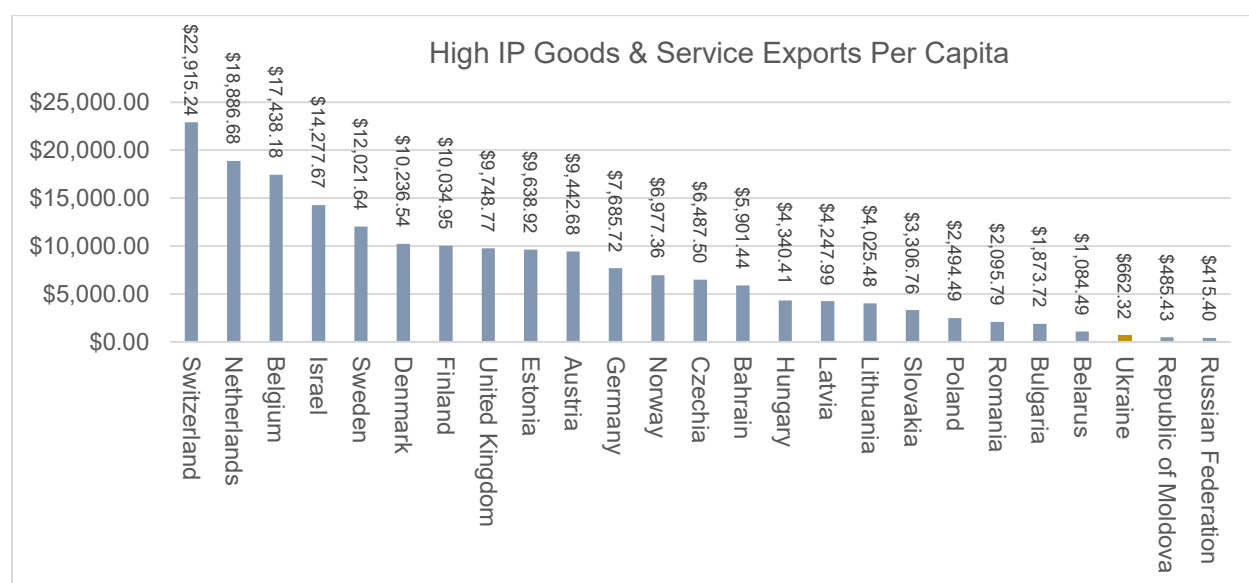


Figure 30: High-IP Exports Per Capita Regional Comparative (IMF, UN, WB)

Dividing high-IP goods and services exports by population allows comparative analysis between economies. While Ukraine's high-IP service industries are growing, per-capita performance is lower than global and regional peer economies.

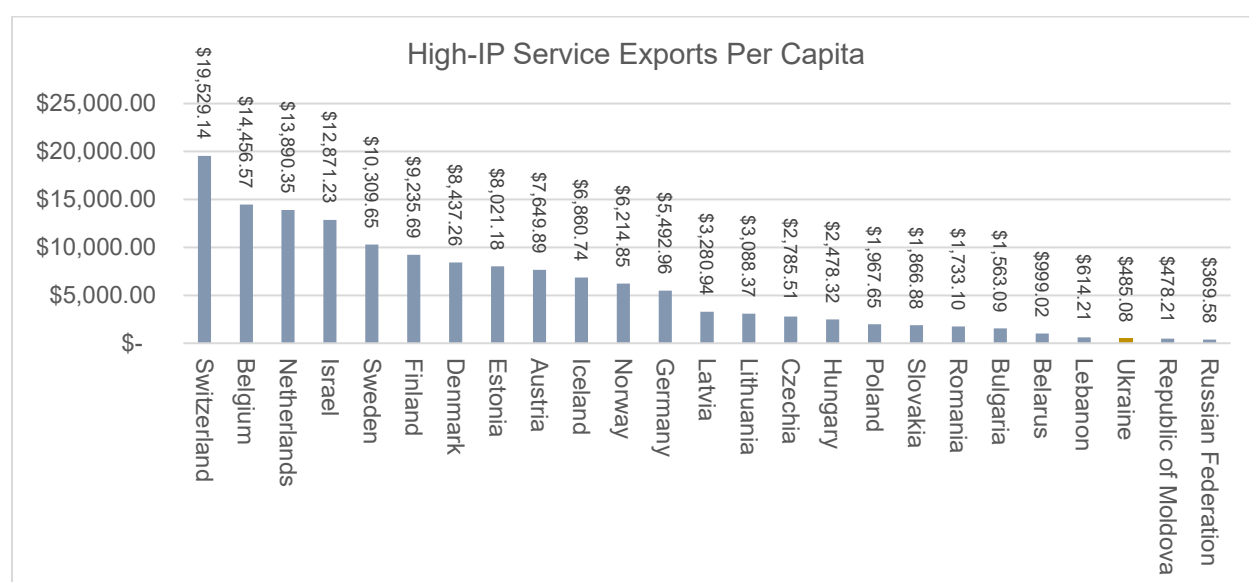


Figure 31: High-IP Service Exports Per Capita Regional Comparative (IMF BOP, WB)

Limiting the analysis to high-IP service exports (removing Ukraine's low high-IP goods exports rate) continues to show a general underperformance against peer economies.

ICT Exports

Information, computer, and telecom (ICT) services are forecasted to have high job growth globally and represent Ukraine's fastest-growing export industry.

Breaking ICT exports down into service and goods exports demonstrates that Ukraine's tech hardware export industry is materially trailing service exports. The result is not unexpected. ICT hardware exports (goods exports) are highly sensitive to a country's risk profile- including corruption rates.



Figure 32: Ukrainian YOY ICT Exports Per Capita (IMF BOP, WB)

ICT Service Exports

Within ICT service exports (IMF BoP code BXSOTCM_BP6_USD for measurement in US dollars), there are three subcategories:

1. Computer service exports (IMF BoP code BXSOTCMC_BP6_USD)
2. Information service exports (IMF BoP code BXSOTCMM_BP6_USD)
3. Telecommunication service exports (BXSOTCMT_BP6_USD)

Comparative analysis will primarily be performed using the top category (including all three subcategories). For analysis, "Computer Service Exports" will be synonymous with "ICT Service Exports." The reasoning is as follows:

1. Numerous countries do not report at the subcategory level.
2. Not all countries report subcategories the same way.
3. Computer service exports are the largest component of ICT service exports. In many cases, computer service exports are materially equal to the value of the parent category.

	ICT Service Exports Total (\$B)	Computer Services (\$B)	Telecom Services (\$B)	Information Services (\$B)	Computer Services %	Telecom Services %	Information Services %
India	\$119.52	\$116.11	\$3.07	\$0.35	97.14%	2.57%	0.29%
Israel	\$41.23	\$40.98	\$0.25	\$0.00	99.39%	0.61%	0.00%
Belgium	\$17.79	\$13.42	\$3.54	\$0.82	75.47%	19.89%	4.64%
Poland	\$11.58	\$10.33	\$0.64	\$0.61	89.17%	5.56%	5.27%
Ukraine	\$7.11	\$6.94	\$0.12	\$0.05	97.69%	1.63%	0.68%
Romania	\$8.25	\$6.03	\$1.03	\$1.19	73.09%	12.44%	14.47%
Portugal	\$3.89	\$3.41	\$0.41	\$0.07	87.67%	10.54%	1.79%
Belarus	\$3.22	\$3.02	\$0.17	\$0.03	93.85%	5.31%	0.84%
Estonia	\$2.08	\$1.65	\$0.25	\$0.18	79.41%	11.83%	8.76%
Latvia	\$1.13	\$0.72	\$0.35	\$0.06	64.09%	30.87%	5.05%

Table 4: ICT Service Exports Subcategories (IMF BOP)

ICT Service Exports Per Capita

Although Ukraine's ICT Service Exports have rapidly grown in recent years, Ukraine underperforms against all peer economies and reference models.

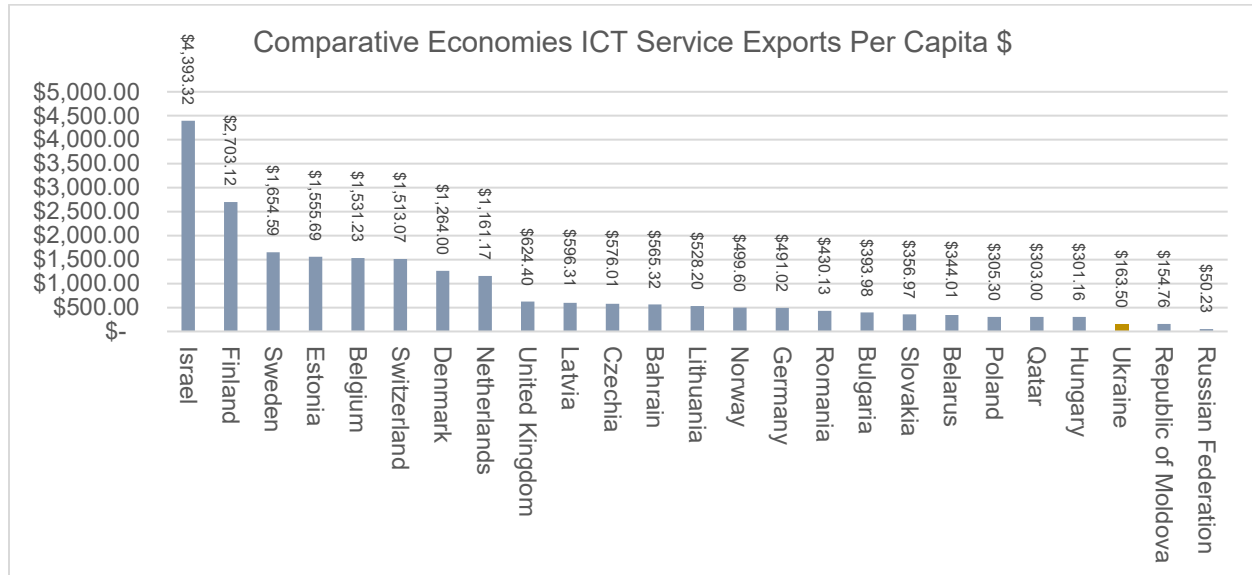


Figure 33: ICT Service Exports Per Capita Regional Comparatives (IMF BOP, WB)

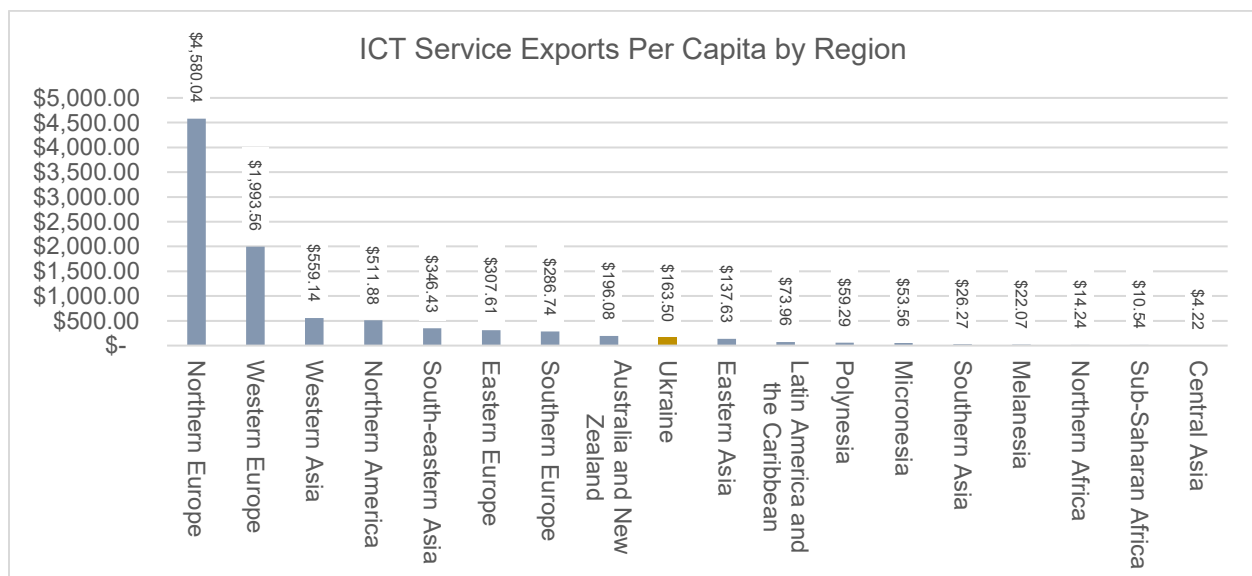


Figure 34: ICT Service Exports Per Capita by Region (IMF BOP, WB)

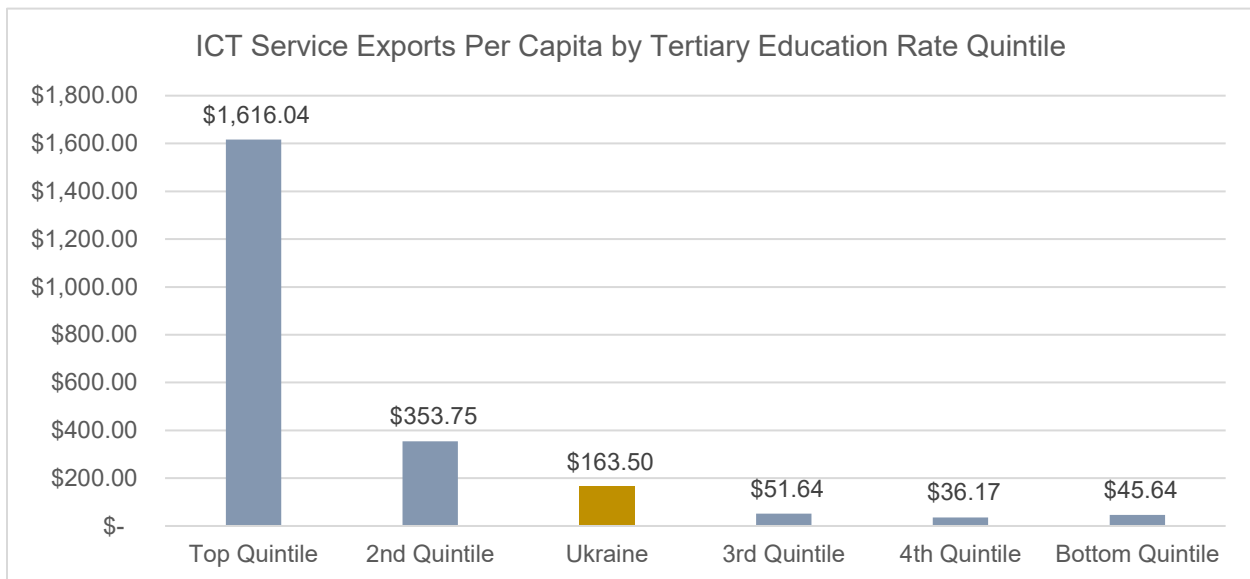


Figure 35: ICT Service Exports Per Capita by Education Quintile (IMF, UNESCO, WB)

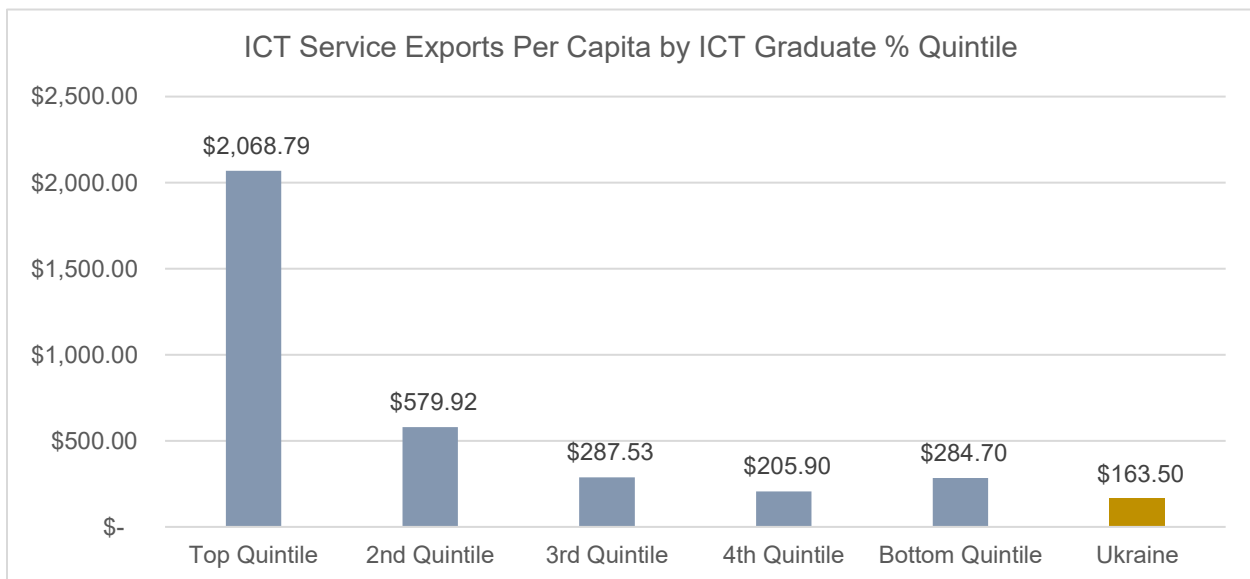


Figure 36: ICT Service Exports by ICT Graduate % Quintile (UNESCO, IMF BOP, WB)

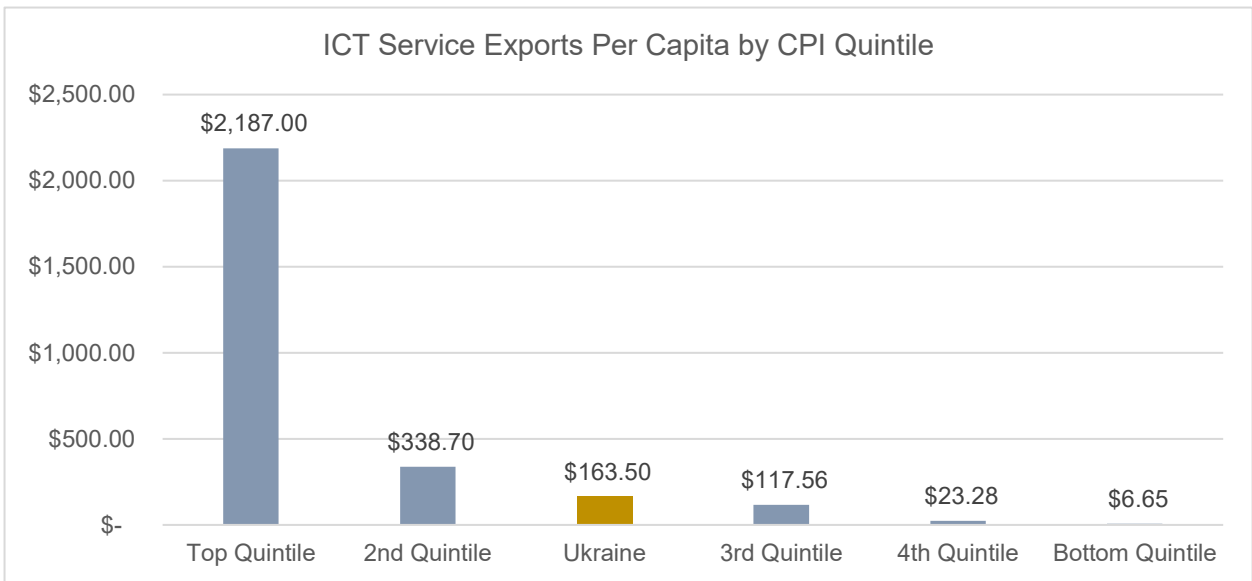


Figure 37: ICT Service Exports Per Capita by CPI Quintile (TI, IMF BOP, WB)

ICT Service Exports Growth

Ukraine had a material increase in the ICT Service Export and ICT Service Export Per Capita growth rate from 2020 to 2021. Ukraine's growth rate ranks among the highest economies that have reported IMF BoP data in 2021. Although Ukraine's growth rate increase is notable:

1. Numerous countries have increased total ICT Service Exports value YOY well above Ukraine. Israel is an example. Ireland's ICT Service Exports Per Capita by \$8.83 thousand from 2020 to 2021.
2. Some countries have increased growth rates and total ICT Service Exports Per Capita \$ value YOY from 2020 to 2021. Of special note, Estonia had a higher growth rate (84%) and ICT Service Exports Per Capita \$ of \$710.62.

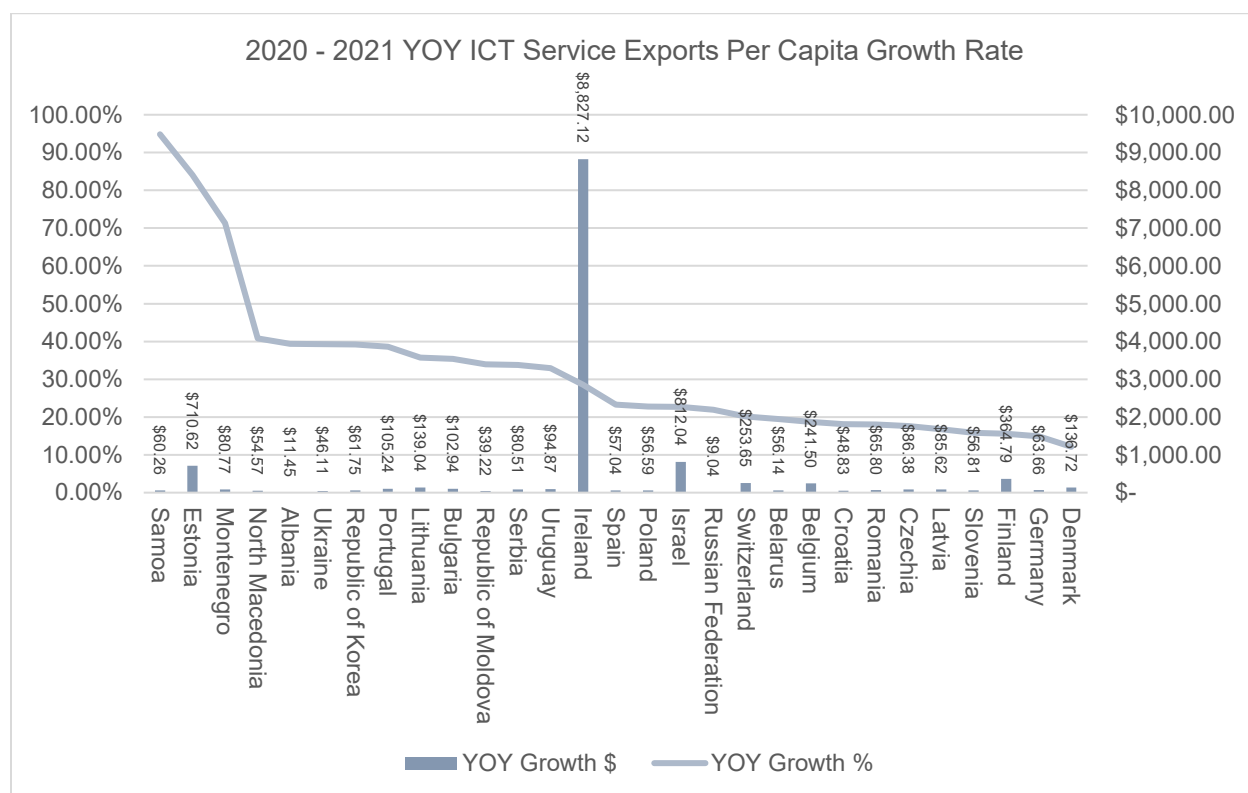


Figure 38: YOY ICT Service Exports Growth Rate Regional Comparative (IMF, WB)

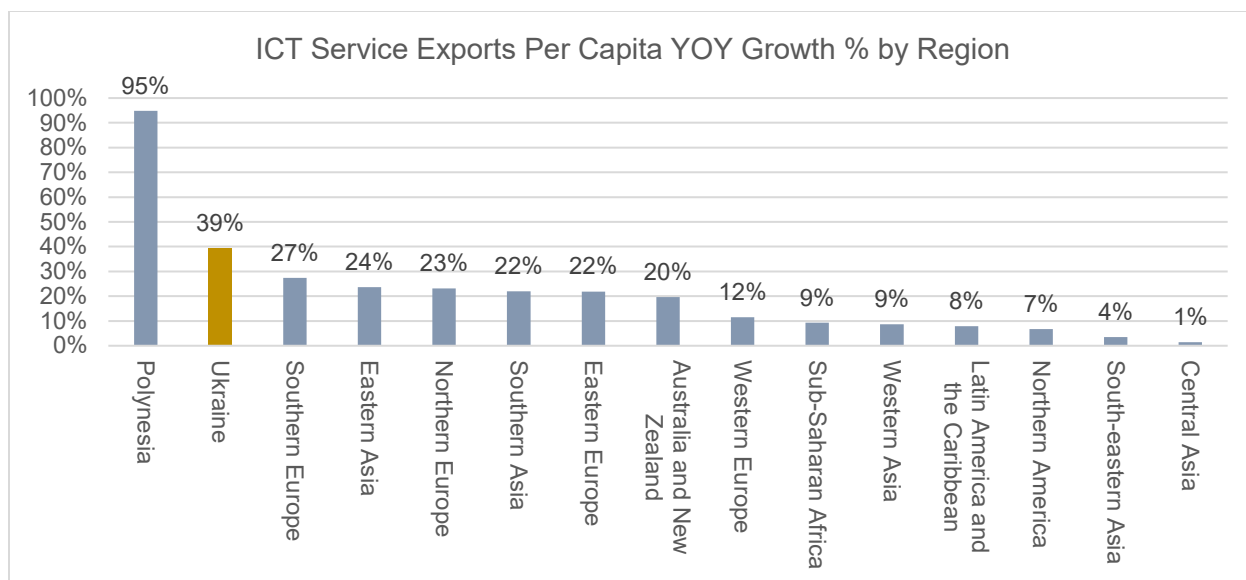


Figure 39: ICT Service Exports YOY Growth % by Region (IMF BOP, WB)

Comparing Ukraine's 2020-2021 YOY growth in ICT Service Exports \$ against all global regions demonstrates Ukraine's overall success. Ukraine's growth rate of 39% is well above the Eastern European average of 22%.

Ukraine's 2020-2021 ICT Service Exports Per Capita YOY growth rate overperformed by every reasonable model.

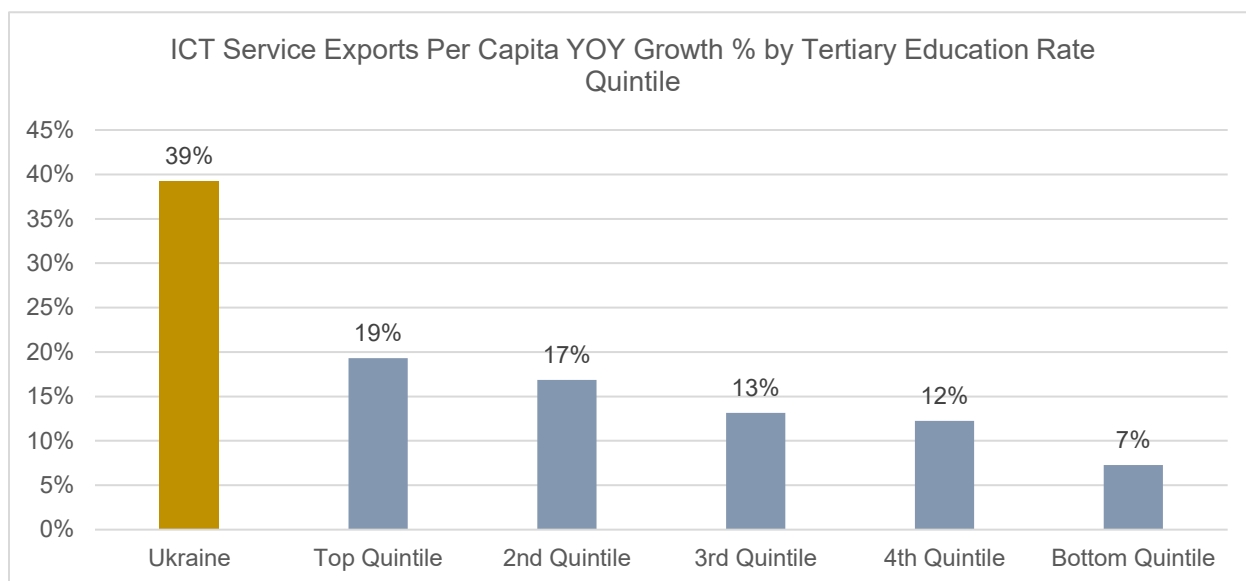


Figure 40: ICT Service Exports Growth Rate by Education Quintile (IMF BOP, UNESCO, WB)

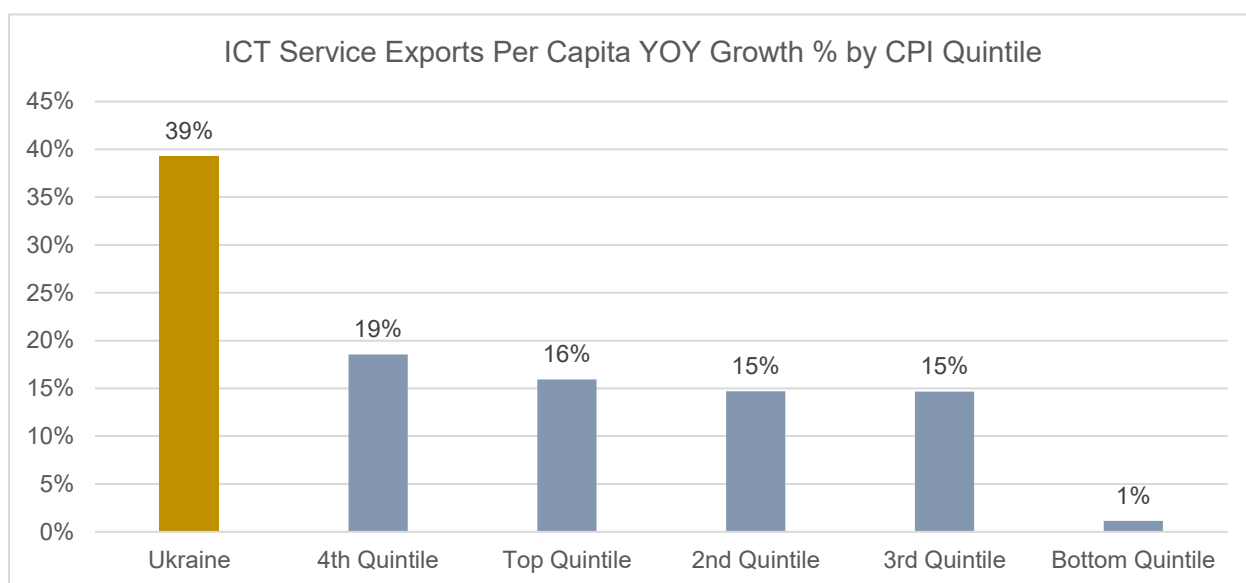


Figure 41: ICT Service Exports YOY Growth % by CPI Quintile (TI, IMF, WB)

Figure 42: ICT Service Exports Growth Rate by ICT Grad % Quintile

While Ukraine's 2020-2021 ICT Service Exports YOY Growth is notable, it is not an anomaly. Ukraine has been climbing the global ranks in total ICT Service Exports \$ and ICT Service Exports Per Capita \$ global rankings for over twenty years. Ukraine's global rankings did not significantly decline following Euromaidan and the outbreak of war in Donbas.

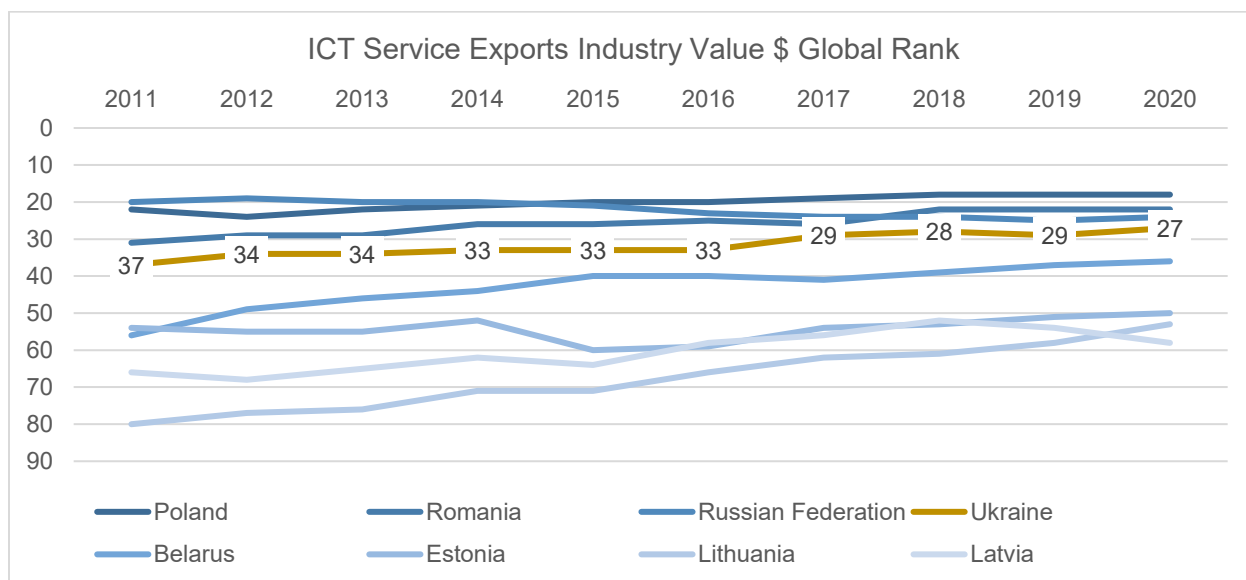


Figure 43: ICT Service Exports \$ Global Rank (IMF BOP)

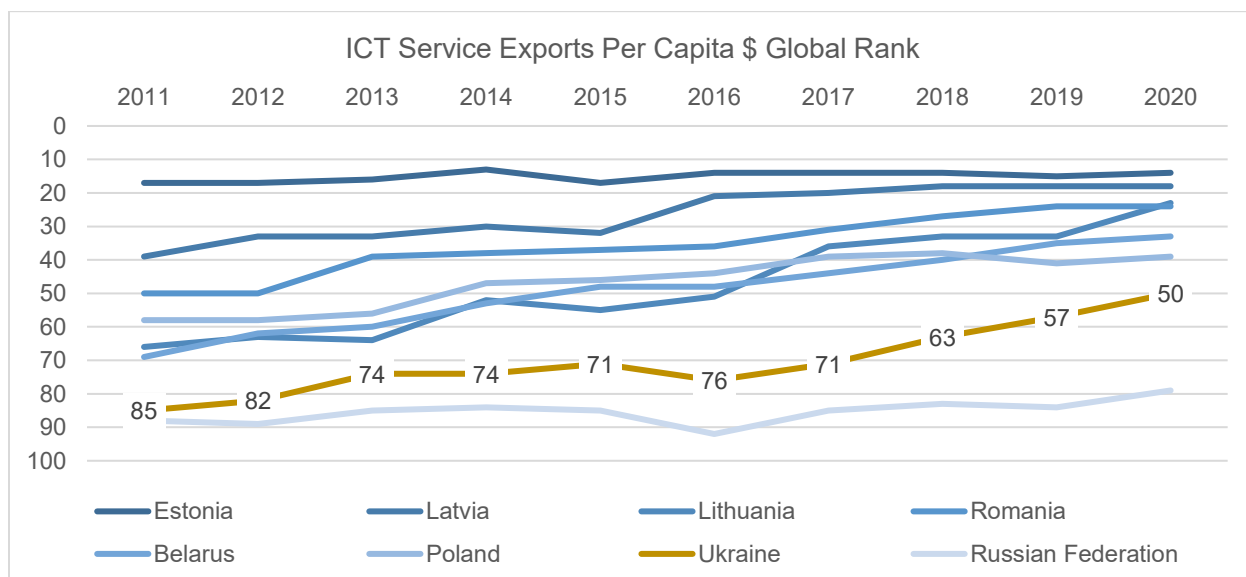


Figure 44: ICT Service Exports Per Capita \$ Global Rank (IMF BOP)

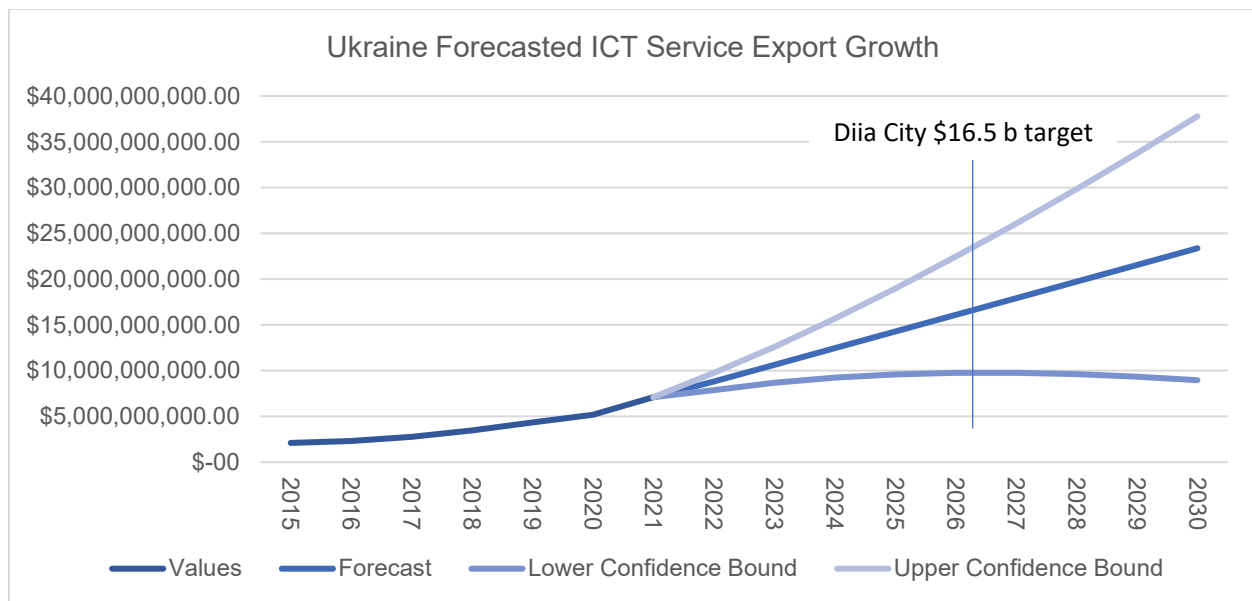


Figure 45: Ukraine Forecasted ICT Service Export Growth (IMF BOP, Hatch)

Pre-war, Ukraine would have likely reached the \$16.5 billion ICT Service Export value noted in President Zelensky's Diia City announcement mid-year 2026.

Causality

For this paper, Ukraine's ICT Service Exports Per Capita were modeled against all peer economies using the following primary and secondary variables.

Primary Model Variable	Secondary Model Variable																
	Brand Awareness	Ease of Doing Business	Corruption	Country Reputation	Crime Rates	Confidence in Gov	Equality	Existing SEZ	ICT Graduate %	Labor Cost	MNC Involvement	National Dev. Plan	Population	Regional Comparatives	STEM Graduate %	Talent Flight Rate	Tertiary Education Rate
Brand Awareness																	
Ease of Doing Business																	
Corruption																	
Country Reputation																	
Crime Rates																	
Confidence in Gov																	
Equality																	
Existing SEZ																	
ICT Graduate %																	
Labor Cost																	
MNC Involvement																	
National Dev. Plan																	
Population																	
Regional Comparatives																	
STEM Graduate %																	
Talent Flight Rate																	
Tertiary Education Rate																	
Workforce Reputation																	
Working Capital																	

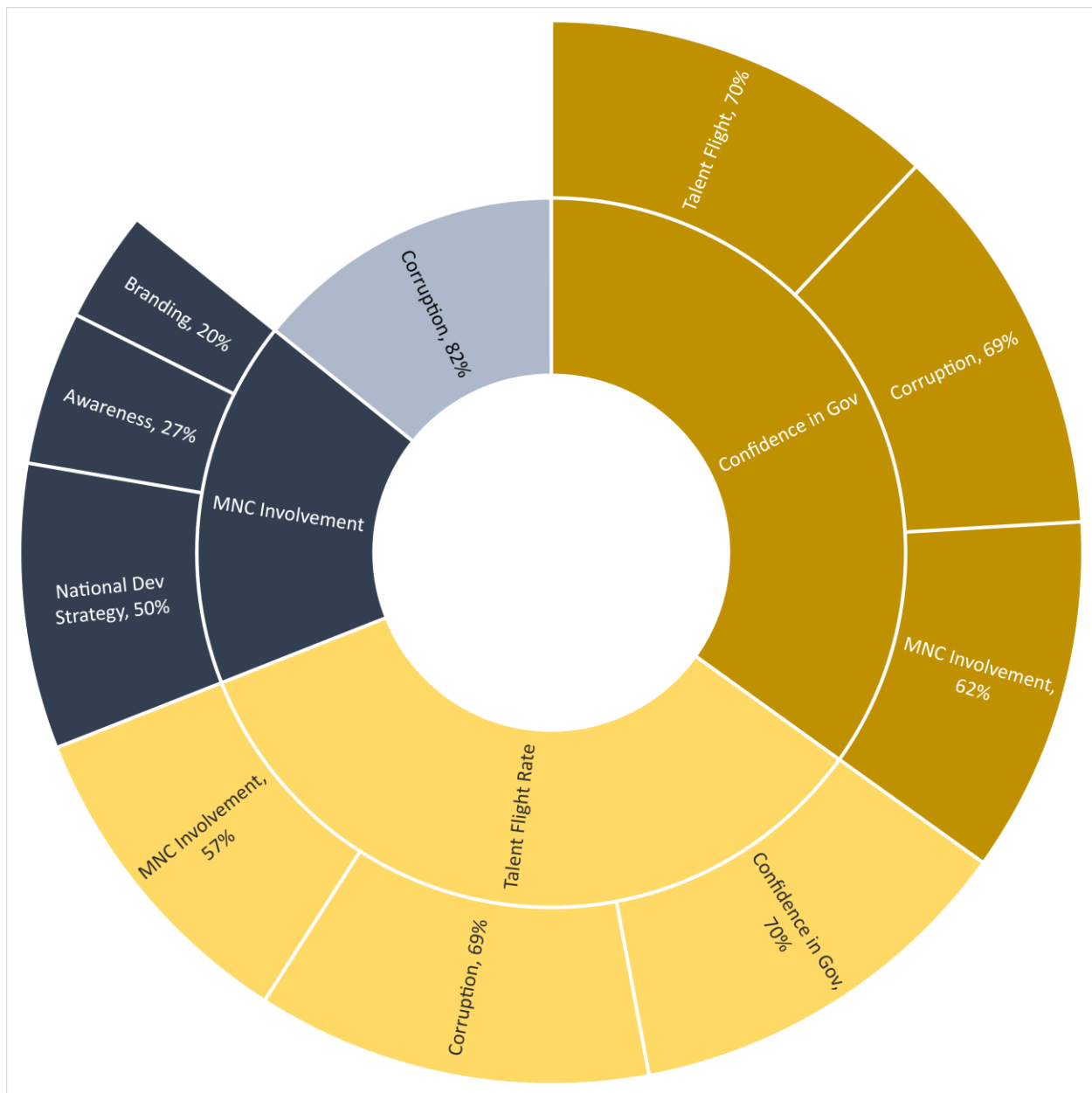


Figure 46: Ukrainian IT Industry Underperformance Correlations

The sparsity of data in some models prevents from making direct causality statements. However, enough data exists to indicate the root cause for Ukraine's low ICT Service Exports Per Capita score.

Confidence Crisis Cycle

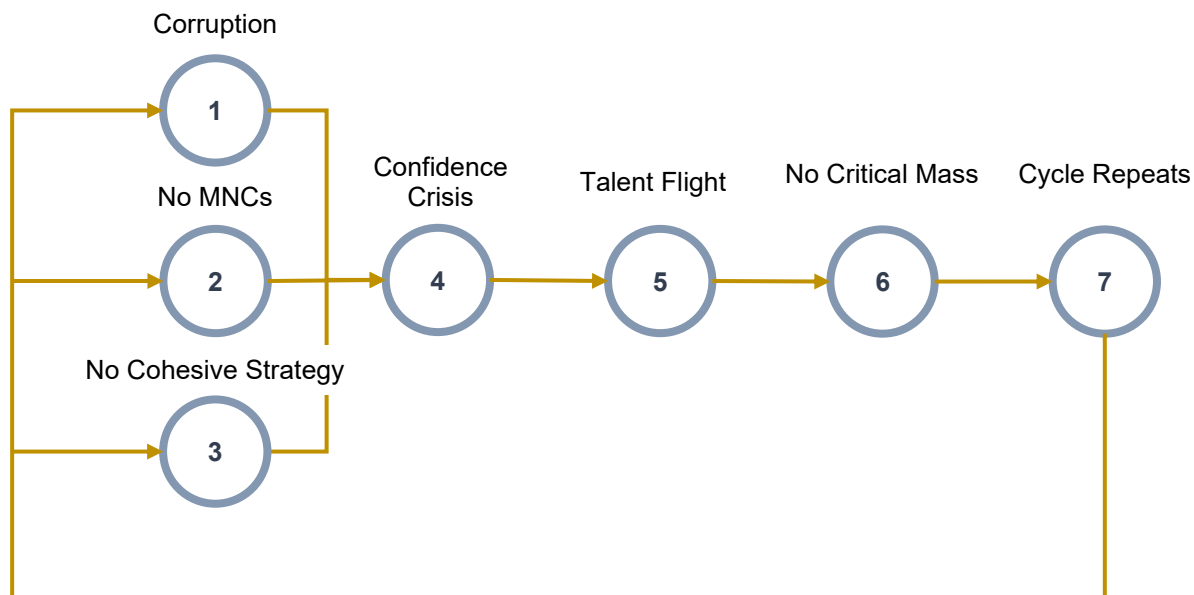


Figure 47: Ukraine ICT Service Exports Underperformance Causality (Hatch)

Data indicates low ICT Service Exports Per Capita performance is rooted in a significant crisis in confidence among the Ukrainian population.

With high corruption rates, a lack of a cohesive industry development plan matured to levels seen in peer nations, and no material involvement from international employers, the greater Ukrainian population has not believed in the potential of the technology industry. Without faith, Ukrainians have left the country in near-record numbers preceding the Russian invasion in February 2022.

With a high talent flight rate, Ukraine has difficulty creating the critical mass of elite talent needed for the technology industry to thrive.

Ukraine's 2021 ICT Service Exports growth may have indicated that the greater population was beginning to believe. Ukraine may have been entering a transitional phase with higher growth rates on the horizon. However, the Russian invasion in February 2022 likely set back the confidence of the Ukrainian population for well over a decade.



Ukrainian Potential

Growth Industries

Twenty-four out of Ukraine's 25 top exports will likely be supply constrained by 2030. Ukraine's total exports within each will be limited by the country's ability to produce. While most exports have a material opportunity for growth in total value, only high-value service exports have a low threat of job displacement from automation and other new technologies.

Ukraine's ICT Service Exports industry has the greatest chance for transformative industry value and job growth among high-value service exports.

Export	2021 (\$B)	Growth from 2015	15 Year Growth	Job Displacement Risk
Iron and steel	\$13.14	63%	-21%	↑
Cereals	\$11.84	96%	1451%	↑
Other Services	\$10.84	127%	269%	↓
ICT Services	\$7.11	238%	1847%	↓
Ores, slag and ash	\$7.03	217%	536%	↑
Animal or Vegetable Fats	\$6.90	109%	302%	↑
Electric Machinery	\$3.17	60%	41%	↑
Other Business Services	\$3.07	70%	137%	↓
Nuclear Reactors, Parts, etc.	\$2.12	8%	-23%	?
Oil Seeds	\$2.12	43%	217%	↑
Wood and Wood Articles	\$1.94	75%	134%	↑
Food industries, residues and wastes thereof; prepared animal fodder	\$1.73	73%	410%	↑
Iron or steel articles	\$1.24	36%	-57%	↑
Furniture	\$1.03	159%	259%	↑
Plastics and articles thereof	\$0.95	178%	35%	↑
Inorganic chemicals	\$0.95	-2%	-18%	↑
Meat and edible meat offal	\$0.83	119%	687%	↑
Mineral fuels, mineral oils and products	\$0.74	52%	-72%	↑
Fertilizers	\$0.63	18%	-52%	↑
Salt; sulphur; earths, stone; plastering materials, lime and cement	\$0.50	27%	-7%	↑
Paper and paperboard; articles of paper pulp, of paper or paperboard	\$0.45	-15%	-35%	↑
Tobacco and manufactured tobacco substitutes	\$0.45	28%	145%	↑
Preparations of cereals, flour, starch or milk; pastrycooks' products	\$0.41	51%	143%	↑
Dairy	\$0.39	0%	-38%	↑
Fruit and nuts, edible; peel of citrus fruit or melons	\$0.34	118%	138%	↑

Table 5: Ukrainian Exports

Within ICT Service Exports, comparative economies indicate Ukraine's potential for growth.

1. Israel generates \$4,393.32 ICT Service Exports Per Capita \$ with a 2027 forecast of \$8,648.69, given Israel's 5-year growth rate.
2. Estonia generates \$1,555.69 ICT Service Exports Per Capita \$ with a 2027 forecast of \$5,525.91, given Estonia's 5-year growth rate.
3. The average ICT Service Exports Per Capita \$ for the Eastern European region is \$307.61, with a forecasted value of \$698.33 in 2027.
4. Ukraine currently generates \$163.50 ICT Service Exports Per Capita \$ after a significant YOY growth into 2021. Given Ukraine's current 5-year growth rate, Ukraine's forecasted 2027 value would have been \$520.84, excluding the current war. Ukraine's Diia City announcement called for a total ICT Service Exports industry value of \$19.5 billion- or \$396.16 given a static 2021 population. Ukraine's natural growth rate would have taken the ICT Service Export industry past Diia City's forecast by 2027 if Russia had not invaded the country in February 2022.

Given:

1. Ukraine's tertiary education rate,
2. The threat of job displacement in 22 out of Ukraine's 25 top exports,
3. The risk tolerance of ICT Service Exports industries,
4. Demonstrated willingness from MNCs to invest in and facilitate large-scale workforce development programs,
5. And speed to scale ICT Service Exports,

Ukraine should set the ICT Service Export industry as a national strategic priority with a higher target than the current stated policy (CSP) and noted Diia City targets. Given comparative economies, Ukraine's 10-year post-war ICT Service Exports Per Capita target should be \$1,500.

Targets

Given the growth in demand for technical services as the world transitions through the 4th Industrial Revolution, ICT Service Exports will continue to rise.

The table below lists each comparative economy's current ICT Service Exports Per Capita and forecasts its 2027 value given the 5-year growth rate specific to the economy.

Comparative Economies	Current (2021) ICT Service Exports Per Capita \$	5 Year Growth	Forecasted 2027 Value \$
Northern Europe	\$5,018.97	216%	\$10,850.06
Israel	\$4,393.32	197%	\$8,648.69
Estonia	\$1,555.69	355%	\$5,525.91
Finland	\$2,703.12	187%	\$5,043.75
India IT Cities	\$2,000.00	150%	\$3,000.00
Europe	\$1,633.71	192%	\$3,139.54
Top Tertiary Education Rate Quintile	\$1,616.04	183%	\$2,963.10
Lithuania	\$528.20	458%	\$2,420.66
Belgium	\$1,531.23	157%	\$2,408.53
Denmark	\$1,264.00	176%	\$2,223.75
Ukraine \$1,500 Target		\$1,500.00	
Latvia	\$596.31	199%	\$1,184.22
Czechia	\$576.01	187%	\$1,079.56
Bulgaria	\$393.98	258%	\$1,017.72
Romania	\$430.13	227%	\$975.51
Belarus	\$344.01	281%	\$966.40
Eastern Europe	\$307.61	227%	\$698.33
Poland	\$305.30	218%	\$665.01
Ukraine	\$163.50	319%	\$520.84
Ukraine Diia City		\$396.16	
Hungary	\$301.16	153%	\$462.14

Table 6: Ukraine ICT Service Exports Targets (Hatch)

Multiplying the comparative ICT Service Exports Per Capita \$ rate against Ukraine's 2021 population indicates Ukraine's potential ICT Service Exports total industry value.

Model	Ukraine's ICT Service Exports (\$b) 2021 Model	Ukraine's ICT Service Exports (\$b) 2027 Model
Northern Europe	\$209.04	\$451.90
Israel	\$182.98	\$360.22
Estonia	\$64.79	\$230.15
Finland	\$112.58	\$210.07
India IT Cities	\$83.30	\$124.95
Europe	\$68.04	\$130.76
Top Tertiary Education Rate Quintile	\$67.31	\$123.41
Lithuania	\$22.00	\$100.82
Belgium	\$63.78	\$100.32
Denmark	\$52.65	\$92.62
Ukraine \$1,500 Target	\$62.48	
Latvia	\$24.84	\$49.32
Czechia	\$23.99	\$44.96
Bulgaria	\$16.41	\$42.39
Romania	\$17.91	\$40.63
Belarus	\$14.33	\$40.25
Eastern Europe	\$12.81	\$29.09
Poland	\$12.72	\$27.70
Ukraine	\$7.11	\$21.69
Ukraine Diia City	\$16.50	
Hungary	\$12.54	\$19.25

Table 7: Forecasted ICT Service Exports Value (Hatch)

Achieving these targets translates to the following job growth. Of special note:

1. Ukraine would need to match Finland's 2027 forecasted ICT Service Exports Per Capita rate of \$5.5k before total technology jobs created in Ukraine would clear a point of materiality in resolving the forecasted shortage of 85 million tech and tech-enabled jobs by 2030.
2. Without adjusting the ICT Service Exports value per worker, Ukraine would have 1.79 million tech workers by reaching the \$1,500 per capita target. Using 2021 populations, 1.79 million developers would place Ukraine between Hyderabad and Israel in developer density within the greater population.

Model	Total Tech Jobs (Thousand) 2021 Model	Total Tech Jobs (Thousand) 2027 Model	% Forecasted Skilled Talent Shortage 2021 Model	% Forecasted Skilled Talent Shortage 2027 Model
Northern Europe	5,973	12,912	7.03%	15.19%
Israel	5,228	10,292	6.15%	12.11%
Estonia	1,851	6,576	2.18%	7.74%
Finland	3,217	6,002	3.78%	7.06%
India IT Cities	2,380	3,570	2.80%	4.20%
Europe	1,944	3,736	2.29%	4.40%
Top Tertiary Education Rate Quintile	1,923	3,526	2.26%	4.15%
Lithuania	629	2,881	0.74%	3.39%
Belgium	1,822	2,866	2.14%	3.37%
Denmark	1,504	2,646	1.77%	3.11%
Ukraine \$1,500 Target	1,785		2.10%	
Latvia	710	1,409	0.83%	1.66%
Czechia	685	1,285	0.81%	1.51%
Bulgaria	469	1,211	0.55%	1.42%
Romania	512	1,161	0.60%	1.37%
Belarus	409	1,150	0.48%	1.35%
Eastern Europe	366	831	0.43%	0.98%
Poland	363	791	0.43%	0.93%
Ukraine	220	620	0.23%	0.73%
Ukraine Diia City	471		0.55%	
Hungary	358	550	0.42%	0.65%

Table 8: Forecasted Job Growth (Hatch)

Target Justification

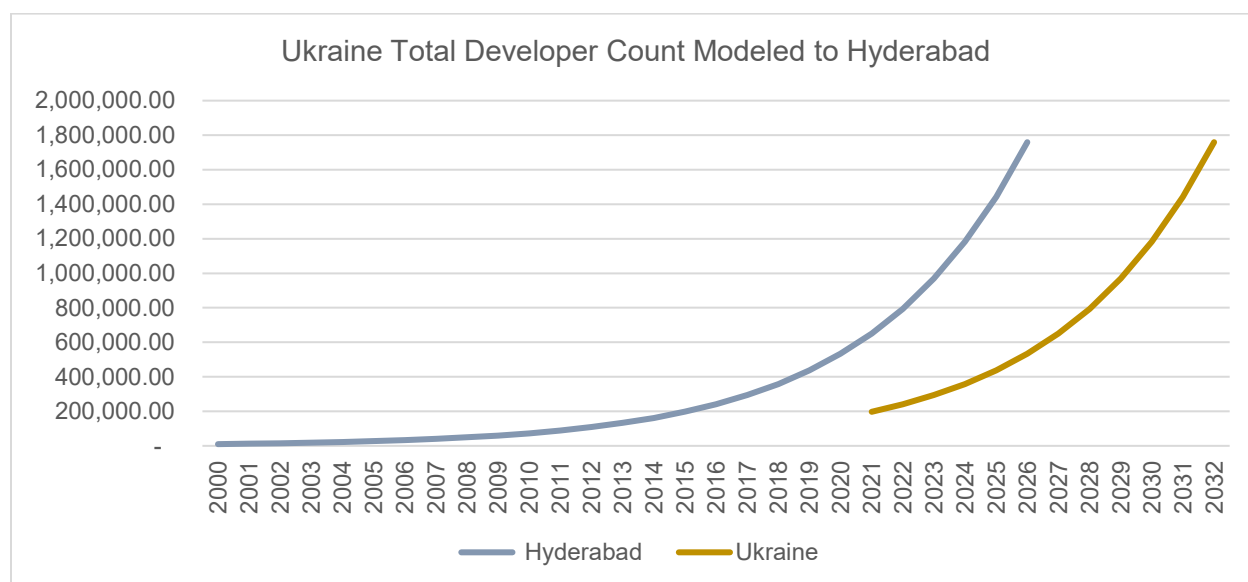
Naturalized Growth



Figure 48: Ukraine YOY University Graduates (UNESCO)

To achieve a target of \$1.5 thousand ICT Service Exports \$ Per Capita, Ukraine would need to add 1.57 million technology workers (up from 220,000). Using standardized data from UNESCO UIS, Ukraine generates 92.66 thousand STEM graduates per year (2020 performance). In a perfect model without talent flight or an increase in STEM graduation rates, Ukraine likely would hit this target within a 15 to 18-year timeframe- or well within a 20-year development cycle.

Comparative Economy Model: Hyderabad India



Hyderabad, India, has rapidly grown its IT industry over the past twenty years. Today, Hyderabad has over 600,000 tech workers and added 65,000 tech jobs per year as of 2019. (The Hindu Business Line, 2019) Using Hyderabad's growth rate, Ukraine would hit the targeted 1.785 million developers in 2032.

Keep in mind:

1. India's tertiary education rate of 29.44% is significantly below Ukraine's 82.67%.
2. India's 2012 CPI score of 36 is similar to Ukraine's 2021 score. There is no reason Ukraine's current CPI score must limit Ukraine's 10-year ICT industry growth.

Comparative Economy: Israel

President Zelensky publicly stated his vision of Ukraine as being a "big Israel." While Zelensky was largely referencing the future of Ukraine's domestic security structure, Israel is a valid representative of what Ukraine's technology industry can be.

Although Ukraine's CPI 2021 score (32) is materially below Israel's (59), Israel has material risk. Between the outbreak of war in the Donbas region following Euromaidan to the Russian invasion of Ukraine in February 2022, Ukraine's risk profile was not dissimilar to Israel. In many ways, Israel's risk profile exceeded Ukraine's. From 2014 through 2021, Israel was regularly hit by missiles. Outside of the Donbas region, Ukraine had no such threat.

Israel's Tertiary Education Participation Rate (60%) is well below Ukraine's (82%).

Lastly, the Israeli technology industry is significantly based on ex-Soviet Jews that migrated to Israel. Almost 50% of the Israeli technology industry are ex-Soviet state migrants. 40% are Russian Jews that migrated to Israel. (Remennick, 2007), (Lépina & Biagioli, 2019)

Israel demonstrates the potential of the Ukrainian technology workforce. As demonstrated by Israel, the world has a material appetite for Ukrainian technology workers. Ukraine does not package or market Ukrainian talent as well as Israel does.

Also important: Israel is one of the top technology economies and is not a member of any formal trade structure such as the EU.

Comparative Economy: The Baltics

	2021 ICT Service Exports Per Capita	5-Year Growth Rate	2027 ICT Service Exports Per Capita
Estonia	\$1,555.69	355%	\$5,525.91
Weighted Baltic-Region Averages	\$781.20	289%	\$2,727.00
Lithuania	\$528.20	458%	\$2,420.66
Ukraine \$1,500 Target		\$1,500.00	
Latvia	\$596.31	199%	\$1,184.22
Ukraine	\$163.50	319%	\$520.84

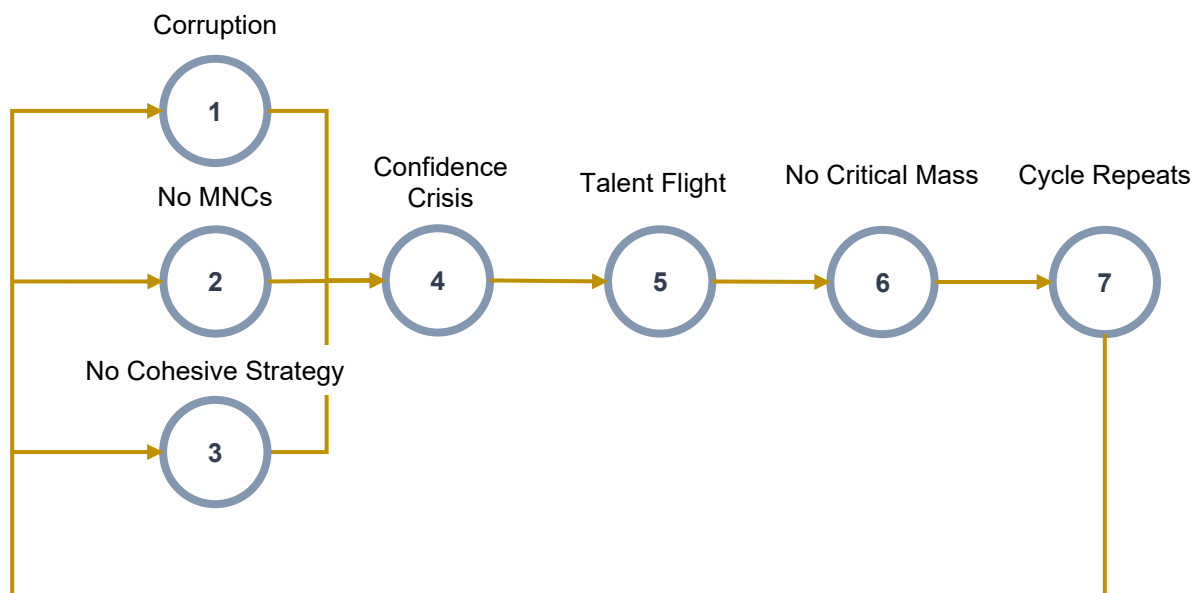
Table 9: Baltic Comparative (IMF BOP, Hatch)

The Baltics provide a valid comparative model for Ukraine's technology industry. With similar education, education rates, and technology labor costs, the region will likely reach a weighted ICT Service Exports per Capita rate of \$2,727 by 2027.

The image features a close-up of several young green seedlings with two leaves each, growing out of dark, rich brown soil. The background is a soft, out-of-focus green, suggesting a natural, sunlit environment. The text is overlaid on the left side of the image, partially covering the seedlings.

Ukrainian Technology Industry Development Plan

Concept Model



Ukraine's crisis in confidence challenge offers a clear framework for developing the ICT Service Exports industry.

Any program must address core challenges leading to high talent flight rates.

Of special note:

1. Talent flight has been the most prominent negative dynamic affecting the growth of the Ukrainian ICT Service Exports industry.
2. Talent flight is occurring due to a combination of poor CPI scores, a lack of a cohesive national development plan, and a lack of MNCs.
3. Following the end of the war, Ukraine will likely experience a significant talent flight challenge unless the population gains confidence in the country's ability to provide high-value jobs. Only 3% of refugees living outside of Ukraine today believe the country can do so.
4. Ukraine will need high-value ICT resources extensively for reconstruction activities outside the ICT Service Exports industry.
5. People trust major multinational companies in transforming an economy more than governments. (Chris Morris- NASDAQ, 2022)

Ukraine needs major international employers to publicly recognize the value of the Ukrainian technology workforce now and state their commitment to helping Ukraine establish a thriving ICT Service Exports industry following the war. Given the forecasted skilled talent shortage and the effect on revenues, MNCs are looking for such programs. Through the Center for Biostatistical Programming (Hatch proof of concept program in Kharkiv), MNCs have demonstrated their willingness to tolerate risk in Ukraine to produce and consume elite Ukrainian talent. However, best practices must be followed.

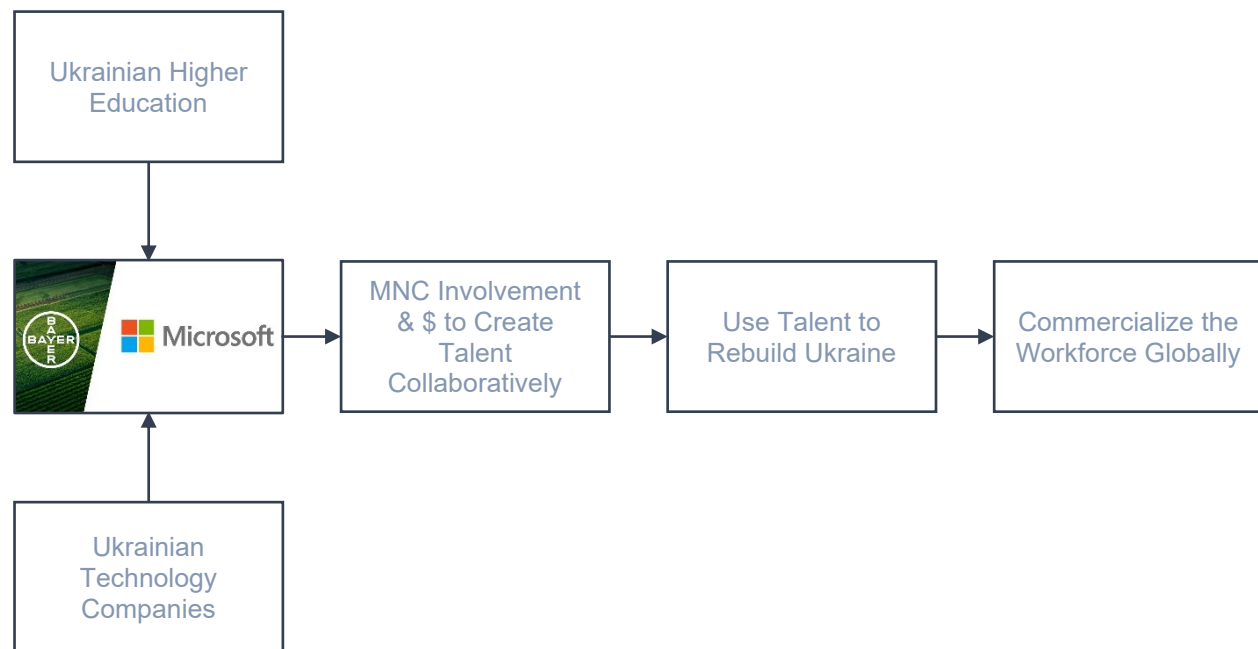


Figure 49: Development Framework Core Concept

Although best practices need to be understood and followed, the development framework for Ukraine is straightforward.

1. Identify core technology-industry centers (such as the Microsoft-Bayer agriculture technology partnership) that can generate transformative tech export growth and will be needed to rebuild Ukraine's durable industries within a 4th Industrial Revolution context.
2. Partner with these programs and have them make a public announcement with the Ukrainian government regarding their belief in the people of Ukraine and the potential of the Ukrainian technology industry.
3. Engage Ukrainian higher education institutions and technology companies.

4. Through a close working relationship with MNCs, Ukrainian higher education, and technology companies, define and implement collaborative workforce development programs as soon as possible. If the war prevents in-person learning, implement online learning opportunities with additional practical learning options (e.g., internships).
5. Push enrollment as much as possible given current circumstances.
6. As the war ends, use talent produced by these programs and all involved companies (foreign and domestic) to rebuild Ukraine's durable industries using new technologies.
7. As capacity grows, leverage involved MNCs to promote a thriving service exports industry specific to the COE.

Keys to Success

Start Now

Ukraine needs to capitalize on the transition catalyst created by war. Further, Ukraine needs to seed confidence in the population before the end of the war to hedge the likely coming talent flight post-war.

Ukraine must begin working with MNCs now in planning and launching collaborative workforce development programs in preparation for the end of the war.

Think Big

President Zelensky referenced his future vision of Ukraine as being a larger Israel. This vision should include a significantly larger technology industry emphasizing ICT service exports. Ukraine must target a per capita figure representing Ukraine's real potential.

Ukraine must target collaborative workforce development programs of the size, nature, and scope of the Microsoft-NASSCOM AI program.

Involve MNCs

Ukraine needs jobs and FDI stemming from the active involvement of multinational corporations. MNCs are key to success. Ukrainians need the recognition of their potential by MNCs now.

Ukraine's technology industry will likely never reach its full potential without MNC involvement. Further, announcements made by a combination of President Zelensky and major international corporations regarding the development of the Ukrainian technology workforce will go a long way toward hedging the likely talent flight coming at the end of the war.



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Bibliography

- Aghion, Antonin, Bunel, & Jaravel. (2021, December). *What Are the Labor and Product Market Effects of Automation?* Retrieved from harvard.edu: https://scholar.harvard.edu/files/aghion/files/what_are_the_labor_and_product_market_effects_of_automation_dec_2021.pdf
- Amy Murphy. (2018). *SKILLS SHORTAGE IN THE AGRITECH SECTOR HOLDING BACK IOT INNOVATION*. Retrieved from Irishtechnews.ie: <https://irishtechnews.ie/skills-shortage-in-the-agritech-sector-holding-back-iot-innovation/>
- Astana Hub. (n.d.). *How to open an IT company*. Retrieved from astanahub.com: <https://astanahub.com//welcome-page-all?locale=en>
- China Power. (2018). *Is China Ready for Intelligent Automation?* Retrieved from Chinapower.com: <https://chinapower.csis.org/china-intelligent-automation/>
- Chris Morris- NASDAQ. (2022, March 1). *People Trust Businesses More Than Government*. Retrieved from nasdaq.com: <https://www.nasdaq.com/articles/people-trust-businesses-more-than-government>
- CNBC - Scott Cohn. (2019, July 10). *Amazon reveals the truth on why it nixed New York and chose Virginia for its HQ2*. Retrieved from cnbc.com: <https://www.cnn.com/2019/07/10/amazon-reveals-the-truth-on-why-it-nixed-ny-and-chose-virginia-for-hq2.html>
- CNBC - Yuliya Talmazan. (2019, March 30). *A brain drain is devastating Ukraine*. Retrieved from CNBC: <https://www.nbcnews.com/news/world/brain-drain-devastating-ukraine-n976936>
- Enno de Boer. (2019, January 21). *The Fourth Industrial Revolution's scarcest commodity? Time*. Retrieved from mckinsey.com: <https://www.mckinsey.com/business-functions/operations/our-insights/operations-blog/the-fourth-industrial-revolutions-scarcest-commodity-time>
- Fuller, Lipson, Encinas, Forshaw, Gable, & Schramm. (2021, April 7). *Working to Learn: New Research on Connecting Education and Career*. Retrieved from <https://www.pw.hks.harvard.edu/>: <https://www.pw.hks.harvard.edu/post/working-to-learn>

Grandview Research. (2022, April). *Business Software And Services Market Size, Share & Trends Analysis Report By Software, By Service, By Deployment, By Enterprise Size, By End Use, By Region, And Segment Forecasts, 2022 - 2030*. Retrieved from <https://www.grandviewresearch.com:https://www.grandviewresearch.com/industry-analysis/business-software-services-market#:~:text=The%20global%20business%20software%20and%20services%20market%20size%20was%20estimated,USD%20474.61%20billion%20in%202022>.

HTP-Belarus. (n.d.). *ADVANTAGES AND BENEFITS*. Retrieved from <https://www.park.by:https://www.park.by/en/membership/benefits/>

Imed Bouchrika - Research.com. (2020, June 18). *68 Training Industry Statistics: 2021/2022 Data, Trends & Predictions*. Retrieved from Research.com: <https://research.com/careers/training-industry-statistics>

Joe McKendrick, Forbes. (2022, May 14). *Paradox: Artificial Intelligence Helps Solve, But Suffers From Skills Shortages*. Retrieved from Forbes.com: <https://www.forbes.com/sites/joemckendrick/2022/05/14/paradox-artificial-intelligence-helps-solve-but-suffers-from-skills-shortages/?sh=17f252c85003>

Kate Whiting-WEF. (2020, October 21). *These are the top 10 job skills of tomorrow – and how long it takes to learn them*. Retrieved from World Economic Forum: <https://www.weforum.org/agenda/2020/10/top-10-work-skills-of-tomorrow-how-long-it-takes-to-learn-them/>

Korn Ferry. (2018). *Future of Work: The Global Talent Crunch*. Retrieved from kornferry.com: https://www.kornferry.com/content/dam/kornferry/docs/article-migration/FOWTalentCrunchFinal_Spring2018.pdf

Krakow Technology Park. (n.d.). *Polish Investment Zone*. Retrieved from <https://www.kpt.krakow.pl:https://www.kpt.krakow.pl/en/polish-investment-zone/general-information/>

Lépina & Biagioli. (2019). *From Russia with Code: Programming Migrations in Post-Soviet Times*. Duke University Press Books.

McKinsey & Company. (2021, February). *The future of work after COVID-19*. Retrieved from <https://www.mckinsey.com/featured-insights/future-of-work/the-future-of-work-after-covid-19>

- Microsoft. (2020, September 10). *NASSCOM FutureSkills and Microsoft launch AI Classroom Series to skill India's future workforce with AI capabilities*. Retrieved from microsoft.com: <https://news.microsoft.com/en-in/nasscom-futureskills-microsoft-launch-ai-classroom-series-skill-students/>
- OECD. (2018). *Automation, skills use and training*. Retrieved from Nedelkoska, L. and G. Quintini (2018), "Automation, skills use and training", OECD Social, Employment and Migration Working Papers, No. 202, OECD Publishing, Paris, <https://doi.org/10.1787/2e2f4eea-en>: https://www.oecd-ilibrary.org/employment/automation-skills-use-and-training_2e2f4eea-en
- OECD, WTO, & IMF. (2020). *Handbook on Measuring Digital Trade*. Retrieved from oecd.org: <https://www.oecd.org/sdd/its/Handbook-on-Measuring-Digital-Trade-Version-1.pdf>
- Remennick, L. (2007). *Russian Jews on Three Continents: Identity, Integration, and Conflict*. Routledge; 1st edition (December 15, 2006).
- Ruy de Castro Sobrosa Neto, Et. Al. (2020, December). *The fourth industrial revolution and the coronavirus: a new era catalyzed by a virus*. Retrieved from sciencedirect.com: <https://www.sciencedirect.com/science/article/pii/S2590051X20300137>
- Supplychaindrive.com. (2020). *Learning from Adidas' Speedfactory blunder*. Retrieved from <https://www.supplychaindrive.com/news/adidas-speedfactory-blunder-distributed-operations/571678/>
- TAYLOR SOPER. (2015, October). *Nike COO: You'll soon be able to make shoes at your home with a 3D printer*. Retrieved from Geekwire.com: <https://www.geekwire.com/2015/nike-coo-youll-soon-be-able-to-make-shoes-at-your-home-with-a-3d-printer/>
- The Economic Times - India. (2021, January). *FDI in technology sector saw a 336% rise in Apr-Sep 2020: Economic Survey*. Retrieved from The Economic Times - India: <https://economictimes.indiatimes.com/tech/technology/fdi-in-technology-sector-saw-a-336-rise-in-apr-sep-2020-economic-survey/articleshow/80586966.cms>
- The Hindu Business Line. (2019). *IT staff strength in Telangana to double to 10 lakh in 3-4 years*. Retrieved from The Hindu Business Line: <https://www.thehindubusinessline.com/info-tech/it-staff-strength-in-telangana-to-double-to-10-lakh-in-3-4-years/article28445718.ece>

- Training Magazine. (2021, November). *2021 Training Industry Report*. Retrieved from <https://pubs.royle.com/publication/?m=20617&i=727569&p=24&ver=html5>
- Ukrainian Presidential Office. (2022, February). *The launch of "Diia City" will allow Ukraine to become the largest IT hub in Europe - President*. Retrieved from <https://www.president.gov.ua>: <https://www.president.gov.ua/en/news/zapusk-diya-city-dast-ukrayini-zmogu-stati-najbilshim-it-hab-72753>
- UNCTAD. (2021). *TECHNOLOGY AND INNOVATION REPORT 2021*. Retrieved from unctad.org: https://unctad.org/system/files/official-document/tir2020_en.pdf
- UNDP. (2022, March 16). *Every day of delayed peace will accelerate a freefall into poverty for Ukraine, warns UNDP*. Retrieved from [undp.org](https://www.undp.org): <https://www.undp.org/press-releases/every-day-delayed-peace-will-accelerate-freefall-poverty-ukraine-warns-undp>
- UNHCR. (2022, May 27). *Ukraine Refugee Situation*. Retrieved from [UNHCR.org](https://data.unhcr.org/en/situations/ukraine): <https://data.unhcr.org/en/situations/ukraine>
- VIVIENNE WALT, Fortune.com. (2022, April 21). *Who will pay to rebuild Ukraine? Economists have a plan for Russia to foot what could be a \$1 trillion bill*. Retrieved from [Fortune.com](https://fortune.com): <https://fortune.com/2022/04/21/ukraine-reconstruction-cost-rebuild-economists-plan-russia-foot-trillion-bill/>
- World Health Organization. (2022, April). *WHO records 100th attack on health care in Ukraine*. Retrieved from [who.int](https://www.who.int): <https://www.who.int/news/item/07-04-2022-who-records-100th-attack-on-health-care-in-ukraine>