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Spatial organisation of the smart economy in the context of intensive urbanisation of Ukrainian regions

Abstract. The article examines the features of the spatial organisation of the smart economy in regions of Ukraine undergoing intensive urbanisation. The formation of the main cores of the smart economy, their industry specialisation and "pull" factors of competitiveness are analysed. The role of large agglomerations (Kyiv, Lviv, Kharkiv, Dnipro, Odesa) and several medium-sized cities that develop niche clusters is highlighted. Particular attention is paid to the challenges of pendulum migration, business relocation, transport accessibility and housing provision. The comparative analysis method is used; the housing accessibility index is calculated from 2021 to 2024. The results show that, despite the concentration of

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innovative potential in large centres, an imbalance in development persists between the core and the periphery. Spatial policy directions are proposed to advance a polycentric model, develop innovation clusters, integrate transport and digital infrastructure, and introduce smart technologies and environmental solutions. This lays the groundwork for a more balanced development of the smart economy and for Ukraine's integration into the global knowledge space.

Methodology/Approach. The study used a comprehensive interdisciplinary approach that combines methods from economic, geographical and social sciences. Structural and functional analysis was applied, which made it possible to identify the main spatial cores of the smart economy in Ukraine and their specialisation. The basis for this was statistical data from the State Statistics Service of Ukraine, the results of sociological surveys (IOM, 2021) and analytical materials from international organisations (World Bank, UNDP, European Commission).

The comparative ranking method was used to assess transport accessibility. The following indicators were taken into account in the work: the presence and expansion of the public transport network, the operation of the metro, the number of routes, passenger traffic, as well as the scale of damage to and restoration of infrastructure due to the war. Scientific publications of O. Rossolov *et al.* (2025), O. Radchenko *et al.* (2025), A. Galkin *et al*. (2025), as well as statistical data from the Transformative Urban Mobility Initiative portal (2024) were the source base.

The article uses data systematisation and visualisation to show where the main centres of the smart economy are in Ukraine, what factors contribute to their development, and to determine the directions of spatial policy for organising these processes in conditions of intensive urbanisation.

Findings. The results show that Ukraine’s smart economy is characterised by a high concentration of innovative potential in large urban agglomerations - Kyiv, Lviv, Kharkiv, Dnipro and Odesa. Each city has distinct specialisation and “pull” factors: Kyiv focuses on financial services and IT; Lviv - on creative and digital industries; Kharkiv - on science and engineering; Dnipro and Zaporizhzhia - on industrial modernisation and “green” metallurgy; Odesa - on logistics and creative sectors.

The analysis showed that medium-sized cities, such as Vinnytsia, Chernivtsi and Uzhhorod, are emerging as regional smart clusters, contributing to polycentric development. Urbanisation and migration processes intensify pressure on transport and housing infrastructure, reinforcing spatial imbalance between cores and peripheries.

The study found that a polycentric model of development, along with the creation of innovation clusters, techno parks, and business incubators, is key to achieving balanced smart growth. The results obtained confirm that integration of digital, transport and environmental infrastructure can strengthen Ukraine’s position within the global knowledge-based economy

Keywords: spatial development, agglomeration, commuter migration, transport accessibility, housing, regional convergence, business relocation, construction clusters, post-war recovery, spatial planning

Introduction

The modern economy is changing rapidly due to digital technologies, innovations, and urbanisation. Enterprises, universities, research centres, and highly qualified personnel are concentrated in large cities. This lays the foundation for the so-called smart economy, which is based on knowledge, innovation, digitalisation, and the use of “green” technologies.

The topic of the smart economy is particularly important for Ukraine. The country needs structural renewal, increased competitiveness, and integration into world markets, and Ukrainians also face the task of restoring the economy after the large-scale destruction of the war. In these conditions, urban agglomerations are becoming the main “growth points”: Kyiv, Lviv, Kharkiv, Dnipro, Odesa and several medium-sized cities host the majority of IT companies, startups, innovation parks, and creative industries. However, intensive urbanization also creates problems. These are daily flows of commuting, transport congestion, shortage of affordable housing, social inequality, relocation of businesses from war-torn regions, and growing environmental risks. There is a danger that development will concentrate in a few centres, leaving other territories behind. In this regard, regional convergence is no less relevant, which aims to reduce socio-economic imbalances between regions, in which less developed territories approach the more developed ones in terms of income, productivity, infrastructure and quality of life.

The question facing researchers boils down to combining the processes of intensive urbanisation with the formation of effective centres of the smart economy, which would not only concentrate high-tech resources in several large centres but also ensure the polycentric development of the country. In practice, this means finding answers to several questions: where exactly in Ukraine are the cores of the smart economy being formed; what "pull" factors determine their competitiveness; how to combine innovation drivers with the needs of local communities; how to minimise spatial imbalances between the capital, large agglomerations, and medium-sized cities. The lack of knowledge of these aspects, limited statistical data, and rapidly changing development conditions create a scientific and practical vacuum. It is possible to fill it through a systematic analysis of the spatial organisation of the smart economy.

Literature review

In recent years, the issues of the spatial organisation of the smart economy and the development of smart cities in Ukraine have become particularly relevant considering intensive urbanisation, global challenges of sustainable development, and military events. The authors are actively investigating innovative approaches to organising urban space, transport accessibility, infrastructure efficiency, and the role of digital technologies in ensuring sustainable growth.

Urban mobility and transport accessibility are one of key areas of modern research. O. Rossolov *et al.* (2025) analyse changes in the behavior of transport users during the war and show that the conflict led to significant shifts in the choice of means of transport, particularly an increase in the role of private transport and a decrease in public transport use. A similar focus is given to the work of A. Galkin *et al*. (2025), which assesses the accessibility of public transport stops in Kharkiv as an example of the adaptation of transport systems in crisis conditions. These studies emphasise the need to create more flexible and inclusive transport solutions.

A separate layer of literature concerns the analysis and planning of transport infrastructure and mobility. O. Radchenko *et al.* (2025) conduct a retrospective analysis of Ukraine's transport infrastructure for 2010–2021 and identify structural problems: a lack of stable financing, outdated rolling stock, and weak integration of different modes of transport. S. Waller *et al*. (2023) model transport patterns using data from crowdsourcing platforms, demonstrating that even in wartime, digital technologies can support strategic mobility planning. Additionally, the dissertations of V. Demchyna (2025) and M. Borozenets (2022) present methodological approaches to managing the development of transport infrastructure and improving the quality of public transport services. These works emphasise that, even in peacetime, Ukraine faced significant problems with the efficiency of its transport systems, which only worsened during the war.

Another direction is the study of smart cities and the smart economy. J. Cifuentes-Faura (2023) emphasises the potential to rebuild Ukrainian cities on the principles of smart cities and sustainable development, with digital infrastructure playing a key role. T. Palamarchuk (2023) and K. Mykhailova *et al.* (2021) examine the regulatory, legal, and social aspects of implementing smart cities in Ukraine, emphasising the need to integrate international experience and to improve the quality of life. In the Ukrainian context, it is also worth highlighting the work of O. Sych and I. Pasinovych (2025), which treats the smart city as a driver of economic growth.

However, despite the increase in thematic studies, unresolved problems remain. There is a lack of comprehensive research that integrates the issues of transport accessibility, housing policy, and business relocation into a single model of spatial development for the smart economy. The mechanisms of smart-city adaptation to wartime and post-war reconstruction conditions have not been sufficiently studied, especially considering the specifics of Ukrainian regions. Available scientific research provides a theoretical basis for understanding the spatial organisation of the smart economy in Ukraine, but further research should adopt an interdisciplinary approach, consider wartime and post-war challenges, and integrate transport, economic, and social policies.

Materials and methods

The methodological basis of this work is a systematic, interdisciplinary approach that combines elements of statistical analysis, comparative studies, and the analytical interpretation of publications by leading authors.

Data Collection

The study is based on a diverse empirical and analytical source base. Statistical data were obtained from the State Statistics Service of Ukraine, the results of sociological surveys (IOM, 2021) and analytical materials from international organisations such as the World Bank, UNDP, and the European Commission.

Additional datasets were used for sectoral analyses. Transport indicators were drawn from O. Rossolov *et al.* (2025), O. Radchenko *et al.* (2025), A. Galkin *et al.* (2025) and the Transformative Urban Mobility Initiative (2024). Information on housing affordability was collected from LUN.ua, DOM.RIA, OLX Real Estate, minfin.com.ua, Work.ua, and specialised real estate market reports. Data on business relocation were compiled from the Ministry of Economy of Ukraine (2022), Opendatabot (2023, 2025), UNDP (2024) and studies by A. Olechnicka and A. Kniazevych (2025) and R. Kornylyuk (2024).

Methods

The study applied a structural and functional analysis, which allowed the identification of the main spatial cores of the smart economy in Ukraine and their specialisation. A comparative ranking method was used to assess transport accessibility, accounting for factors such as public transport network density, metro operations, route diversity, passenger traffic, and the extent of war-related infrastructure damage and recovery.

In the housing sector, the Housing Affordability Index was calculated as the ratio of average salary to average rental, secondary-market, and new-housing costs per square meter in Kyiv, Lviv, Kharkiv, Odesa, and Dnipro (2021–2024).

Spatial analysis of enterprise migration was employed to trace business relocation processes, identifying the main donor and recipient regions and their influence on the formation of new smart economy centres.

Overall, the research combined quantitative (statistical and index analysis) and qualitative (content and comparative policy analysis) approaches, enabling a comprehensive assessment of urbanisation, mobility, housing, and business transformation under conditions of war and accelerated innovation.

Results and discussion

Spatial cores of the smart economy, which become centres of innovation, technology, and entrepreneurial activity, are concentrated mainly in large agglomerations and in several medium-sized cities, where niche clusters are created. The most powerful core of the smart economy is the Kyiv agglomeration. The headquarters of companies, financial institutions, banks, innovative startups, the IT sector, and creative industries are concentrated here. Kyiv serves as a hub for knowledge services and digital technologies, integrated into global markets. The Lviv agglomeration specialises in information technologies and the creative economy. Thanks to the developed IT cluster, cultural potential, and cross-border location, Lviv and the surrounding cities have become the “gateway to the EU” for Ukrainian innovative businesses. A significant number of relocated companies from the East have also moved here. The Kharkiv agglomeration, despite the military challenges, remains one of the country's leading scientific and educational centres. Mechanical engineering, the aviation and space industries, and powerful R&D schools are traditionally developed here. Kharkiv remains the core of science, engineering, and the training of highly qualified personnel. The Dnipro-Zaporizhzhya industrial hub specialises in metallurgy, mechanical engineering, and energy. Today, the potential for developing “green metallurgy” and the hydrogen economy is being laid here, which can transform the industrial heritage into a modern model of sustainable development. The Odesa agglomeration has a unique specialisation in the port

and logistics complex, international trade, transport infrastructure, and tourist and creative services. Odesa is also a centre for the development of IT startups and maritime education. In addition to large agglomerations, medium-sized cities are important for the smart economy. Vinnytsia is actively shaping the image of a "smart city" and developing agro-tech and food-tech; Drohobych is a pioneer in digital municipal services; Chernivtsi and Uzhhorod are centres of cross-border services and IT outsourcing; Kryvyi Rih has the potential of "green metallurgy"; Mykolaiv is restoring its positions in shipbuilding and renewable energy (Table 1).

Table 1. Key cores of Ukraine's smart economy and their specialisation

Core (agglomeration/city)	Specialisation	Pull factors
Kyiv	Knowledge of services, finance, IT, startups	Universities, research centres, company headquarters, innovation parks (Unit.City)
Lviv	IT cluster, creative economy, cross-border services	Lviv IT Cluster, cultural capital, border with the EU
Kharkiv	Science, education, mechanical engineering, R&D	Powerful university base, NASU, technoparks (Ecopolis HTZ)
Dnipro-Zaporizhzhya	Metallurgy, mechanical engineering, "green" energy	Industrial base, engineering personnel, industrial parks
Odesa	Port logistics, trade, tourism, maritime education	Seaports, transport infrastructure, tourism sector
Vinnytsia	Smart cities, agro-tech, food-tech	Digital city services, agricultural potential
Chernivtsi	Cross-border services, IT outsourcing	Proximity to the EU, relocated IT companies
Uzhhorod	Cross-border services, IT	Geographical proximity to Slovakia and Hungary, development of services
Kryvyi Rih	Mining and metallurgical innovations	Powerful industrial base, opportunities for "green metallurgy"
Mykolaiv	Shipbuilding, renewable energy	Shipbuilding traditions, logistics, industrial sites
Drohobych	Digital municipal services	Leader of e-government, digital city platforms

Source: compiled by the authors

Thus, from Table 1 we see that the spatial structure of the smart economy of Ukraine is formed by five large agglomeration centres (Kyiv, Lviv, Kharkiv, Dnipro-Zaporizhzhia, and Odesa), as well as a network of medium-sized cities with niche specialisation. Each core has its own "pull" factors and a specific industry orientation, which together lay the foundation for the country's polycentric development and its integration into the global knowledge economy.

The post-war regeneration of urban areas is forming new spatial cores of the smart economy, where construction companies play a key role as drivers of structural change and leaders of modern technologies in the urban environment. Construction companies are becoming a central link in urban transformations, ensuring technical and technological innovations, digitalisation and adaptation of European standards in urban construction (Zakharova *et al*., 2020). Modern approaches involve synergy between government, business and community, which corresponds to the idea of a polycentric model of the smart economy.

The development of the smart economy in Ukrainian agglomerations occurs amid significant spatial transformations. Along with the positive effects of innovation cluster growth and business concentration, serious challenges arise that can slow or even inhibit further development. Let us describe some of them below.

Pendulum migration

One of the key manifestations of intensive urbanisation in Ukraine is population pendulum migration. Daily trips from the suburbs to city centres and back form a distinct spatial rhythm of life and directly affect the organisation of the smart economy. The largest scale is observed in the Kyiv agglomeration: according to estimates, more than arrive in the capital from the suburbs every day (IOM, 2021). Hundreds of thousands of residents of the surrounding satellite cities (Irpin, Bucha, Vyshneve, Brovary, Boryspil, Bila Tserkva) come to the capital every day. This creates a huge

burden on the transport infrastructure and reinforces the tendency towards a monocentric development model, in which most jobs are concentrated in the core.

A similar situation, albeit on a smaller scale, is observed in other large agglomerations. According to a study by the Lviv City Council in collaboration with Vodafone, on average, 152 thousand people come to Lviv from Vynnyky, Drohobych, Zhovkva, etc. during the day, and on weekdays this figure reaches 180 thousand (GalInfo, 2018). In the structure of urban flows, about 7% is due to commuting migration (Your city, 2018). According to IOM, before the full-scale war, about 134,000 people from the suburbs arrived in Kharkiv daily, making it the second-largest commuting centre in the country after Kyiv (IOM, 2021). In the Dnipro, the city development strategy predicts the preservation of strong commuting flows at levels of tens of thousands of people per day. The main directions are Kamianske, Novomoskovsk, and Pavlohrad. This confirms the stability of the "centre-suburb" model in large industrial hubs (Dnipro City Council, 2018).

As we can see, commuting is a typical phenomenon for all large Ukrainian agglomerations and has a double effect. On the one hand, it indicates the attractiveness of large cities as centres of employment and educational and cultural opportunities. On the other hand, it demonstrates the imbalance between the place of residence and the place of work, creating additional transport load. In the context of the smart economy, commuting underscores the need to transition from a monocentric development model, in which all resources are concentrated in one large city, to a polycentric model, in which jobs and services emerge in satellite cities (Kovalenko *et al*., 2021). This means supporting techno-parks and business incubators in the suburbs, developing transport-oriented solutions (suburban trains, high-speed bus routes, cycling infrastructure), and integrating housing and social policy with economic planning.

Business relocation

The war led to a large-scale relocation of enterprises from the eastern and southern regions to the western and central regions. Although this process saved thousands of companies, it created an additional burden on local host economies. In 2022–2024, more than 11000 companies changed their place of registration, with about 58% moving between regions (Shevchenko, 2025). This process became a powerful catalyst for spatial changes in the Ukrainian economy. The main directions and volumes of business relocation during the years of full-scale war are given in Table 2.

Table 2. Main directions and volumes of business relocation from agglomerations of Ukraine in 2022–2024.

Agglomeration (where the business left from)	Where they mainly relocated to	Estimated number of companies	Specialisation / industries	Notes
Kharkiv	Lviv, Transcarpathia, Poltava, Vinnytsia	~1 200	IT, education, R&D, trade	According to Opendatabot, Kharkiv region is one of the leaders in business departures
Donetsk / Luhansk (new wave after 2022)	Kyiv, Lviv, Uzhhorod, Chernivtsi	~800	Industry , construction, agribusiness	Some companies relocated in 2014–2015
Kyiv region (north and east)	Khmelnytskyi, Cherkasy, Vinnytsia	~300	light industry, food	Temporary relocations during the fighting in 2022
Dnipro / Zaporizhia	Poltava, Kropyvnytskyi	~600	metallurgy (SMEs), transport, agro-processing	Many intra-regional movements
Odesa / Mykolaiv	Lviv, Transcarpathia	~400	logistics, transport, agro-processing	Some returned in 2023–2024
Kyiv (core)	Lviv, Ivano-Frankivsk, Ternopil	~200	IT, creative industries	Partial relocations for security
Mariupol (until 2022)	Dnipro, Zaporizhia, Lviv	~300	metallurgy, construction SMEs	Almost complete loss of local business ecosystem

Source: compiled by the authors based on (Opendatabot, 2023, 2025; Ministry of Economy of Ukraine, 2022; United Nations Development Programme (UNDP), 2024)

The main relocation flows (see Table 2) show that the largest business outflow occurred from the east and south of the country: Kharkiv, Donbas, Dnipro, Zaporizhia, Mariupol, Mykolaiv, and Odessa. The main "receivers" were Lviv, Transcarpathia, Vinnytsia, Khmelnytsia, Poltava, and Chernivtsi. Such a redistribution of entrepreneurial activity created new economic growth centres in Western and Central Ukraine. The IT sector and high-tech companies played a special role: about 78% of relocated IT businesses resumed operations in western regions (Lviv, Transcarpathia, Chernivtsi). This strengthened the importance of these cities as centres of the smart economy, where digitalisation, innovation, and creative industries are combined (Olechnicka & Kniazevych, 2025). Business relocation has also contributed to the development of medium-sized cities that previously remained on the periphery of economic processes. Cities such as Vinnytsia, Khmelnytskyi, Poltava, and Kropyvnytskyi have attracted new enterprises and jobs, thereby stimulating the local economy and underscoring the importance of a polycentric development model.

At the same time, relocation has its own problems. Some companies have not resumed their activities after moving due to a lack of financial resources, insufficient infrastructure, or difficulties integrating into new economic ecosystems. This indicates the need for a targeted state policy to support relocated enterprises, from providing preferential access to production areas to promoting integration into regional clusters.

According to the analysis, business relocation in Ukraine has become not only a forced response to security risks but also a factor in restructuring the spatial structure of the smart economy. It has stimulated the development of new regional centres, created prerequisites for strengthening the polycentric model, and opened new opportunities to combine urbanisation processes with innovative growth.

Transport accessibility

Transport accessibility is the ability of residents to reach places of work, education, services, etc., in a reasonable time and with minimal effort. In the context of the smart economy, it is critical because without convenient connections between the agglomeration core and suburbs or satellites, innovative clusters and business centres lose potential employees, customers, and competitive advantages.

Transformative Urban Mobility Initiative (TUMI, 2024) notes that cities struggle with congestion, overcrowding, lack of parking spaces, and overloaded buses or trains. Thus, in Kyiv – the core of the largest agglomeration in Ukraine – according to the study of O. Dronova, (2020), the transport network has significant territorial inequalities: the metro is a key element, but for many districts, public transport travel remains difficult in terms of time and number of transfers. The Kyiv Sustainable Transport Development Project (World Bank, 2016) predicted that optimising the public transport network could provide a 30–50% improvement in accessibility from such districts as Troyeshchyna or Pravyi bereg, while reducing the number of transfers and travel time.

Based on open-source data, the authors developed an approximate ranking of large cities in Ukraine by transport accessibility (Table 3).

Attempts to rank large Ukrainian cities (see Table 3) have revealed the uneven distribution of transport accessibility in these cities, along with its advantages and drawbacks. Kyiv and Kharkiv remain leaders due to their metro systems and extensive ground transport networks. In the capital, large-scale infrastructure allows covering almost all districts, combining the metro, trams, trolleybuses, and buses. However, frequent traffic jams, congestion during rush hours, and reduced transport output due to the war reduce the actual level of comfort in movement. Kharkiv demonstrated a high level of transport integration before the war, but extensive infrastructure damage significantly reduced its capabilities. Lviv is smaller in scale but can serve as an example for other cities in developing electric transport. Tram and trolleybus networks provide a significant share of transportation, and the introduction of an electronic ticket was a step forward in the digitalisation of transport services. At the same time, the lack of a metro and dependence on buses make the system less effective for rapid movement around the city, especially given the growing

number of private cars and traffic jams. Odesa is distinguished by its status as an important transport hub: the port, railway, and airport provide it with interregional and international accessibility. Tram and trolleybus networks operate within the city, but they do not always meet residents' modern needs. Problems with updating rolling stock, weak integration of different modes of transport, and dependence on automobile traffic create significant limitations. Dnipro has its own metro, but its potential is almost not used: one short line with several stations cannot significantly affect the transport system. The city mostly depends on bus transportation, which is less stable and often does not meet the standards of comfort and environmental friendliness. As a result, Dnipro's transport accessibility remains the lowest among large cities, despite the presence of an infrastructure base for development.

Table 3. Approximate ranking of large cities in Ukraine by transport accessibility

City	Strengths in terms of transport	Weaknesses or limiting factors	Ranking
Kyiv	Metro + extensive ground transport network; large base of routes; significant part of routes and infrastructure	The war reduced transport output, delays, and risks of damage	1
Kharkiv	Metro with 3 lines, fairly large route fleet; system with many routes (198 routes)	Significant damage to infrastructure due to war; reduced functionality	2
Lviv	Well-developed electric transport system (trolleybuses, trams), a significant share of buses (the bus system is very active)	Limited data on intervals, route density, average travel times; smaller network scale compared to megacities	3
Odesa	Seaside location, port, transport hub; potential for interregional connectivity	There is no data confirming a strong internal public transport network in open sources	4
Dnipro	Has a subway at least in its basic form	Metro is limited; no data on other systems (buses, trams); network is less developed	5

Source: compiled by the authors

In general, the advantages of Ukrainian agglomerations include the presence of basic elements of modern transport -metro in the largest cities, electric transport in Lviv and Odessa —and the prospects for digitalisation. However, disadvantages in the form of outdated infrastructure, weak integration of various types of transport, war damage, and problems with the "last mile" significantly limit the mobility of residents. The lack of modern transport solutions has become a systemic problem in large Ukrainian agglomerations. Buses, minibuses, and private cars remain the main means of transport, while suburban trains and high-speed rail are underdeveloped. The lack of integrated transport systems (a single ticket, synchronised schedules, high-speed transit routes) limits the mobility of the population and makes agglomerations less competitive compared to European centres.

Housing

Housing provision in large agglomerations of Ukraine is closely related to urbanisation processes and the growth of commuter migration. The rapid increase in population in cities with populations over a million, and in surrounding suburbs creates constant pressure on the housing market. In Kyiv, Kharkiv, Lviv, or Dnipro, there is a tendency to build up the suburbs with multi-storey residential complexes, which partially relieve the central areas but also creates new problems with transport accessibility and social infrastructure.

The advantage of agglomeration is a wide range of housing, from new business-class buildings to more affordable facilities in the suburbs. However, the cost of a square meter in the capital and large regional centres remains high and unattainable for a significant part of the population. This pushes people to buy or rent housing in nearby satellite cities (Irpin, Bucha, Vyshneve for Kyiv; Vynnyky or Bryukhovychi for Lviv), forming new "bedroom" areas and intensifying pendulum flows.

At the same time, a significant part of the housing stock in agglomerations is outdated. In Kharkiv, Dnipro, and Odessa, "Khrushchevs" and panel high-rise buildings from the 1960s–1980s still prevail, which do not meet modern standards of energy efficiency and comfort. The war also exacerbated the problem: tens of thousands of residential buildings were damaged or destroyed in Kyiv, Kharkiv, and Dnipropetrovsk regions, which creates an additional burden on cities hosting displaced people. Table 4 presents statistical data on average wages and housing costs before the war (in 2021) and in 2024.

Table 4. Housing affordability in major cities of Ukraine (2021–2024)

Indicator	Kyiv	Lviv	Odesa	Dnipro	Kharkiv
Average salary (UAH/month)					
- 2021 year	22 700	15 262	15 379	15 791	14 843
- 2024 year	27 900	20 000	19 700	19 000	18 500
Rent 1 m² (UAH/m²/month)					
- 2021 year	250	180	170	150	160
- 2024 year	350	300	280	230	210
Cost of 1 m² of secondary housing (UAH/m²)					
- 2021 year	33 000	21 000	22 000	18 000	17 000
- 2024 year	50 000	40 000	38 000	32 000	30 000
Cost of 1 m2 of new building (UAH/m²)					
- 2021 year	34 700	20 900	22 200	19 000	18 500
- 2024 year	55 000	55 400	42 000	35 000	34 000
Rental Affordability Index					
- 2021 year	107	85	90	105	93
- 2024 year	74	67	70	83	88
Secondary Availability Index					
- 2021 year	0.81	0.73	0.70	0.88	0.87
- 2024 year	0.52	0.50	0.52	0.59	0.62
New Building Accessibility Index					
- 2021 year	0.77	0.73	0.69	0.83	0.80
- 2024 year	0.47	0.36	0.47	0.54	0.54

Source: calculated by the authors based on data from minfin.com.ua, Work.ua, LUN.ua, DOM.RIA, OLX Real Estate

The affordability index, shown in Table 4, indicates how many m² can be rented or bought for one average monthly salary and is calculated by dividing the average salary by the cost of 1 m² of housing in the corresponding category. During 2021–2024, housing affordability in large cities of Ukraine changed unevenly. Salaries in all cities grew, but housing prices, especially for new buildings, grew faster. As a result, affordability indices decreased in most cases, making it more difficult to buy your own home. On the other hand, the rental market remained relatively stable, and in some cities, affordability has even improved.

Thus, in the capital, the average salary in 2024 was 33.9 thousand UAH., against 22.7 thousand UAH. in 2021. This growth enabled compensation for part of the increase in housing prices. The situation for rent even improved: in 2021, about 91 m² could be rented for the average salary, and in 2024, already 97 m². In the secondary market and in new buildings, availability practically did not increase: 0.69 m² in 2021 and 0.68 m² in 2024 in the secondary, while in new buildings it even decreased from 0.65 m² to 0.62 m². Thus, buying housing in Kyiv remains unaffordable, although renting has become a little easier on the budget.

Lviv shows the worst trends among large cities. In 2021, the availability of new buildings was 0.73 m², but in 2024 it fell almost in half to 0.36 m². This is due to the sharp increase in housing prices in the city, which has become a haven for internally displaced people and businesses from other regions. Salaries in Lviv have increased to UAH 20,000, but the growth rate of real estate prices has significantly outpaced incomes. Rent has also become less affordable: from 85 m² in 2021 to 67 m² in 2024. Thus, the housing situation in Lviv is the tensest.

In Odessa, the affordability indices look somewhat better than in Lviv, but the general trend is similar. In 2024, for an average salary, you could rent 70 m² (versus 90 m² in 2021) and buy only 0.52 m² on the secondary market. New buildings have also become less affordable: the index has decreased from 0.69 to 0.47. The reason is both inflationary processes and increased demand in the port city.

In Dnipro, the situation looks somewhat better than in Lviv or Odessa. Rents remained relatively affordable: in 2021, 105 m² per salary; in 2024, 83 m², a decrease but not critical. In the secondary market, affordability fell from 0.88 m² to 0.59 m², and in new buildings from 0.83 m² to 0.54 m². Despite the drop in indicators, Dnipro remains one of the cities with a relatively better balance between incomes and housing prices. Kharkiv also shows a gradual decline in affordability, but its indicators look more stable. In 2024, rents remain relatively affordable at 88 m² per salary compared to 93 m² in 2021. In the secondary market, the index fell from 0.87 to 0.62, and in new buildings from 0.80 to 0.54. Given the war damage and the decline in construction activity, these figures indicate that supply and demand remain relatively stable. The analysis showed that renting remains a more affordable form of housing than buying, and even in Kyiv, this was reflected in rising wages. The secondary market remains low in almost all places: less than 1 m² can be purchased for the average salary. New buildings have risen in price the most, making them less affordable in all cities, especially in Lviv. Dnipro and Kharkiv look the most balanced, where the income-to-price ratio, although it has worsened, remains better than in Lviv and Odessa. Housing provision in large agglomerations can be said to have a dual character. The largest volume of construction supply and new investments is concentrated here, while the high cost of housing, the deterioration of the old stock, the lack of social infrastructure, and war damage make this area one of the most problematic areas for the development of urban systems.

Intensive urbanisation in Ukraine necessitates a new model of spatial policy that would not only address the problems of population concentration in large agglomerations but also create conditions for the development of a smart economy - an economy of knowledge, innovation, and digital technologies. A balanced approach to the use of territories will allow combining the interests of cities with populations of millions, medium-sized cities, and rural communities, minimising regional disparities. Spatial policy measures should stimulate the concentration of innovative enterprises, startups, and research centres within urban agglomerations and near universities. This involves developing science and technology parks in Kyiv, Lviv, Kharkiv, Dnipro, and Odessa, integrating into European innovation networks, and creating conditions for technology transfer between science and business (Zahynei-Zabolotenko *et al*., 2023). At the same time, to avoid excessive concentration of resources in the capital and several megacities, spatial policy should support medium-sized cities as “subcentres” of the smart economy. It is worth placing some state institutions, IT campuses, logistics parks, and industrial clusters here.

The condition for the development of a smart economy is the rapid mobility of people and data. The development of integrated public transport in large agglomerations, the creation of high-speed intercity corridors, and the provision of broadband Internet even in peripheral communities should be envisaged.

Spatial policy should support the introduction of smart technologies in urban management: electronic services, traffic monitoring systems, “smart” lighting, and energy consumption management. This will make cities more environmentally friendly, comfortable, and competitive for business.

Post-war reconstruction should aim not only at restoring housing and infrastructure, but also at introducing modern energy-efficiency standards, digital technologies in municipal services, and creating a barrier-free environment.

In the processes of redistribution of economic activity, relocation of businesses and reconstruction of affected cities, new architectural and construction clusters are formed, which strengthen the competitiveness of regions. Modern research indicates that the construction industry

not only performs the function of physical reconstruction, but also becomes a system-forming element of spatial organisation, integrating port logistics, housing and communal infrastructure and innovative technologies of territorial development (Greits & Liventsov, 2025). This defines construction companies as important stakeholders in the spatial organisation of a smart economy, especially in large agglomerations and medium-sized cities, where the restoration of critical infrastructure is intensifying.

The proposed directions of spatial policy can create conditions for the balanced development of a smart economy. The combination of innovation clusters, transport, and digital accessibility, the development of smart cities, and support for medium-sized centres will ensure the integration of the entire country into the global economic space. The success of implementation will depend on effective coordination between central authorities (the Cabinet of Ministers, the Ministry of Regional Development, the Ministry of Digital Transformation, and the Ministry of Infrastructure) and local governments, which should receive real tools to implement modern spatial solutions.

Conclusions

The study's results allow us to make several important generalisations about the spatial organisation of the smart economy in Ukraine in the context of intensive urbanisation. The key centres of innovation are large agglomerations: Kyiv, Lviv, Kharkiv, Dnipro, and Odessa. Each of them has its own specialisation and “pull” factors: Kyiv accumulates financial services, the IT sector and startups; Lviv is distinguished by a powerful IT cluster and cultural capital; Kharkiv remains a scientific and educational centre and retains significant engineering potential; Dnipro and Zaporizhia specialise in heavy industry and lay the foundations of “green” metallurgy; Odesa combines the functions of an international port, logistics hub and centre of creative industries. Along with large cities, medium-sized centres (Vinnytsia, Chernivtsi, Uzhhorod, Kryvyi Rih, Mykolaiv, Drohobych) also make significant contributions, forming niche clusters and advancing polycentric development.

Intensive urbanisation creates not only advantages, but also serious challenges for the balanced development of the smart economy, such as commuting migration, which creates excessive pressure on transport infrastructure and reinforces the monocentric nature of agglomerations. The relocation of businesses due to the war contributed to the emergence of new centres of economic activity in the western and central regions, but it also placed additional pressure on local infrastructure and the social sphere. Transport accessibility remains uneven: in Kyiv and Kharkiv, it is supported by the metro and an extensive surface transport network, while in Dnipro and Odessa the infrastructure is much weaker.

The problem of housing provision has become critical: the rise in prices for new buildings is outpacing income growth, reducing housing affordability even for the middle class. Calculations of the housing affordability index for 2021–2024 show that in most cities, buying your own home has become less affordable. The most threatening trends are in Lviv, where prices for new buildings have almost doubled, while wage growth has been moderate. At the same time, the rental market demonstrates relative stability and, in some cases (particularly in Kyiv), even an improvement in the income-to-expenses ratio. This means that renting remains the most affordable mechanism for providing housing for the majority of the urban population.

The development of the smart economy in Ukrainian regions requires systemic spatial solutions. A polycentric model can become an alternative to the current excessive concentration of resources in a few large cities. Support for medium-sized centres, the creation of innovative techno parks and business incubators in satellite cities, and the development of modern public transport and digital infrastructure are necessary prerequisites for balanced development.

The results obtained not only outline the current state of the spatial organisation of the smart economy in Ukraine but also provide a methodological basis for the development of state and regional policies aimed at integrating Ukraine into the global knowledge and technology space.

Further scientific research should focus on quantitative modeling of the processes that determine the spatial organisation of the smart economy. It is necessary to develop integrated indicators of sustainable spatial development that account for the combination of economic, social, and environmental parameters. Another promising direction is to study the role of medium-sized cities and peripheral communities in the formation of a polycentric network of the smart economy. The issues of post-war reconstruction require special attention: how to integrate restored territories into the smart economy and how to combine infrastructure reconstruction with innovative, "green" solutions. An important task is also to study the possibilities of attracting international technical assistance, foreign investments, and European spatial planning practices for the formation of modern Ukrainian smart cities.

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Conflict of interest

None.

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Просторова організація смарт-економіки в умовах інтенсивної урбанізації регіонів України

Анотація. У статті досліджено особливості просторової організації смарт-економіки в умовах інтенсивної урбанізації регіонів України та структурних трансформацій, зумовлених глобалізаційними процесами, цифровізацією та військовими викликами.

В основу методологічного підґрунтя дослідження був покладений порівняльний аналіз соціально-економічних показників, а також розрахунок індексу доступності житла у 2021–2024 рр. Обрані методи та прийоми дали змогу оцінити вплив урбанізаційних процесів на якість життя населення.

В статті проаналізовано формування основних ядр смарт-економіки, їх галузеву спеціалізацію, інноваційний потенціал. Виділені ключові «тяглові» фактори конкурентоспроможності регіонів, такі як: людський капітал, науково-освітня база, інституційна спроможність та доступ до цифрової інфраструктури. Показано роль великих міських агломерацій (Київ, Львів, Харків, Дніпро, Одеса) як центрів концентрації високотехнологічних секторів, стартап-екосистем та креативних індустрій. Авторами приділена особлива увага розвитку потенціалу середніх міст, що формують спеціалізовані інноваційні та виробничі кластери.

Здійснено поглиблений аналіз просторових викликів розвитку смарт-економіки, зокрема, маятникової міграції, релокації бізнесу та населення. У фокусі дослідження авторів були диспропорції транспортної доступності, дефіциту житла та зростання соціальної напруги у тих громадах, що приймали та приймають релокований бізнес.
Результати дослідження свідчать, що незважаючи на високу концентрацію інноваційного та інтелектуального потенціалу у великих міських центрах, в Україні зберігається значний дисбаланс між ядром та периферією, що стримує стійкий регіональний розвиток. Запропоновано напрями просторової політики, спрямовані на формування поліцентричної моделі розвитку, підтримку інноваційних кластерів у середніх містах, інтеграцію транспортної та цифрової інфраструктури, впровадження smart-технологій та екологічно орієнтованих рішень. У статті наголошено, що реалізація цих підходів створює передумови для збалансованого розвитку смарт-економіки та поглиблення інтеграції України до глобального простору знань

Ключові слова: просторовий розвиток, агломерація, маятникова міграція, транспортна доступність, житлове забезпечення, конвергенція регіонів, релокація бізнесу, будівельні кластери, післявоєнне відновлення, просторове планування