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THE IMPACT OF LOGISTICS AND KEY MACROECONOMIC INDICATORS ON THE DEVELOPMENT OF THE STARTUP ECOSYSTEM IN EUROPE

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Abstract. The article highlights that the synergetic relationship between macroeconomic indicators and logistics efficiency shapes the trajectory of startup ecosystems and global economies. By leveraging tools such as the Logistics Performance Index (LPI) and the Global Startup Ecosystem Index (GIS), policymakers and business leaders gain insights into the interconnectedness of infrastructure, economic output, and innovation. The Global Knowledge Index (GKI) and Global Innovation Index (GII) further reveal the intellectual and creative capacities of nations, while GDP per capita and the Capital Investment Index (CII) underline the financial underpinnings of economic competitiveness.

Much of the analysis delves into the transformative impact of modern logistics solutions. Innovative technologies like the Internet of Things (IoT) enhance supply chain visibility and efficiency, while warehouse automation and big data analytics streamline operations. Blockchain technology, with its transparency and security, fosters trust and efficiency in supply chains, a critical factor for startups seeking cost-effective and reliable logistics frameworks.

Through correlation analysis, the article underscores the measurable impact of these macroeconomic and logistical elements on the growth of startup ecosystems. Countries that effectively integrate these indicators are better positioned to attract investments, nurture entrepreneurial activity, and achieve sustainable economic growth. The findings suggest that fostering a dynamic startup ecosystem requires an integrated approach, combining robust macroeconomic policies with cutting-edge logistical innovations. This strategy not only propels startups into the competitive global market but also strengthens the economic fabric and welfare of the population.

Keywords*:* macroeconomic indicators, innovation, investment, logistics, startups, startup ecosystem.

JEL Classification: L26, R58, M13

1. INTRODUCTION

Start-ups are a key element of the modern economy, playing a significant role in stimulating innovation, developing new industries and shaping competitiveness in the global market. They help to increase employment, create added value and attract investment, making them an important driver of economic growth. However, the effective development of start-ups depends on the interaction of a number of factors, including macroeconomic indicators and logistics infrastructure.

Macroeconomic indicators, such as gross domestic product (GDP) per capita, capital investment, global knowledge indices (GKI), innovation indices (GII), and startup ecosystems (GIS), form the overall

environment for entrepreneurship. High scores on these criteria indicate favorable conditions for the growth of startup ecosystems, while low scores may limit their potential. The study of these indicators allows us not only to assess the current state of startup ecosystems in different countries but also to identify the factors that facilitate or hinder their growth.

At the same time, efficient logistics is an important tool for ensuring the operational efficiency of startups. It ensures the timely supply of resources, storage, transportation, and delivery of products or services, which has a direct impact on customer satisfaction and the competitiveness of startups. Innovative logistics technologies, such as the Internet of Things (IoT), big data analytics, blockchain, and warehouse automation, open up new opportunities for optimizing supply chains, reducing costs, and scaling businesses to international markets.

The study's relevance is driven by the need for an integrated approach to analyzing the impact of macroeconomic indicators and logistics processes on the formation and development of startup ecosystems. The paper focuses on identifying the key factors that contribute to the effective functioning of startups, assessing their impact on the economic development of countries, and formulating recommendations for improving the conditions for supporting entrepreneurship.

2. THEORETICAL BACKGROUND

The theoretical background of this study explores the current state of research on the impact of macroeconomic indicators and logistics on startup ecosystems and their role in economic development. Emphasis is placed on analyzing relevant studies published in high-impact databases such as Web of Science and Scopus, which provide a robust foundation for the evaluation of international trends and findings.

Startup ecosystems are complex networks of entrepreneurs, investors, incubators, accelerators, and policymakers that collectively facilitate innovation and entrepreneurial activity. Studies such as those by Audretsch (2021) highlight that regions with higher levels of innovation, knowledge diffusion, and entrepreneurial networks exhibit accelerated growth in startup activity, particularly in sectors such as technology and green energy.

For example, Zoltan and Acs (2016) demonstrate that countries with higher GDP per capita are more likely to support robust startup ecosystems due to greater access to funding, infrastructure, and skilled labor. Research emphasizes the strong correlation between macroeconomic indicators—such as GDP per capita, levels of capital investment, and knowledge indices—and the vitality of startup ecosystems.

Logistics plays a fundamental role in supporting startup ecosystems by ensuring the efficient flow of goods, services, and information. Lambert (2014) describes logistics as the backbone of supply chain management, emphasizing its importance for startups seeking to optimize operations and minimize costs. Recent advancements in logistics technology, such as blockchain, IoT, and AI, have further revolutionized the field, enabling greater transparency and efficiency. Studies like those by Christopher (2022) reveal that effective logistics systems directly impact customer satisfaction and operational scalability, which are critical for startup success.

Emerging technologies in logistics have received significant attention in recent literature. For instance, IoT and blockchain applications in supply chain management have been widely studied Kamal, (2024). These technologies enable real-time tracking, enhance supply chain transparency, and reduce transaction costs.

While macroeconomic indicators provide the broader context for startup ecosystem development, logistics acts as the operational enabler that determines their functionality. A study by Porter and Kramer (2019) highlights the importance of aligning macroeconomic policies with technological advancements in logistics to create a synergistic environment that supports innovation and economic growth. Moreover, Chen et al. (2020) argue that integrated policies aimed at improving logistics infrastructure while simultaneously investing in education and R&D can yield exponential growth in

startup ecosystems.

Despite the growing body of research, several gaps remain in understanding the dynamic interplay between macroeconomic factors and logistics. This theoretical framework provides a comprehensive overview of the factors influencing startup ecosystems, particularly emphasizing the dual roles of macroeconomic indicators and logistics. Further research should focus on empirical validations using comparative studies across different regions to deepen understanding of these interactions.

3. RESEARCH OBJECTIVE, METHODOLOGY AND DATA

The primary objective of this research is to analyze the impact of macroeconomic indicators and logistics on the development and efficiency of startup ecosystems. The study aims to:

1. Examine the relationship between key macroeconomic factors (e.g., GDP per capita, capital investment, innovation indices) and the performance of startup ecosystems.
2. Evaluate the role of logistics efficiency in enabling startups to optimize operations, reduce costs, and scale globally.

This study employs a mixed-methods approach, combining quantitative analysis of macroeconomic and logistical data with qualitative evaluation of trends and practices in startup ecosystems. This combined methodological and data-driven approach ensures a comprehensive understanding of the interplay between macroeconomic factors, logistics, and startup ecosystem dynamics.

4. RESULTS AND DISCUSSION

The author introduces research results that should be obtained using in the economies of the European Union, start-ups play an important role in the development of technologies, the creation of new industries, and thousands of new jobs. Start-ups have become a driver of innovative economic development, producing a significant share of added value, ensuring employment growth, and increasing economic productivity. In particular:

1) Stimulating innovation: Startups often create innovative products and services that bring new solutions to existing problems or meet new needs.

2) Job creation: Startups are a source of new jobs, especially for young people and highly skilled professionals. The development of startup ecosystems creates favorable conditions for the growth of this sector and provides more employment opportunities.

3) Economic development: startups are an important source of economic growth, creating new markets, attracting investment, and contributing to a competitive environment. The growth of startup ecosystems in the European Union can contribute to overall economic development.

4) Global competitiveness: In a world where competition is becoming increasingly global, startups have the potential to become catalysts for change in industries that have traditionally been considered conservative. The development of startup ecosystems contributes to the competitiveness of countries in the global market.

5) Supporting technological progress: startups often introduce new technologies and working methods that contribute to technological progress.

Logistics plays a key role in the development of start-ups, as the efficient management of the supply, storage, transportation, and delivery of products or services has a significant impact on the success of a young business. Let's look at the main aspects of its role:

1. Cost optimisation. Logistics helps startups minimize the costs associated with the supply and distribution of goods. For example, well-organized logistics processes allow you to:

- reduce transport costs;
- avoid overstocking of goods;
- reduce the risk of losses due to poor storage organization.

2. Speed and efficiency. Modern startups often operate in a competitive environment where the

speed of order fulfillment is critical. Well-developed logistics ensures:

- fast delivery of raw materials or components;
- prompt delivery of products to customers;
- timely response to changes in demand.

3. Ensuring the quality of service. Efficient logistics helps to increase customer satisfaction, as timely delivery and quality service form a positive image of a startup.

4. Flexibility and scalability. Startups often change their strategies and scale of operations depending on their success and market conditions. A flexible logistics system allows you to:

- quickly adapt to the growth or reduction of production volumes;
- enter new markets;
- integrate new technologies, such as warehouse automation or the use of drones for delivery.

5. Competitive advantage. Innovation often plays a crucial role in the start-up sector. The use of modern logistics solutions, such as artificial intelligence, blockchain for tracking deliveries, or big data for demand forecasting, helps companies stand out from the competition.

6. Strategic planning. Logistics affects the overall development strategy of a startup. For example:

- the geography of warehouses or offices depends on logistics routes;
- partnerships with suppliers are built taking into account logistics costs and deadlines.

Companies such as Amazon or Glovo have built their business models on innovative logistics solutions. They demonstrate how the right approach to logistics can become the foundation of a successful startup.

Modeling the impact of logistics and macroeconomic factors on the development of the startup ecosystem and the economy of Ukraine and other countries is an important tool for analysis and forecasting. Such modeling will help to understand what factors facilitate or hinder the development of startups and, accordingly, how this affects the economy (Kondur, O., & Tomashevska, A., 2021).

The influence of logistics and macroeconomic factors on the development of the startup ecosystem and the economies of Ukraine and other countries can be calculated based on the multiple correlation coefficient and the creation of a correlation matrix. The correlation coefficient is used to study the relationship between variables measured in metric scales on the same sample. It allows you to determine how proportional the variability of the variables is. With the help of the multiple correlation coefficient, you can determine the strength of the linear relationship between variables.

In the first stage, we identified logistical factors and macroeconomic factors influencing the development of startups. To do this, we ranked and compiled a catalog of factors influencing the level of development of the startup ecosystem. The catalog of such factors is supplemented based on expert analysis (Tab. 1).

Tab. 1

Catalogue of factors influencing the level of development of start-ups and economies

Features in the correlation matrix	Factor (2023)
LPI (B)	Logistics performance index
GIS (A)	Global startup ecosystem index by StartupBlink
GKI (C)	Global knowledge index
CII (E)	Capital investment index
GDP (D)	Gross domestic product per capita

Source: compiled on the basis of own research

The study was based on the Global Startup Ecosystem Index by StartupBlink - GIS. The top ten startup ecosystems in 2023 are shown in Tab. 2, however, it should be noted that the top five have not changed over the past year. The Ukrainian startup ecosystem ranked 33rd in 2023.

Tab. 2

Top ten startup ecosystem ranking

№	Position in the ranking relative to 2023	Countries	Total indicator
1	0	USA	198,080
2	0	United Kingdom	51.218
3	0	Israel	46.573
4	0	Canada	34.490
5	0	Sweden	27.074
6	+1	Singapore	26.571
7	-1	Germany	25.939
8	+1	France	22.916
9	-1	Austria	21.503
10	+1	Netherlands	21.423

Source: compiled from StartupBlink (World Competitiveness Rankings https://www.imd.org/centers/wcc/world-competitiveness-center/rankings/world-competitiveness-ranking/)

We studied the European countries that are in the top ten in the ranking along with Ukraine as of 2023 (Tab. 3).

Tab. 3

Ranking of countries according to the Global Startup Ecosystem Index

Place in the global ranking	Countries	Total indicator
28	Italy	9,768
29	Portugal	9,397
31	Luxembourg	8,523
32	Czech Republic	8,474
33	Iceland	8,104
34	Poland	7,442
37	Bulgaria	6,396
44	Romania	5,023
45	Cyprus	4,967
46	Ukraine	4,909
47	Latvia	4,777

Source: compiled from StartupBlink (World Competitiveness Rankings https://www.imd.org/centers/wcc/world-competitiveness-center/rankings/world-competitiveness-ranking/)

According to the World Bank's Logistics Performance Index (LPI), Ukraine has risen 14 positions over two years to rank 88th among 160 countries (Tab. 4).

The Logistics Performance Index (LPI) is an interactive tool for benchmarking countries' logistics profiles, which helps countries compare the challenges and opportunities they face in trade logistics and identify ways to improve efficiency in logistics activities. The LPI is based on a global survey of local operators (global freight forwarders and express carriers) and quantitative data on the performance of key components of the supply chain.

The development of start-ups is influenced not only by the relevant ecosystem but also by the importance of human potential, characterized by the level of education and the formation of new knowledge. In particular, the Boston startup ecosystem is ranked 5th in the ranking, as it has the advantage of access to world-class talent from institutions such as the University of Massachusetts, Boston University, and Harvard. The Global Knowledge Index (GKI) is a comprehensive tool used to

measure the level of knowledge and education in different countries of the world. This index helps to assess the quality of education, research, and innovation potential in different regions.

Tab. 4

Ranking of countries according to the logistics efficiency index

Place in the global ranking	Countries	Total indicator
23	Italy	3,7
41	Portugal	3,4
31	Luxembourg	3,6
45	Czech Republic	3,3
28	Iceland	3,6
34	Poland	3,6
53	Bulgaria	3,2
57	Romania	3,2
54	Cyprus	3,1
88	Ukraine	2,7
36	Latvia	3,5

Source: compiled on the basis of (Logistics Performance Index (LPI) https://lpi.worldbank.org/international/global)

The GKI consists of various indicators that take into account different aspects of knowledge and education, namely: education (pre-university education and higher education); research and technology development; information technology (level of use of and access to information technology); economic potential and enabling environment (level of economic development and investment in knowledge, development of infrastructure to support the creation of new knowledge and dissemination of existing knowledge, etc.) (Tab. 5).

Tab. 5

Ranking of countries by the Global Knowledge Index

Place in the global ranking	Countries	Total indicator
33	Italy	58,1
27	Portugal	60,1
7	Luxembourg	66
25	Czech Republic	60,9
21	Iceland	62,3
37	Poland	56,0
38	Bulgaria	55
42	Romania	53,0
29	Cyprus	59,3
68	Ukraine	46,5
28	Latvia	59,5

Source: compiled on the basis of (Global Knowledge Index. https://www.knowledge4all.com/gki)

In addition, the development of start-ups creates opportunities for innovation, access to international markets, etc. To ensure sustainable development, entrepreneurs improve themselves using innovative methods and acquired knowledge, which is most often revealed during the creation of startups. We need to investigate how the development of startups affects innovation, economic growth, and the country's competitiveness, so we used the Global Innovation Index (GII). According to the GII, Ukraine was classified as a lower-middle-income country, but according to the overall innovation index, Ukraine exceeded the performance of upper-middle-income countries (Tab. 6).

Tab. 6

Ranking of European countries by the Global Innovation Index

Rating in Europe	Ranking in the world	Countries	Total score
High-income countries			
1	1	Switzerland	67.6
2	2	Sweden	64.2
3	4	United Kingdom	62.4
4	6	Finland	61.2
5	7	Netherlands	60.4
6	8	Germany	58.8
7	9	Denmark	58.7
8	11	France	56.0
9	15	Estonia	53.4
10	17	Австрія	53.2
11	18	Norway	50.7
12	19	Iceland	50.7
13	21	Luxembourg	50,6
14	22	Ireland	50,4
15	23	Бельгія	49,4
16	25	Malta	49,1
17	26	Italy	46,6
18	29	Spain	45,9
19	30	Portugal	44,9
20	31	Czech Republic	44,8
21	33	Slovenia	42,2
22	34	Lithuania	42,0
23	35	Hungary	41,3
24	37	Latvia	39,7
25	41	Poland	37,7
26	42	Greece	37,5
27	44	Croatia	37,1
28	45	Slovakia	36,2
29	47	Romania	34,2
Upper middle-income countries			
1	38	Bulgaria	39,0
3	53	Serbia	33,1
4	54	North Macedonia	33,0
5	60	Moldova	30,3
6	75	Montenegro	27,8
7	77	Bosnia and Herzegovina	27,1
8	80	Belarus	26,8
9	83	Albania	25,4
Lower-middle income countries			
1	55	Ukraine	32,8

Source: compiled on the basis of (The Global Economy.com. https://www.theglobaleconomy.com/rankings/GDP_per_capita_PPP/)

The main macroeconomic indicator is GDP per capita, which is important for comparing the development of economies around the world. This is due to the fact that GDP per capita indicates the average level of income of the population in a country; it allows comparing the level of economic development of different countries, which is important for determining how economically prosperous a country is compared to other countries. The ranking of the surveyed countries in terms of GDP per capita in 2023 is presented in Tab. 7.

Tab. 7

Ranking of countries by GDP per capita

Place in the global ranking	Countries	Total indicator
33	Italy	44292
42	Portugal	35768
1	Luxembourg	117747
36	Czech Republic	41052
15	Iceland	55567
41	Poland	37707
57	Bulgaria	26961
53	Romania	32496
31	Cyprus	44996
108	Ukraine	10731
52	Latvia	32992

Source: compiled on the basis of (The Global Economy.com. https://www.theglobaleconomy.com/rankings/GDP_per_capita_PPP/)

The effectiveness of the business sector, including the development of start-ups, depends on the influence of a large number of factors, among which the overall investment activity of business entities in terms of capital investment is of great importance (Tab. 8).

Tab. 8

Ranking of countries according to the capital investment index

Place in the global ranking	**Countries**	**Total indicator**
8	Italy	471,65
40	Portugal	56,24
66	Luxembourg	15,39
31	Czech Republic	95,94
83	Iceland	7,57
20	Poland	146,5
60	Bulgaria	19,15
33	Romania	90,05
86	Cyprus	7,04
52	Ukraine	27,05
76	Latvia	10,03

Source: compiled on the basis of (The Global Economy.com. https://www.theglobaleconomy.com/rankings/GDP_per_capita_PPP/)

We calculated the degree of importance of the factors influencing the development of startups and the country's economy by means of multiple correlation using the online calculator Math Help Resources and created a correlation matrix (Fig. 1).

	A	B	C	D	E
1	**Y**	**X1**	**X2**	**X3**	**X4**
2	9,768	58,1	44292	471,65	3,7
3	9,397	60,1	35768	56,24	3,4
4	8,523	66	117747	15,39	3,6
5	8,474	60,9	41052	95,94	3,3
6	8,104	62,3	55567	7,57	3,6
7	7,442	56,0	37707	146,5	3,6
8	6,396	55	26961	19,15	3,2
9	5,023	53,0	32496	90,05	3,2
10	4,967	59,3	44996	7,04	3,1
11	4,909	46,5	10731	27,05	2,7
12	4,777	59,5	32992	10,03	3,5

Fig. 1. Matrix for calculating multiple correlation using the online calculator Math Help Resources

Source: https://mathcracker.com/

In our case, the correlation between the studied indicators is very high.

The proposed research method can serve as a tool for analyzing the impact of various factors on the development of startups and economies of countries around the world. It allows: analyzing the interactions between factors affecting the development of startups and the economy; forecasting future development based on current data and exploring scenarios for the development of startups and economies of countries around the world; testing hypotheses and formulating scenarios for supporting the startup ecosystem to select the most effective ones; identifying potential risks and assessing their impact on the development of startups and the economy; identifying new opportunities and ways to develop the startup ecosystem.

Startups often face major challenges in the early stages of their development, with operational efficiency and logistics costs playing an important role. Logistics is a key element for startups to be competitive, as the success of a business depends on how quickly and cost-effectively goods or services are delivered. In recent years, innovations in logistics technology, such as automation, real-time data, robotics, increased use of big data analytics, and advanced transportation solutions, have opened up new opportunities for startups to reduce costs, increase efficiency, and improve customer service. Innovations in logistics are enabling startups to manage their supply chains more efficiently, reduce costs, and shorten delivery times. Innovative technologies provide greater flexibility and the ability to adapt to changing market conditions. The most common and promising technologies are:

Internet of Things (IoT): IoT technology allows collecting a large amount of data from different points of the supply chain (warehouses, vehicles, containers), which makes it possible to track the location of goods and monitor their condition in real-time. This helps to reduce the risk of loss or damage to goods, as well as to respond quickly to unforeseen circumstances.

Big data and analytics: Startups can use big data analytics to optimize delivery routes, forecast demand, monitor inventory levels, and improve customer service. Analytics can help reduce delivery times and improve the efficiency of the entire supply chain.

Warehouse automation and robotics: automated warehouses and robots for cargo transportation help reduce the cost of warehouse management and reduce the number of human errors. This allows startups to speed up the processing and shipment of goods and reduces the need for manual labor.

Unmanned aerial vehicles and drones: The use of unmanned aerial vehicles (drones) for the delivery of goods is one of the most innovative areas in logistics. They can significantly reduce delivery times,

especially in urban environments where transportation is restricted.

Blockchain for logistics: blockchain can be used to improve transparency and security in supply chains, as well as to reduce administrative costs. The technology allows for a high level of control over all stages of the delivery process, which is important for startups operating in international markets.

5. CONCLUSIONS

This study emphasizes the key role of startups in stimulating innovation, job creation, economic development, and increasing the competitiveness of countries, including Ukraine. The analysis reveals that logistics is a critical factor for the successful development of startup ecosystems. The introduction of innovative technologies in logistics opens up broad prospects for optimizing business processes, reducing costs, and improving the quality of customer service. Indicators such as GDP per capita, the Knowledge Index (GKI), the Capital Investment Index (CII), and the Logistics Performance Index (LPI) directly affect the development of startup ecosystems. Despite the challenges, Ukraine is showing positive dynamics, rising in the global rankings of logistics and startup ecosystems. At the same time, GDP and the Global Knowledge Index show significant potential for growth.

The development of startups and their integration with innovative technologies in logistics is a powerful engine of economic growth and competitiveness of countries. For Ukraine, this area is becoming increasingly relevant, given its potential in IT, education, and innovation. Investing in the startup ecosystem, improving the efficiency of logistics, and implementing modern technologies will allow our country to achieve sustainable economic growth and become a significant player on the global stage.

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Якубів Валентина, Томашевська Антоніна, П'ятничук Ірина, Туровська Лілія, Картер Фінбар. Вплив логістичних та макроекономічних показників на розвиток екосистеми стартапів в Європі. *Журнал Прикарпатського університету імені Василя Стефаника*, **11** (4) (2024), 59-69.

У статті досліджується, що синергетичний зв'язок між макроекономічними показниками та ефективністю логістики формує траєкторію розвитку стартап-екосистем та глобальної економіки. Використовуючи такі інструменти, як Індекс ефективності логістики (LPI) та Глобальний індекс екосистеми стартапів (GIS), можна сформувати взаємозв'язок між інфраструктурою, економічним виробництвом та інноваціями. Глобальний індекс знань (GKI) та Глобальний індекс інновацій (GII) ще більше розкривають інтелектуальний та творчий потенціал країн, тоді як ВВП на душу населення та Індекс капітальних інвестицій (CII) підкреслюють фінансову основу економічної конкурентоспроможності.

Значна частина аналізу присвячена трансформаційному впливу сучасних логістичних рішень. Інноваційні технології, такі як Інтернет речей (IoT), підвищують прозорість та ефективність ланцюгів поставок, а автоматизація складів та аналітика великих даних оптимізують операції. Технологія блокчейн, завдяки своїй прозорості та безпеці, сприяє підвищенню довіри та ефективності ланцюгів поставок, що є критично важливим фактором для стартапів, які шукають економічно ефективні та надійні логістичні структури.

За допомогою кореляційного аналізу в статті підкреслюється вимірний вплив цих макроекономічних і логістичних елементів на зростання стартап-екосистем. Країни, які ефективно інтегрують ці показники, мають кращі можливості для залучення інвестицій, розвитку підприємницької діяльності та досягнення сталого економічного зростання. Отримані дані свідчать про те, що розвиток динамічної стартап-екосистеми вимагає комплексного підходу, що поєднує ефективну макроекономічну політику з передовими логістичними інноваціями. Така стратегія не лише виводить стартапи на конкурентний світовий ринок, але й зміцнює економічну структуру.

Ключові слова: макроекономічні показники, інновації, інвестиції, логістика, стартапи, екосистема стартапів.