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FACTORS OF INFLUENCE AND TRENDS IN THE EXPORT OF HIGH-TECH GOODS ON THE WORLD MARKET

Abstract

The purpose of this article is to reveal trends in the development of high-technology exports and identify key determinants that directly affect their growth. The authors employ comparative and regression analysis methods to assess the relationship between the volumes of high-tech exports and various factors, including R&D expenditures, the number of researchers, proceeds from the use of intellectual property, payments for the use of intellectual property, broadband Internet access, and the volume of FDI. The object of the study is a group of leading countries in terms of the share of high-tech exports in total exports for 2021: Malaysia, Vietnam, Korea, the Republic of China, Singapore, the Czech Republic, and Thailand.

It was found that the volume of high-tech exports worldwide increased 3.4 times between 2000 and 2021. During crisis periods, the rate of decline in high-tech exports shows more positive results than the rate of decrease in total goods exports. A positive correlation with high-tech exports characterises the selected factors.

Based on the analysis, the authors identified that each country has its unique profile of high-tech leadership, characterised by dominant factors. In China, these are payments for the use of intellectual property and R&D expenses, in Vietnam – broadband Internet access and FDI volumes, for R. Korea – R&D expenses, for Czechia – R&D expenses and the number of researchers, for Malaysia – payments for the use of intellectual property and FDI, for Singapore – R&D expenses and FDI, for Thailand – payments for the use of intellectual property.

Keywords: high-technology exports, R&D expenditures, foreign direct investment, use of intellectual property, global leadership

Introduction

Strategic guidelines for the development of the world's most advanced economies are closely tied to increasing exports of high-tech goods. High-technology exports in national development programs are considered a priority factor for sustainable economic growth and leadership in the world market. This is explained by the fact that high-tech production generates innovations, puts a demand on highly qualified specialists, creates higher added value, and ensures technical and technological progress in the economy due to its impact on related industries and production sectors. However, not all countries manage to increase exports of products with a high level of technological complexity. In this regard, it is crucial to identify the reasons for gaining leadership in this advanced segment of individual economies and to determine their export profile.

The purpose of this article is to reveal trends in the development of high-technology exports and identify key determinants that directly affect their growth.

The primary hypothesis of the study is based on the assumption that a country's ability to export high-tech goods depends on several factors. Therefore, the purpose of this article is to substantiate the key determinants that directly affect the growth of high-tech exports.

Literature review. A significant amount of attention in the scientific literature is devoted to various issues related to high-tech production and exports. Dosi, G., Pavitt, H., & Soete, L.[1] substantiate the competitiveness of countries and their leading positions in the world market by producing goods with high technology intensity. The significant contribution of high-tech exports to the economic growth of national economies is highlighted by Buchinskaya O. N., Dyatel E. P.[2]. According to Śledziewskak K., Akhvlediani T. [3], the reasons for the differentiation of countries in terms of production and export of high-tech goods lie in the different availability of factors of production (physical capital and the quality of human capital) and the presence of a technological gap between trading partners. Van Roy V. и Nepelski D. [4] note the direct dependence of the growth rate of high-tech production and the growth rate of high-tech exports. According to

scientists, the growth of high-tech output is observed in those EU states where entrepreneurs have access to banking and venture financing, R&D infrastructure is developed, minimal institutional bureaucracy exists, intellectual property rights are protected, and a capacious internal market is available. The publications pay special attention to the determinants of high-tech exports' growth. As such, Lubacha–Sember J [5] examines the costs of intellectual capital, while Gökmen Y. and Turen U. [6] substantiate the role of foreign direct investment, the quality of human capital, and the degree of economic freedom among economic entities. Taking into account the specifics of the monetary union in the EU, Tohmo T., Heimonen K., Nieminen M.[7] focus on the positive impact of the single currency on the growth of trade in high-tech goods and the spread of scientific achievements in the EU. According to the authors, this will contribute to a more efficient use of the EU countries' resources and their transition to a higher stage of development – a knowledge-based economy. The study by Navarro Zapata, A., Arrazola, M., and de Hevia, J. [8], which analysed data from 35 OECD countries, expands the number of factors determining the volume of high-tech exports. According to scientists, when analyzing high-tech exports, it is necessary to take into account such factors as the share of university graduates in the total population, the share of R&D expenditures in GDP, the share of foreign direct investment in GDP, the share of imports of high-tech industries in GDP, the quality of national governance and regulation, the country's population and EU membership.

Scientific publications also highlight the importance of R&D expenditures in conjunction with other factors for the production and growth of exports of high-tech products. Several scientists focus on various sources of R&D financing. Based on empirical studies, a more significant impact of private R&D financing on the volume of high-tech exports has been revealed compared to public financing [9], [10]. However, public funding of R&D, according to the experts of Oxford Economics [11], has a stimulating effect on private investment in R&D. An important area of theoretical and methodological research in modern economics is to identify the impact of foreign direct investment on the exports of the host country in general and on high-tech exports in particular. In part, the role of FDI was raised in the so-called new international trade theories in the second half of the XX century. Caves R.E. [12], Findlay R.[13] They also play a crucial role in highlighting the significance of FDI in the context of this article, which focuses on the development of technologies in the host country. Finally, in recent years, studies have emerged that indicate the direct impact of FDI on the growth of high-tech exports of the host country. At the same time, in particular, in the work of Özsoy S. [14] it is noted that a tangible effect for high-tech exports is possible if there is a developed financial infrastructure and regulatory environment in the host country. Thus, the analysis of scientific literature suggests the relevance of investigating the fundamental factors that influence the volume of high-tech production and exports.

Materials and research methods

To analyse the factors affecting the export of high-tech goods, statistical data from the World Trade Organisation (WTO) on the structure and volume of world exports from 2000 to 2022, as well as country ratings in terms of high-tech exports for 2023 and 2024, were utilised. The study used scientific publications and reports, focusing on the impact of technology, public policy, globalization, and competition.

The research methods included a comparative analysis of export volumes between key countries, a content analysis of the literature on high-tech policy, and a case study for individual countries such as Germany, the United Kingdom, the Netherlands, and South Korea. Statistical analysis of the data revealed deviations and percentage changes in exports between 2023 and 2024.

The study identified key factors influencing the export of high-tech goods, including technological advancements, government policies, globalisation, and market competition. The central leading countries were selected for the analysis, which enabled the substantiation of conclusions about the current state and prospects of exports, as well as the development of recommendations for countries seeking to improve their positions in the international high-tech market.

Quantitative and qualitative indicators were employed in the research to conduct a comprehensive analysis.

Results and their discussion

Quantitative and qualitative indicators were employed in the research to conduct a comprehensive analysis.

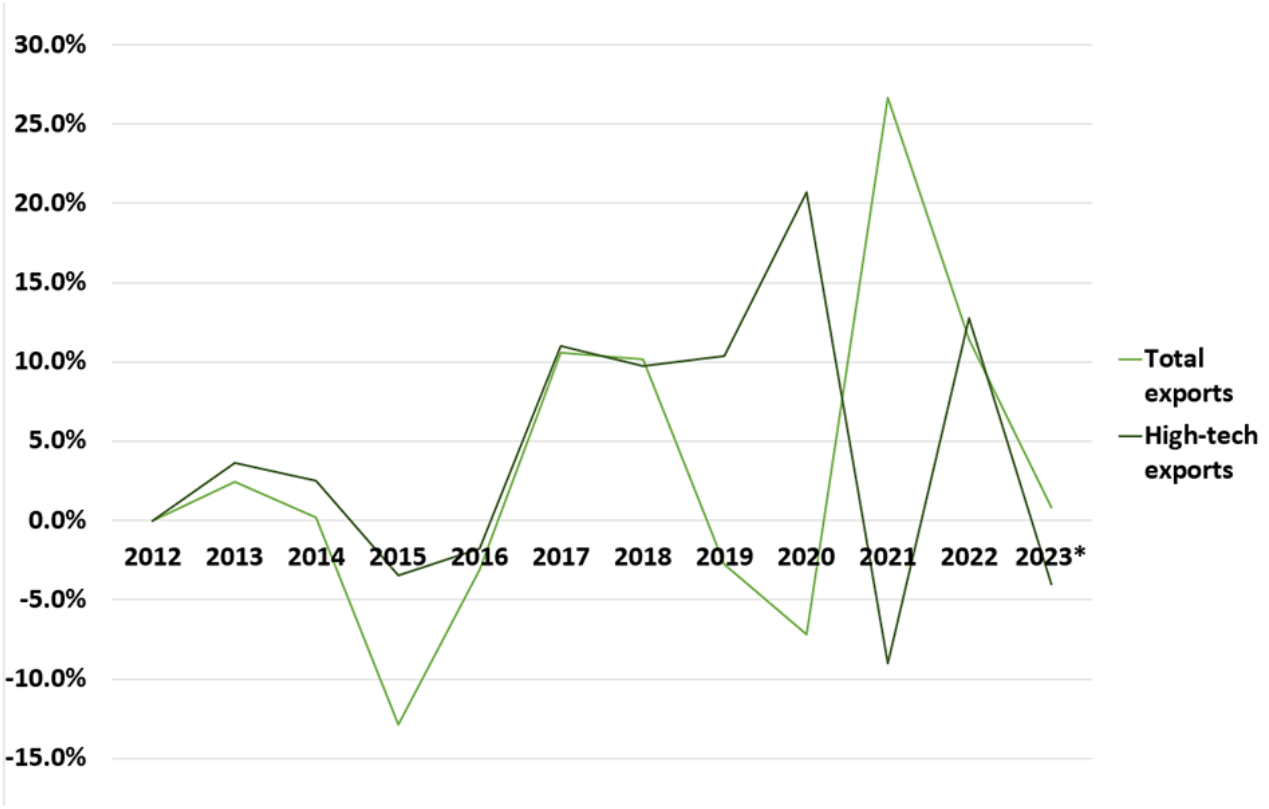

Fig. 1 - Total global exports and exports of high-tech products. Annual dynamics in percentage terms in US dollars 2012-2023*

Notes: The authors' calculations are based on data from the World Trade Organization and the Trade Data Monitor company (January 12, 2024)

https://www.wipo.int/ru/web/global-innovation-index/w/blogs/2024/high-tech-trade

The forecast for 2023 is based on current data available.

In the first ten months of 2023, the volume of high-tech product exports from China decreased by 11.4% to 728.2 billion US dollars. Smartphone exports from this country declined by almost 7% to $106.8 billion, while processor sales decreased by 24% to $82.8 billion (see Chart 3). Additionally, China's supplies to many of its traditional trading partners have decreased. Exports to the United States decreased by 21% to $102.7 billion, to the Republic of Korea by 13.4% to $33.9 billion, and to the Netherlands by almost 20% to $33 billion.

In recent decades, high-tech products have become a key category of goods on global markets. The export of such goods is becoming an essential indicator of a country's economic development, its level of technological maturity, and competitiveness. The article focuses on the examination of factors influencing the export of high-tech goods, as well as current trends in this sector.

High-tech products encompass a diverse range of categories, including electronics, software, biotechnology, and aerospace technologies. The increase in their share of global exports is due to growing demands for innovation and quality. According to the World Trade Organization (WTO), the share of high-tech goods in total global exports has increased from 20% in 2000 to 34% in 2022.

Let's consider the factors influencing the export of high-tech goods:

China and the United States are at the forefront of technological progress. China (2023: $3,370 billion, 2024: $3,410 billion) demonstrates a steady increase in exports of high-tech goods due to significant investments in research and development. The country is a.ctively

developing areas such as artificial intelligence and 5G. The United States (2023: $ 2010 billion, 2024: $ 2650 billion) is a leader in most high technologies, including software and aerospace technologies. Innovations from major technology companies, such as Apple and Microsoft, are driving steady export growth.

Politics and regulation as factors affect countries such as Germany and the United Kingdom. Germany (2023: $1,690 billion, 2024: $1,900 billion) has an advanced policy in the field of scientific research and technology. Supportive legislation in the field of technology, including intellectual property protection, contributes to an increase in exports of high-tech goods. United Kingdom (2023: $889 billion, 2024: $970 billion). It also uses incentives and regulations to maintain and grow its technology sector, which has a positive impact on exports.

Let us consider the factors of globalisation and integration using the examples of the Netherlands and South Korea. The Netherlands (2023: $ 741 billion, 2024: $ 849 billion) actively participates in global supply chains, which enables them to export high-quality, high-tech goods. Their strategic location in Europe also contributes to increased exports. South Korea (2023: $ 552.8 billion, 2024: $ 609 billion) is integrated into many international agreements, which facilitate access to foreign markets and increase exports of high technologies, especially in the fields of electronics and semiconductors.

The competition has a significant impact on exports from India and Singapore. India (2023: $ 408 billion, 2024: $ 473 billion). He actively works in the field of IT and outsourcing, which forces local companies to increase the level of innovation. This helps to increase their competitiveness in international markets. Singapore (2023: $ 449.9 billion, 2024: $ 507 billion). As a centre of high technology and start-ups, it also benefits from active competition, which allows it to develop new technologies and increase its exports. Factors influencing the export of high-tech goods, including technological advancements, government policies, globalisation, and market competition, are crucial to understanding the dynamics of global markets. Examples from countries such as China, the United States, Germany, the United Kingdom, the Netherlands, South Korea, India, and Singapore illustrate how these aspects interact to shape the current state and future directions of high-tech exports.

Table 1 - Ranking of countries by exports of high-tech goods in 2023-2024

№	Countries	2023 y		2024 y		Deviations	
1	China	3370	28,22	3410	25,34	40	1,2
2	USA	2010	16,83	2650	19,69	640	31,8
3	Germany	1690	14,15	1900	14,12	210	12,4
4	Great Britain	889	7,44	970	7,21	81	9,1
5	Netherlands	741	6,21	849	6,31	108	14,6
6	Japan	717	6,00	820	6,09	103	14,4
7	Italy	608	5,09	693	5,15	85	14,0
6	South Korea	552,8	4,63	609	4,52	56,2	10,2
7	Hong Kong	505,7	4,23	578	4,29	72,3	14,3
8	Singapore	449,9	3,77	507	3,77	57,1	12,7
10	India	408	3,42	473	3,51	65	15,9
	Total	11941,4	100	13459	100	1517,6	12,7
Note: The table was compiled by the author using the data https://surl.lu/xoxecn, https://surl.li/vulldd							

An analysis of Table 1, the world's ranking of high-tech exports for 2023 and 2024, reveals significant changes in volumes and shares in the global market. The total volume of high-tech

exports increased from $ 1,194.4 billion to $ 1,345.9 billion, representing an increase of $ 151.5 billion, or 12.7%.

China remains in the first place among the leading countries, with exports increasing from $3,370 billion to $3,410 billion. However, its market share has decreased from 28.22% to 25.34%, which may indicate increased competition from other countries, in particular the United States.

The United States, which ranks second, showed significant growth, increasing its exports from $2,650 billion in 2010 to $2,650 billion, while its market share increased from 16.83% to 19.69%. This is the most significant increase in both absolute and relative terms, underscoring the country's growing position in the high-tech sector.

Germany, in third place, also showed an increase in exports from $ 1,690 billion to $ 1,900 billion, while the share remained almost unchanged (14.15% to 14.12%). This confirms Germany's stability in the international high-tech arena, despite moderate growth rates.

The UK, in fourth place, increased its exports from $889 billion to $970 billion, but the share of the total decreased from 7.44% to 7.21%. This suggests that, although volumes are increasing, competitive pressures may prompt a country to reassess its market strategies.

The Netherlands and Japan experienced significant growth, with exports increasing to $849 billion and $820 billion, respectively. Both countries have achieved an increase of about 14%, which highlights their successful high-tech strategies.

Italy and South Korea, which occupy corresponding places in the ranking, also showed positive growth, although South Korea's increase was less noticeable, at 10.2%. India, however, showed impressive growth, increasing exports from $408 billion to $473 billion and improving its share from 3.42% to 3.51%. This suggests that India is emerging as a significant player in the high-tech market.

Trends in the export activity of high-tech goods include:

1) Increased investment in R&D. Countries continue to invest actively in research and development. The United States remains at the forefront of this field thanks to companies such as Google and Apple, which export high-quality technologies and software solutions.

2) The growing importance of green technologies. In the context of climate change, there is an increasing interest in sustainable technologies. Japan, with its focus on developing renewable energy sources and environmentally friendly technologies, is actively exporting innovative solutions in this area.

3) Digitalization of the economy. The transition to digital technologies is changing the way goods are produced and distributed. South Korea is a leader in e-commerce, exporting products such as electronics and home appliances.

4) The development of new markets: Countries such as Brazil are actively developing their high-tech sectors, creating new opportunities for both imports and exports, especially in South America.

The export trends of high-tech products on the global market demonstrate a growing interest in innovation and product quality. In the context of globalisation and technological progress, countries that can adapt to new challenges and capitalise on opportunities in the international competitive environment will be able to significantly strengthen their positions in global markets. An analysis of the factors influencing high-tech exports, as well as examples of successful countries, demonstrates the importance of a strategic approach to optimise export flows and achieve sustainable economic growth.

In general, the market for high-tech goods continues to grow, but there are significant changes in the market shares of countries. This indicates the emergence of a new dynamic in the global economy, requiring leading countries to adapt their strategies to maintain their competitive positions.

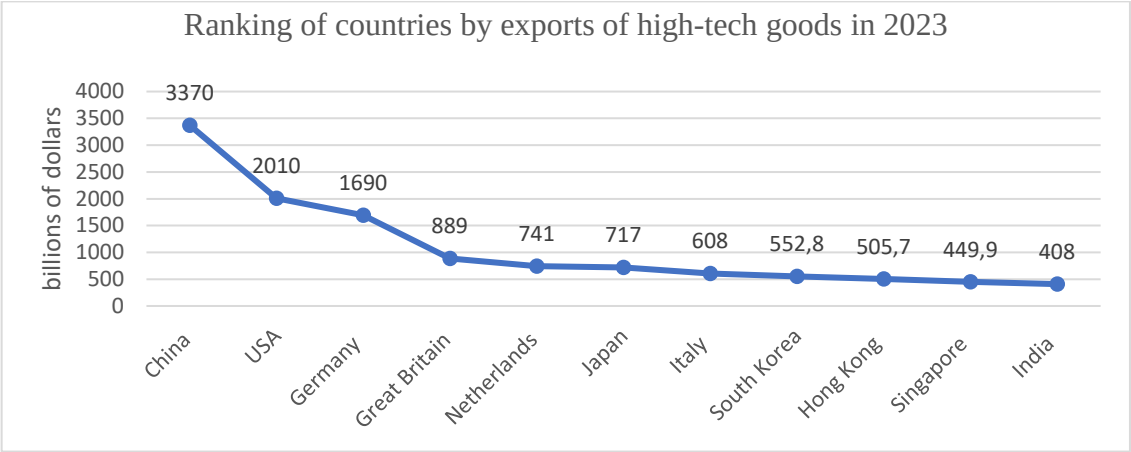

Figure 2 - Ranking of countries by exports of high-tech goods in 2023

Note: The drawing was compiled by the authors using the data https://surl.lu/xoxecn , https://surl.li/vulldd

In 2024, China is the leading exporter of high-tech goods, followed by the United States and Germany. Other countries, such as Japan, South Korea, the Netherlands, and India, also play a significant role in this sector. For example, exports of high-tech products from India in 2023-2024 are mainly directed to the United States, Great Britain, Singapore and China, according to ET Government.

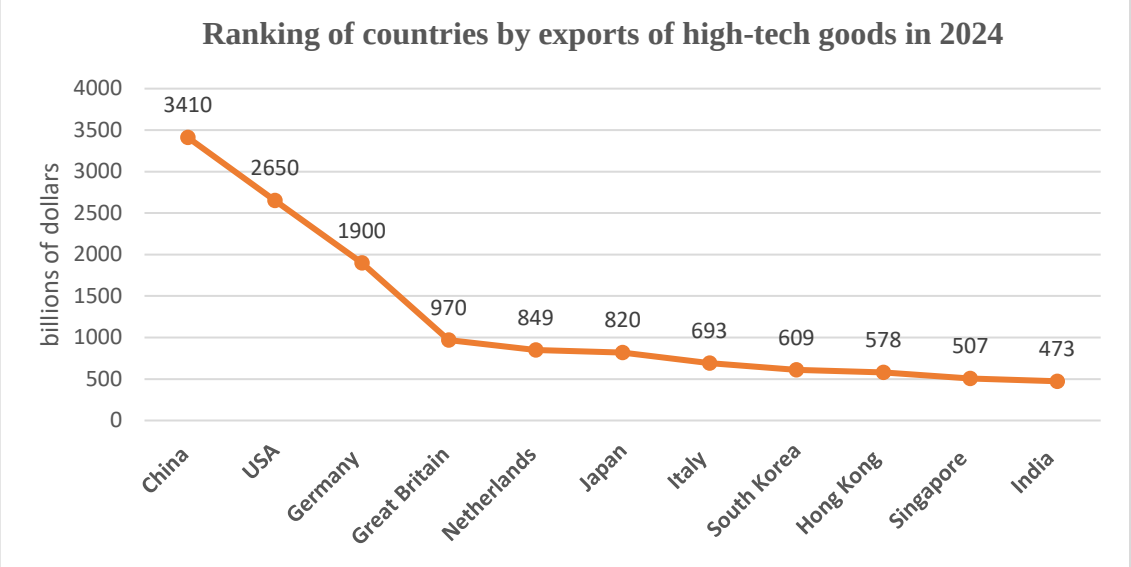

Figure 3 - Ranking of countries by exports of high-tech goods in 2023

Note: The drawing was compiled by the authors using the data https://surl.lu/xoxecn , https://surl.li/vulldd

In 2022-2023, China ranked first in electronics exports, accounting for about 33% of the global market. According to the WIPO - World Intellectual Property Organization, exports of high-tech products from China increased by 3.4% in 2024, reaching 825.2 billion US dollars. Overall, China, the United States, and Germany are major players in global exports of high-tech goods, and this market continues to grow.

Conclusions

An analysis of the factors influencing high-tech exports, as well as examples of successful countries, demonstrates the importance of a strategic approach to optimise export flows and achieve sustainable economic growth. Organizations and States that take note of current trends and potential development directions will be able not only to improve their positions in the international arena, but also to contribute to the sustainable development of the global economy.

Thus, combining all of the above, we can say that promising countries and companies that actively innovate and adapt their strategies to changing market conditions will not only successfully compete but also set the tone in the global high-tech market of the future.

Based on the research conducted on the factors influencing the export of high-tech goods, several key conclusions can be drawn.

First, high-tech products are becoming an increasingly important part of global exports, reflecting the growing demands on innovation and quality. The share of high technologies in total global exports has increased from 20% in 2000 to 34% in 2022, underscoring the importance of this segment of the economy for countries.

Secondly, technological progress is the primary factor driving the growth of exports of high-tech goods. Leaders such as China and the United States are actively investing in research and development, which enables them to secure leading positions in the global market.

Third, government policy and regulation have a significant impact on the export of high technologies. The examples of Germany and the UK demonstrate how supportive legislation and incentives can foster the development of the technology sector and enhance external supply.

Globalisation and integration into international markets also play a crucial role. The Netherlands and South Korea demonstrate how participation in global supply chains, combined with the presence of international agreements, facilitates access to foreign markets and promotes export growth. In addition, the level of competition within countries, such as India and Singapore, encourages local companies to increase their innovation activities, which has a positive impact on their international competitiveness.

In conclusion, understanding the factors that affect the export of high-tech goods is crucial for assessing the dynamics of global markets and developing strategies that can help countries improve their positions in this competitive and rapidly evolving segment of the economy. This study has empirically identified the key factors influencing the volume and dynamics of high-technology exports across a diverse set of countries, with a focus on the top-performing economies. The following specific conclusions and recommendations can be drawn:

Global Growth in High-Tech Exports:

The export of high-tech goods remains one of the fastest-growing segments of international trade, with an average annual growth rate of 6.7%. The sector demonstrates resilience during economic downturns, as shown by its relative stability during the 2008 and 2020 crises. This confirms the strategic importance of high-tech trade as a buffer against global financial volatility.

Geographic Redistribution of Leadership:

East and Southeast Asian countries—especially China, Vietnam, Malaysia, and South Korea—have either maintained or ascended into leading positions in global high-tech exports. Conversely, the United States and some European economies have lost relative ground. This shift reflects the reconfiguration of global supply chains, as well as targeted policy interventions in emerging economies.

Country-Specific Factor Profiles:

Econometric analysis reveals that determinants of high-tech export performance are heterogeneous across countries:

China, Singapore, and Czechia show strong positive correlations with nearly all factors studied, suggesting comprehensive innovation ecosystems.

Malaysia and Thailand rely more heavily on foreign direct investment and technology imports (IP payments), reflecting their roles as manufacturing hubs within global value chains.

Vietnam exhibits a strong dependence on FDI and digital infrastructure, highlighting its growing integration into high-tech production networks despite weaker innovation inputs.

South Korea and Singapore exemplify successful cases of combining public investment in R&D with openness to international collaboration and capital.

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ФАКТОРЫ ВЛИЯНИЯ И ТЕНДЕНЦИИ В ЭКСПОРТЕ ВЫСОКОТЕХНОЛОГИЧНЫХ ТОВАРОВ НА МИРОВОМ РЫНКЕ

Аннотация

Целью статьи является выявление тенденций в развитии высокотехнологичного экспорта и выявление ключевых детерминант, непосредственно влияющих на его рост. Авторы используют методы сравнительного и регрессионного анализа для оценки взаимосвязи между объемами экспорта высокотехнологичной продукции и такими факторами, как расходы на НИОКР, количество исследователей, доходы от использования интеллектуальной собственности, платежи за использование интеллектуальной собственности, широкополосный доступ в Интернет, объем прямых иностранных инвестиций.

Объектом исследования является группа стран-лидеров по доле высокотехнологичного экспорта в общем объеме экспорта на 2021 год: Малайзия, Вьетнам, Республика Корея, Китай, Сингапур, Чехия, Таиланд. Было установлено, что объем экспорта высокотехнологичной продукции в мире в 2000-2021 годах увеличился в 3,4 раза; в кризисные периоды темпы снижения экспорта высокотехнологичной продукции показывают более положительные результаты, чем темпы снижения общего объема экспорта товаров. Выделенные факторы характеризуются наличием положительной корреляции с высокотехнологичным экспортом.

На основе проведенного анализа авторы определили, что каждая страна имеет свой собственный профиль лидерства в области высоких технологий, основанный на доминирующих факторах. В Китае это платежи за использование интеллектуальной собственности и расходы на НИОКР, во Вьетнаме – широкополосный доступ в Интернет и объемы прямых иностранных инвестиций, в Южной Корее – расходы на НИОКР, в Чехии – расходы на НИОКР и количество исследователей, в Малайзии – платежи за использование интеллектуальной собственности и ПИИ, для Сингапура – расходы на НИОКР и прямые иностранные инвестиции, для Таиланда – платежи за использование интеллектуальной собственности.

Ключевые слова: высокотехнологичный экспорт, расходы на НИОКР, прямые иностранные инвестиции, использование интеллектуальной собственности, мировое лидерство

ЖОҒАРЫ ТЕХНОЛОГИЯЛЫҚ ТАУАРЛАР ЭКСПОРТЫНЫҢ ӘЛЕМДІК НАРЫҚТАҒЫ ӘСЕР ЕТУ ФАКТОРЛАРЫ МЕН ҮРДІСТЕРІ

Аңдатпа

Мақаланың мақсаты жоғары технологиялық экспорттың даму тенденцияларын анықтау және оның өсуіне тікелей әсер ететін негізгі детерминанттарды анықтау болып табылады. Авторлар салыстырмалы және регрессиялық талдау әдістерін жоғары технологиялық өнімдер экспортының көлемі мен ҒЗТКЖ шығындары, зерттеушілер саны, зияткерлік меншікті пайдаланудан түсетін кірістер, зияткерлік меншікті пайдаланғаны үшін төлемдер, кең жолақты Интернет, тікелей шетелдік инвестициялар көлемі сияқты факторлар арасындағы байланысты бағалау үшін пайдаланады.

Зерттеу нысаны - 2021 жылға арналған экспорттың жалпы көлеміндегі жоғары технологиялық экспорттың үлесі бойынша көшбасшы елдер тобына енген Малайзия, Вьетнам, Корея Республикасы, Қытай, Сингапур, Чехия, Таиланд елдері. 2000-2021 жылдары әлемде жоғары технологиялық өнімдер экспортының көлемі 3,4 есеге ұлғайғаны анықталды. Дағдарыс кезеңдерінде жоғары технологиялық өнімдер экспортының төмендеу қарқыны тауарлар экспортының жалпы көлемінің төмендеу қарқынына қарағанда оң нәтижелерді көрсетеді. Бөлінген факторлар жоғары технологиялық экспортпен оң корреляцияның болуымен сипатталады.

Жүргізілген талдау негізінде авторлар әр елдің басым факторларға негізделген жоғары технологиялық көшбасшылық профилі бар екенін анықтады. Қытайда бұл зияткерлік меншікті пайдаланғаны үшін төлемдер және ҒЗТКЖ шығындары, Вьетнамда - Интернетке кең жолақты қолжетімділік және тікелей шетелдік инвестициялар көлемі, Оңтүстік Кореяда - ҒЗТКЖ шығындары, Чехияда - ҒЗТКЖ шығындары мен зерттеушілер саны, Малайзияда – зияткерлік меншік пен ТШИ пайдаланғаны үшін төлемдер, Сингапур үшін - ҒЗТКЖ шығындары ҒЗТКЖ және тікелей шетелдік инвестициялар, Таиланд үшін - зияткерлік меншікті пайдаланғаны үшін төлемдер.

Негізгі сөздер: жоғары технологиялық экспорт, ҒЗТКЖ шығындары, тікелей шетелдік инвестициялар, зияткерлік меншікті пайдалану, әлемдік көшбасшылық

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