SvedbergOpen
DISSEMINATION OF KNOWLEDGE

International Journal of Artificial Intelligence and Machine Learning

Publisher's Home Page: https://www.svedbergopen.com/

Research Paper Open Access

AI, intellectual security and demographic challenges in the context of regional integration

Nairi Sargsyan

PhD Scholar – Ph.D. in Law, Doctorate applicant in Economics at NAS RA

ABSTRACT
Ethereum smart contracts enable decentralized applications, yet they are highly prone to vulnerabilities, which results in severe financial losses. Objective: This research develops an intelligent and automated detection framework called Osprey-Hen Optimized Gated Graph Sequence with Vulnerability Aware Graph Attention (Oshen-VAGA-GGS) Network for detecting vulnerabilities in Ethereum smart contracts. Method: The acquired data are preprocessed via normalizing Solidity, stripping comments, flattening inheritance. Moreover, a heterogeneous multigraph is constructed by combining Abstract Syntax Tree (AST), basic-block Control Flow Graph (CFG), def-use Data Flow Graph (DFG), and inter-contract call graph using Slither, and labelled edges as control/data/call. Then significant features are extracted via Word2Vec-embed opcodes and identifiers, numeric literal bins, positional encodings and one-hot node-types and balance the data by SMOTE during training only. These features are passed to the proposed Gated Graph Sequence Neural Network (GGNN) and Set2Set readout with attention pooling is added to give contract-level and function-level logits. To enhance the efficacy of the proposed Oshen-VAGA-GGS, an optimization is developed using wrap AdamW with OsHen metaheuristic global osprey exploration, local hen exploitation. Novelty: The VAGA enhances heterogeneous graph representations by explicitly modeling vulnerability semantics. The framework represents smart contracts using structural and semantic program information and employs gated graph propagation to learn long-range dependencies among contract components. Findings: Comprehensive experiments are conducted against GNN, Bi-LSTM, MLP+LSTM, and BERT-ATT-BiLSTM baselines. With 80% training data, the corresponding results increase to 98.57%, 98.56%, 99.79%, 98.57%, and 98.56%, respectively. In the ablation analysis, the complete GGNN + OsHen-VAGA configuration achieves 98.80% accuracy and 98.79% F1-score, compared with 94.99% for the baseline GGNN.

Keywords: competitiveness, AI, intellectual security, technological development, demographic challenges, regional integration, economic growth

Introduction

Dynamic changes in the world economy, current trends in regional integration, and the challenges in local markets strongly depend on the ability of each nation to utilize competitive and cooperative advantages. The latter is based on the efficient use of innovations, AI and other achievements of science and technology. All mentioned factors are products of human intellectual activity therefore our focus is the ability of the state to maintain proper level of intellectual security. In turn, it is closely related to demographic challenges that face each country, particularly in developing part of the world. Obviously, member states of the Eurasian Economic Union are not isolated from contemporary trends and challenges.

It is our firm perception that the development of Eurasian integration is driven not only by purely economic factors, but also by social and demographic ones. Our research confirms the idea that all EAEU countries face common threats to demographic security. This applies to population aging, rising mortality rates, and declining birth rates, as well as mass migration, brain drain, and so on.

Of course, intellectual security is viewed primarily as the protection of the results of intellectual activity, and intellectual security can be compared to intellectual property. However, the concept of intellectual security encompasses not only the protection of intellectual products, but also the rational use, reproduction, and improvement of the intellectual capacity of people, which determines their activities.

Methodology

In our study different methods of economic analysis are used. The use of statistical lines helps to gather required data on the state of economic growth and competitiveness of each country. Method of comparative analysis allowed to reveal the levels of economic growth in EAEU member states with a particular emphasis on the knowledge based fields of economy. Among the useful methods of economic analysis we have exercised the method of generalizations, as well as the methods of analysis and synthesis.

Literature review

Recent academic findings explore relevant issues related to artificial intelligence, intellectual security, and demographic shifts separately or in pair and less intersect within regional integration frameworks. Some experts analyze the geopolitical and regional impact and how AI alters international relations and why data

sovereignty has become a core element of national and regional security [Zai et al., 2025, 2244-2263], others concentrate on AI and predictive analytics to model migration trends, workforce evolution, and demographic pressures to support evidence-based regional integration policies [Frantini et al., 2026]. Demographic trends are widely discussed by academia [Pulami & Nepal, 2024, 43-58], however, the interrelation with the AI and other achievements are still missing. In addition, among the new analysis one of the most relevant is the attempt to explore significant relations between AI, local and regional economic growth and regional disparities and the utilization of reduced-form evidence and quantitative spatial model.

Active research is conducted on frameworks like digital sovereignty, the risks of technological dependency, brain drain, and digital divides that threaten intellectual security during rapid digital transformation, intellectual property and data governance frameworks, as well as the issues on the Fourth industrial revolution presenting developing regions with advanced technologies in the context of various interdisciplinary studies. Concepts are developed on intellectual security—defined through the lens of data sovereignty, cross-border data flows, and localized governance exploring how regional economic integration shall negotiate regional data-sharing trade-offs to prevent technological dependency and preserve regional cognitive/intellectual independence. Finally, some comparative studies highlights how non-Western regions view AI: intellectual security around themes of technological dependency, information manipulation, and state governance, illustrating how historical and demographic factors influence a region's willingness to integrate AI into its sovereignty frameworks. [Frimpong, 2024].

Mentioned and other works are considered as valuable contribution to the separate issues. At the same time, no attempt is made so far to explore the ties among them, most specifically, to present how AI, intellectual security and demographic challenges are essential from the point of regional integration in the era of digitalization.

Scientific novelty

Although the issues related to the role of AI in economic development from one side and the issues of intellectual security and demographic challenges are separately widely discussed in economic literature, we have attempted to examine jointly the relationship between the use and the role of the AI, intellectual security, technological development, demographic challenges, regional integration, and the economic growth in the context of regional integration, particularly in the countries of Eurasian Union.

Analysis

It is worth noting the impact of the level of intellectual security on the process of ensuring demographic security. Moreover, according to many analysts, genetics and intellectual security are also interconnected: on the one hand, a violation of a country's intellectual security leads to genetic consequences for the population, the results of which are difficult to predict, and on the other, the state and changes in a society's gene pool have a direct impact on the state's intellectual security. Many may ask: why is intellectual security an integral part of national security? As is well known, the EAEU pursues the dynamic development of high technologies, which were previously closely associated only with certain cutting-edge industrial subsectors with a high share of specific expenditures on research, development, and innovation. However, in the context of the demographic development of Eurasian integration, this concept can and should now be interpreted more broadly: high technologies exist as part of the technological base in all sectors of the modern national economy of each of our countries, as well as for industrial cooperation within the framework of Eurasian integration as a whole. Therefore, in relation to the structure of industrial production, high-tech industries should include a number of industrial sub-sectors—the production of electronic equipment and peripherals, aviation and rocket-space technology, industrial robots and integrated automation equipment, radio communications, radar and radio navigation, complex household electronic equipment, instrument making, etc. These industries also include the pharmaceutical industry, some chemical industries, and the nuclear industry, which all have a relatively high share of innovation expenditures. High-tech production contributes to improving the quality and standard of living of the population of our countries, boosting the overall economy and the common market of the EAEU. This is why the Eurasian Economic Commission must seriously consider the state of high-tech development in the Union countries and promote an increase in total expenditure on high-tech development and research. As representatives of the expert community, we are confident that increasing spending on innovative research and development and demand for its results will only be possible with sustained high rates of economic development and, consequently, favorable conditions for large and small private businesses, a healthy competitive environment, and increased competition in the common EAEU market, as well as effective industrial cooperation, which in turn will create the necessary conditions for ensuring intellectual security. Based on the above, we can be confident that:

First, intellectual security determines the scientific support and implementation of all other types of national security;

Secondly, the current situation and trends of economic integration in the EAEU countries provide grounds for considering intellectual security issues as a critical regional, economic, social, and political challenge. Thirdly, the consequences of an intellectual crisis could prove far more dangerous than, for example, a political, military, economic, or informational crisis, and overcoming it will require several decades, perhaps even centuries.

Fourthly, the multifaceted nature, complexity, scale, and depth of the problem of developing and preserving intelligence elevates ensuring the intellectual security of the EAEU (along with demographic and other issues) to the ranks of the most pressing contemporary issues.

As for the possible aspects of intellectual security, it is appropriate to consider it as a component – a subsystem of a higher-level system, such as national security. At the same time, it is viewed as a complex, multi-level system, including a number of subsystems or components of a lower order. Finally, we are talking about the internal or external state or situation of the state, in which there are no real or potential threats to the intellectual interests of the individual, society and the state, and, if they arise, a system of measures to ensure the protection or defense of the bearers of intellect and the products of their mental labor. The intellectual interests of our countries and the EAEU as a whole are, undoubtedly, vital and long-term. Consequently, the essence of intellectual interests, ultimately, comes down to the effective use and reproduction of the intellectual potential of the people, as well as the development, preservation and accumulation of intellectual potential and intellectual resources. A special role in the system of intellectual interests belongs to scientific intelligence, since it determines the level of development, genuine independence, authority and power of the state and the integration union. In the context of digitalization and the dynamic development of high technologies, the threats to intellectual security in the context of the demographic development of Eurasian integration are: - low interest or inability of scientists and specialists with higher education to work in their field of training; - "brain drain" abroad; - employment of scientists and specialists with higher education in fields other than their acquired specialty; - aging and shortage of scientific personnel and personnel with higher education; - moral and material undervaluation of the work of scientists and specialists with higher education and experience; - underestimation of the social significance of scientists and specialists with higher education in society; - lack of prestige of professions related to science and work for the state; - decreasing desire of young people to engage in science and obtain higher education; - decreasing quantity and decreasing quality of defended diploma and final theses, dissertations for the degree of candidate or doctor of science. Given the existing trends and problems, it is advisable to take the following active measures to ensure intellectual security: • development of a modern concept of the scientific and technical policy of the EAEU for the development of science and education, corresponding to the new challenges and socio-economic conditions of the development of our countries;

• development of laws, legislative and regulatory acts that ensure and stimulate the development of science and education;

• development and harmonization of laws and legislation protecting the intellectual interests of the EAEU member states, intellectual property, intellectual property holders, and the products of their intellectual labor;

• development of general requirements for the training of specialists with higher education and scientific personnel;

• development of general requirements for diploma and final theses, dissertations for academic degrees submitted for defense, etc. In addition, we believe it is necessary to: • practically and consistently realize the intellectual potential of the individual, society, and the state;

• enhance the social and public importance of specialists with higher education and scientists in solving state and other problems;

• improve the working and living conditions of intellectuals – scientists and specialists with higher education;

• effectively protect the products of intellectual activity from various types of encroachment;

• employ scientists and specialists with higher education only in their field of training;

• provide moral and material incentives for the work of intellectuals;

• timely and adequate implementation and application of the results of the activities of scientists and specialists with higher education in practice, etc.

Conclusion

Thus, it can be concluded that intellectual security is an important element in the economic and national security system, which is based on intellectual interests, intellectual threats, and intellectual protection. At the same time, it must be taken into account that the EAEU countries possess significant intellectual potential for addressing intellectual security issues, and this potential must be harnessed.

Consequently, maintaining and strengthening intellectual security in today's environment is only possible by eliminating intellectual threats, satisfying the intellectual interests of individuals, society, and the state, and implementing effective intellectual protection activities. Finally, a significant threat to intellectual security in the context of the demographic development of Eurasian integration is the targeted activities of various states, on the one hand, "poaching" highly qualified specialists trained in post-Soviet countries and especially in the EAEU countries, and on the other, deliberately underplaying or discrediting the achievements of their own scientific intellect in the global community.

Nairi SARGSYAN

AI, intellectual security and demographic challenges in the context of regional integration

Key words: competitiveness, AI, intellectual security, technological development, demographic challenges, regional integration, economic growth

For some countries, the state of intellectual security is determined primarily by scientific potential and scientific resources, that is, the number and level of training of capable scientific intellect bearers—trained and working scientists and individuals with higher education, high intelligence, skills, and experience. Consequently, intellectual security, like national security, can be external and internal and is based on fundamental categories such as intellectual interests, intellectual threats, and intellectual protection.Clearly, to ensure, maintain, and strengthen intellectual security, it is necessary to implement a range of organizational, legal, economic, and other measures aimed not only at preserving and reproducing existing intellectual potential, but also at enhancing the prestige of intellectual work and encouraging those with scientific intellect to engage in productive work. In implementing these measures, it becomes imperative to shift the focus from passive to active defense.

References

1. Frantini, S., Pohle, J., Di Marco, D., Thabit G., S. and Sgueo, G., Digital Sovereignty as a Geopolitical Strategy - Navigating Dependencies, Power, and Democratic Resilience in a Changing Global Order, European Commission, Ispra, 2026, JRC146878.
2. Chen A. Artificial Intelligence, Economic Growth and Regional Disparities: Reduced-Form Evidence and Quantitative Spatial Model. China Journal of Economics, 2026, 13(2): 149-167. https://doi.org/10.26599/CJE.2026.9300208
3. Victor Frimpong, Cultural and Regional Influences on Global AI Apprehension, Qeios, Nov 18, 2024, https://www.qeios.com/read/YRDGEX.2
4. Acemoglu D, Lelarge C, Restrepo P. 2020. Competing with robots: Firm-level evidence from France[J]. AEA Papers and Proceedings, 110: 383-388.
5. Adão R, Arkolakis C, Esposito F. 2022. General equilibrium effects in space: Theory and measurement, NBER Working Paper No. 25544[R]. Cambridge: National Bureau of Economic Research: 1-63.
6. Aghion P, Antonin C, Bunel S, et al. 2022. The direct and indirect effects of automation on employment: A survey of the recent literature[M]//Ing L Y, Grossman G M. Robots and AI: a New Economic Era. Oxon and New York: Routledge.
7. Alonso C, Berg A, Kothari S, et al. 2022. Will the AI revolution cause a great divergence?[J]. Journal of Monetary Economics, 127: 18-37.
8. Caliendo L, Parro F, Rossi-Hansberg E, et al. 2018. The impact of regional and sectoral productivity changes on the U.S. economy[J]. The Review of Economic Studies, 85(4): 2042-2096.
9. Dauth W, Findeisen S, Suedekum J, et al. 2021. The adjustment of labor markets to robots[J]. Journal of the European Economic Association, 19(6): 3104-3153.
10. Dekle R, Eaton J, Kortum S. 2007. Unbalanced trade[J]. American Economic Review, 97(2): 351-355.
11. Eaton J, Kortum S. 2002. Technology, geography, and trade[J]. Econometrica, 70(5): 1741-1779.
12. Faber B, Gaubert C. 2019. Tourism and economic development: Evidence from Mexico's coastline[J]. American Economic Review, 109(6): 2245-2293.
13. Redding S J. 2016. Goods trade, factor mobility and welfare[J]. Journal of International Economics, 101: 148-167.
14. Redding S J. 2022. Chapter 3—Trade and geography[J]. Handbook of International Economics, 5: 147-217.
15. Tombe T, Zhu X D. 2019. Trade, migration, and productivity: A quantitative analysis of China [J]. American Economic Review, 109(5): 1843-1872.
16. Zeira J. 1998. Workers, machines, and economic growth [J]. The Quarterly Journal of Economics, 113(4): 1091-1117.