THE IMPACT OF TECHNOLOGY AND ARTIFICIAL INTELLIGENCE INVESTMENTS ON ECONOMIC GROWTH IN SEVERAL COUNTRIES AROUND THE WORLD: RECOMMENDATIONS FOR VIETNAM

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Abstract: ***The trends of development, competition, and efficiency, technology and artificial intelligence (AI) plays an enormous role for many countries around the world. In this development process, investment in AI and technology exports are strong moves that many countries are taking to guide their development. So, how does investment in AI and technology impact economic growth? To provide an empirical basis for this research, we use data from 10 representative countries across continents from 2012 to 2024. The research aims to examine how investment in AI (VCI) and technology (Tech) impacts long-term economic growth. Additionally, we use control variables such as government efficiency (GE), foreign direct investment (FDI), and the workforce (La) to examine the impacts more clearly. As a result, all variables in the model are statistically significant, and investment in artificial intelligence and technology has a significantly positive impact on the economic growth of countries, but the role of government management cannot be ignored in the model.***

• Keywords: *artificial intelligence (AI), technology, governance efficiency, economic growth.*

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1. Introduction

With the advancement of science and technology, every field is constantly developing, such as education, economics, healthcare, etc. Furthermore, the prosperity and rapid economic development have spurred the vigorous development of econometrics, statistics, and other economic-related fields, which have expanded significantly, making it difficult for authorities to manage the economic system. Economic management and organization play a crucial role in economic progress, influencing the orderly operation of the economic development process (Maksanova et al., 2021). Therefore, the combination of economic growth and Artificial Intelligence (AI) promotes the advancement of economic control and management technologies. In addition, it stimulates technological approaches in economic policy planning, affirming the prominent role of AI in promoting economic development. Artificial intelligence also facilitates the processing of massive financial data, verifies accuracy, and provides concise analysis of economic data, supporting the development and implementation of effective economic policies. AI technology can improve the efficiency of economic systems by making them more technologically advanced, which can benefit national economic development and also contribute to achieving sustainable economic growth (Wang & Li, 2023). The intersection of technology, energy transition, and economic sectors is increasingly attracting attention (Vu & Hartley, 2021). Among technological advancements, artificial intelligence (AI) plays a key role, bringing new insights and higher operational efficiency to many industries, including tourism (H. M. W. Rasheed et al., 2024). Artificial intelligence (AI), as a disruptive technology, plays a crucial role in integrating with broader economic and environmental transformations to impact sustainable tourism growth. The synergistic effect between AI applications and key economic indicators shows how they enhance efficiency, resilience, and economic development (Siddik et al., 2025). AI can play a significant role in boosting production.

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As a broad field of advanced technology, studying the complex aspects of machine intelligence and the development of intelligent machines (Sarker, 2022), AI can be defined as "systems that exhibit intellectual capacity through careful consideration of their surroundings and take subsequent actions, with a certain degree of autonomy, to accomplish predetermined goals." It has the potential to make a significant contribution to achieving future goals related to renewable energy (Hannan et al., 2021). AI can efficiently manage the components of hybrid systems to ensure energy demand is met cost-effectively (Zahraee, 2016). Artificial intelligence (AI), with its rapid advancements in recent years, has the potential to transform industries, society, and the economy. AI encompasses a range of technologies and applications that mimic human intelligence and perform tasks automatically. Its potential benefits in areas such as automation, data analytics, and decision-making make it a powerful tool for enhancing productivity, efficiency, innovation, and human well-being (Saba & Pretorius, 2024). Technology has brought many opportunities for economic development, promoting the modernization of the world economy and Vietnam (Long, 2023) . One of the solutions is innovation and the application of technology, which has increased our labor productivity by an average of 5.88% (Thang, 2025). Moving towards a new stage of economic development, Vietnam needs to focus on investing in technology and artificial intelligence to achieve its economic goals. The development of science and technology and innovation is a trend and a crucial element in the modern economic growth model. In reality, many difficulties and challenges still exist in the development and application of science and technology in many countries, especially in developing countries like Vietnam (Vo Thanh Danh, 2022). Therefore, it is necessary to consider the impact of investing capital in science and technology and artificial intelligence on economic growth and, from there, make recommendations for Vietnam.

2. Research Overview

The asymmetric impact of artificial intelligence shows an upward trend for the positive component and a downward trend for the negative component. Additionally, interest rates and inflation have been found to have a negative impact on economic growth in both the short and long term. Trade openness and government spending show adverse short-term but positive long-term impacts (Wang & Li, 2023).

As a key driver of the Fourth Industrial Revolution, artificial intelligence (AI) is now widely used in many economic and social sectors. AI has progressively evolved into a new engine for green technological progress, opening new avenues for green economic growth. The core AI industry witnessed phenomenal growth in 2021, exceeding the 2019 figure by more than six times. Simultaneously, global venture capital investment in AI surged from under 5% in 2013 to approximately 20% in 2021, solidifying its position as the second-largest investment sector globally (Lee et al., 2024).

The integration of artificial intelligence (AI) into the fundamental structure of society is creating a transformative process with the potential to profoundly impact many aspects of human life, including environmental quality. Country-specific studies have shown that Austria, Germany, and New Zealand are examples of countries where both positive and negative AI changes significantly improve the clean energy structure in the short term. Natural resources, information and communication technology, and economic growth also drive renewable energy production. Ultimately, policies are geared towards increasing renewable energy production (MQ Rasheed et al., 2024).

The impact of AI investment on employment and economic growth from 2012 to 2022 is significant, taking into account the regulatory role of overall governance as well as specific governance indicators such as political governance, institutional governance, and economic governance. Prioritizing and enhancing the integration of artificial intelligence (AI) into their governance systems is crucial to promoting employment and stimulating growth in both the short and long term (Saba & Ngepah, 2024).

Traditional factors of production such as physical capital and labor may no longer be the primary drivers of growth. The prevailing belief is that AI will play a key role in future employment and growth, and unlike conventional machines that replace human and animal labor

for specific tasks, AI input has the potential to fundamentally transform the nature of work. Artificial intelligence (AI) is widely regarded as a key factor for future growth (Lu, 2021). Research and development plays a vital role in economic growth. The potential of AI to replace workers to some extent could contribute to future growth (Fernald & Jones, 2014).

3. Data and research methods

3.1 Research Data

The research model collected data from 2012-2024 from 10 countries and economic regions representing the continent that have made significant investments in technology and artificial intelligence: the US, China, the EU, the UK, Germany, India, Canada, Israel, Sweden, and South Korea.

Table 1: Data description

Content	Index	Unit of measurement	Source
lnGDP	GDP per capita (calculated at 2015 prices)	USD/person	WDI - World Development Indicators
lnVCI	Venture capital investment in artificial intelligence	Million USD	OECD - Organization for Economic Co-operation and Development
lnGE	The effectiveness of government administration		OECD - Organization for Economic Co-operation and Development
lnFDI	Foreign direct investment	Million USD	OECD - Organization for Economic Co-operation and Development
lnTech	Exporting high-tech products	Million USD	WDI - World Development Indicators
lnLa	workforce	Millions of people	WDI - World Development Indicators

Proposed research model:

Proceed to describe the observed variables as follows:

Table 2: Descriptive statistics of variables

Planet	Obs	Mean	Std.	dev.	Min
lnGDP	130	10.18704	1.027722	7.19526	11.1077
lnVCI	130	7.386704	2.247975	-.3566749	11.67289
lnGE	126	.0245156	.7581483	-4.175483	.6476453
lnFDI	126	4.042561	1.377022	.3972667	6.745386
lnTech	130	4.521353	1.396477	2.44809	6.842037
lnLa	130	4.015828	1.710693	1.310972	6.660816

3.2. Research Results

Table 3 shows that the correlation coefficients between the independent variables are below 0.7. Therefore, there is no serious multicollinearity problem and the model's estimation results are not significantly affected.

Table 3: Correlation coefficient matrix between independent variables

	lnVCI	lnGE	lnFDI	lnTech	lnLa
lnVCI	1.0000				
lnGE	-0.0501	1.0000			
lnFDI	0.6091	-0.1433	1.0000		
lnTech	0.4301	-0.0935	0.6183	1.0000	
lnLa	0.4884	-0.6101	0.6412	0.6682	1.0000

Table 4 presents the results regarding multicollinearity. We can see that lnVCI has a VIF coefficient of 5.46, the highest among the variables, indicating a moderate degree of multicollinearity. Meanwhile, TC1 has the lowest VIF coefficient of 1.73, indicating negligible multicollinearity. The average VIF coefficient across all variables is 2.95, indicating that, on average, the variables exhibit low to moderate levels of multicollinearity. If the VIF value is less than 10, multicollinearity is considered acceptable. Therefore, there are no serious multicollinearity issues in the model.

Table 4: Multicollinearity

Planet	VIF	1/VIF
lnVCI	5.46	0.183232
lnGE	2.61	0.383762
lnFDI	2.57	0.388840
lnTech	2.39	0.418782
lnLa	1.73	0.578027
Mean VIF	2.95	

Table 5: Testing for differences between FEM and REM

	(b) fixed	(B) random	(bB) Difference	sqrt(diag(V_b-V_B)) Std. err.
lnVCI	.0213089	.0289633	-.0076544	.0097036
lnGE	.0676691	.1506817	-.0830126	.0223844
lnFDI	-.0148374	.068355	-.0831924	.0108264
lnTech	.1659803	.4150106	-.2490303	.1378329
lnLa	.1083908	-.5961705	.7045613	.7017908

b = Consistent under H0 and Ha; obtained from xtreg.

B = Inconsistent under Ha, efficient under H0; obtained from xtreg.

Test of H0: Difference in coefficients not systematic

chi2(5) = (bB)'[(V_b-V_B)^(-1)](bB)

= 107.14

Prob > chi2 = 0.0000

Since the p-value > 0.05, we conclude that there is no statistically significant difference between FEM and REM. This result also shows that the uit errors are not correlated with the independent variables in the model, and using a random effects model would be more effective.

Testing for heteroskedasticity across entities in REM (Lagrange multiplier test)

Breusch and Pagan Lagrangian multiplier test for random effects

lnGDP[COU,t] = Xb + u[COU] + e[COU,t]

Estimated results:

| Var SD = sqrt(Var)

---------+----------

lnGDP | .8830502 .9397075

e | .0026191 .0511776

u | .0012653 .0355713

Test: Var(u) = 0

chibar2(01) = 157.63

Prob > chibar2 = 0.0000

Conclusion: p-value < 0.05 ➔ choosing Ho, meaning there is heteroskedasticity across entities.

Testing for heteroskedasticity across entities in FEM (Wald test).

Modified Wald test for groupwise heteroskedasticity in fixed effect regression model

H0: sigma(i)^2 = sigma^2 for all i

chi2 (10) = 515.09

Prob > chi2 = 0.0000

The p-value <0.05, therefore rejecting Ho means there is heteroskedasticity in the FEM model.

Using the Robust Standard Errors and GLS estimation. To address heteroskedasticity (the condition of constantly changing error variance), the following estimation results were obtained:

Table 6: OLS, FEM, and REM Estimates

	OLS	FEM	REM
lnVCI	0.041**	0.021***	0.029***
	(0.018)	(0.004)	(0.011)
lnGE	0.484***	0.068***	0.151***
	(0.064)	(0.013)	(0.042)
lnFDI	0.191***	0.015**	0.068***
	(0.034)	(0.007)	(0.023)
lnTech	0.282***	0.166***	0.415***
	(0.036)	(0.041)	(0.042)
lnLa	-0.494***	0.108	-0.596***
	(0.043)	(0.199)	(0.040)
_cons	9.835***	8.966***	10.225***
	(0.125)	(0.667)	(0.149)
N	122	122	122
adj. R-sq	0.871	0.652	
Breusch and Pagan Lagrangian			0.000
Hausman test		0.000	
Wald test		0.000	
Standard errors in parentheses			
** p<0.1 ** p<0.05 *** p<0.01*			

The Hausman test selects FEM and Rem. Since the result Prob>chi2 = 0.000 < α = 0.05, we reject H0 and conclude that the model chosen in this study is the FEM model. Economic growth in the studied countries is related to venture capital investment in artificial intelligence, government governance efficiency, foreign direct investment, high-tech exports, and the workforce. All variables have a positive impact on economic growth. In particular, the two variables studied, technology investment and investment in artificial intelligence, both have a significant positive impact on economic growth (Lee et al., 2024). (Kalai et al., 2024) . In particular, technology exports are having the strongest positive impact on major economies around the world. Venture capital investment in AI is in its early stages but has already had a very significant impact on their economic growth.

4. Conclusion and some recommendations

The role of technology, digitalization, and AI in the economies of countries around the world has been proven in many nations. Especially after the Covid-19 pandemic, economies are shifting towards digitizing many aspects of management and production processes, leading to increased productivity and a significant reduction in manual labor. The results from the regression model show that technology and investment in AI have a positive impact and make a major contribution to economic growth in a country. Based on these research findings, the authors suggest the following recommendations:

Firstly, Resolution 57-NQ/TW on breakthroughs in national science, technology, innovation, and digital transformation needs to be further promoted in all areas, from the economy and society to the environment. The government, businesses, and schools should take the lead in investing in and applying technology in their daily operations. Investment in technology could include: purchasing application licenses, implementing courses on digital skills and digital transformation for employees to participate in.

The government continues to remove institutional, mechanism, and policy bottlenecks to ensure the science and technology market develops synchronously, efficiently, modernly, and integratedly. As a result, businesses continue to trust and implement policy decisions.

Developing a synchronized national technology infrastructure will serve as a basis for connecting provinces, localities, businesses, and schools across the country.

Establish national technology exchange platforms in major cities or economic regions to both connect the domestic technology network and expand into global technology connectivity.

Secondly, besides investing in technology, other resources such as government governance efficiency also need attention. Currently, government governance efficiency is a key factor in ranking and evaluating government capabilities and attracting investment. However, government governance efficiency is also reflected in investment in digital technology. The terms "digital government" and "digital administration" highlight the strong role of technology in promoting government governance efficiency.

Third, promote international cooperation and attract investment: Vietnam should proactively seek opportunities for cooperation with leading AI centers worldwide to learn, transfer technology, and attract investment capital. Create a favorable policy and mechanism environment for AI startups, especially in areas that attract global AI investment.

Ultimately, the workforce, in any circumstance or stage, always has a significant impact on the economic growth of nations. In the era of globalization and the new era of national development, the quality of the workforce must be improved. With the population growth rate slowing and the country entering a period of population aging, the abundant labor force of previous decades is no longer an advantage in this current phase. Entrepreneurship and innovation among workers need to be strongly encouraged . The workforce needs to enhance its digital capabilities and social responsibility. The continuous growth of global AI scientific publications demonstrates the importance of research and training. Vietnam needs to invest in education, training, and attracting AI talent to meet the demands of this technology's development. Therefore, investing in technology can also be considered an investment in the digital capabilities of the workforce, enhancing their digital thinking and operational skills in work and life.

Science and technology are decisive factors in the development of nations; they are prerequisites and the best opportunities for our country to develop and prosper. Investing in technology requires a significant amount of capital, but its effectiveness has been proven. Therefore, institutions should pave the way for science and technology and innovation. When the legal framework is streamlined, ministries, sectors, and localities will have the basis to rapidly implement science and technology in the coming period.

References:

Fernald, J. G., & Jones, C. I. (2014). The Future of US Economic Growth. American Economic Review, 104(5), 44–49. https://doi.org/10.1257/aer.104.5.44

Hannan, M. A., Al-Shetwi, A. Q., Ker, P. J., Begum, R. A., Mansor, M., Rahman, S. A., Dong, Z. Y., Tiong, S. K., Mahlia, T. M. I., & Muttaqi, K. M. (2021). Impact of renewable energy utilization and artificial intelligence in achieving sustainable development goals. Energy Reports, 7, 5359–5373. https://doi.org/https://doi.org/10.1016/j.egyr.2021.08.172

Kalai, M., Becha, H., & Helali, K. (2024). Effect of artificial intelligence on economic growth in European countries: a symmetric and asymmetric cointegration based on linear and non-linear ARDL approach. Journal of Economic Structures, 13(1), 22. https://doi.org/10.1186/s40008-024-00345-y

Lee, C.-C., Xuan, C., & Wang, F. (2024). Natural resources and green economic growth: The role of artificial intelligence. Resources Policy, 98, 105322. https://doi.org/https://doi.org/10.1016/j.resourpol.2024.105322

Long, B. T. (2023). Phân tích vai trò và đóng góp của tri thức khoa học công nghệ trong phát triển kinh tế ở Việt Nam hiện nay. Quản Lý Nhà Nước. https://www.quanlynhanuoc.vn/2023/10/24/phan-tich-vai-tro-va-dong-gop-cua-tri-thuc-khoa-hoc-cong-nghe-trong-phat-trien-kinh-te-o-viet-nam-hien-nay/

Lu, C.-H. (2021). The impact of artificial intelligence on economic growth and welfare. Journal of Macroeconomics, 69, 103342. https://doi.org/https://doi.org/10.1016/j.jmacro.2021.103342

Maksanova, L., Bardakhanova, T., Lubsanova, N., Budaeva, D., & Tulokhonov, A. (2021). Assessment of losses to the local population due to restrictions on their ownership rights to land and property assets: The case of the Tunkinsky National Park, Russia. In PLoS ONE (Vol. 16, Issue 5 May 2021). https://doi.org/10.1371/journal.pone.0251383

Rasheed, H. M. W., Yuanqiong, H., Khizar, H. M. U., & Khalid, J. (2024). What drives the adoption of artificial intelligence among consumers in the hospitality sector: a systematic literature review and future agenda. Journal of Hospitality and Tourism Technology, 15(2), 211–231. https://doi.org/10.1108/JHTT-02-2022-0045

Rasheed, M. Q., Yuhuan, Z., Ahmed, Z., Haseeb, A., & Saud, S. (2024). Information communication technology, economic growth, natural resources, and renewable energy production: Evaluating the asymmetric and symmetric impacts of artificial intelligence in robotics and innovative economies. Journal of Cleaner Production, 447, 141466. https://doi.org/https://doi.org/10.1016/j.jclepro.2024.141466

Saba, C. S., & Ngepah, N. (2024). The impact of artificial intelligence (AI) on employment and economic growth in BRICS: Does the moderating role of governance Matter? Research in Globalization, 8, 100213. https://doi.org/https://doi.org/10.1016/j.resglo.2024.100213

Saba, C. S., & Pretorius, M. (2024). The impact of artificial intelligence (AI) investment on human well-being in G-7 countries: Does the moderating role of governance matter? Sustainable Futures, 7, 100156. https://doi.org/https://doi.org/10.1016/j.sftr.2024.100156

Sarker, I. H. (2022). AI-Based Modeling: Techniques, Applications and Research Issues Towards Automation, Intelligent and Smart Systems. SN Computer Science, 3(2), 158. https://doi.org/10.1007/s42979-022-01043-x

Siddik, A. B., Forid, M. S., Yong, L., Du, A. M., & Goodell, J. W. (2025). Artificial intelligence as a catalyst for sustainable tourism growth and economic cycles. Technological Forecasting and Social Change, 210, 123875. https://doi.org/https://doi.org/10.1016/j.techfore.2024.123875

Thắng, C. (2025). Khai thác động lực tăng trưởng từ năng suất lao động. https://www.qdnd.vn/bao-xuan-at-ty-2025/khai-thac-dong-luc-tang-truong-tu-nang-suat-lao-dong-813398

Võ Thành Danh., và cộng sự. (2022). Khoa học-công nghệ và tăng trưởng kinh tế: bài học quốc tế và trường hợp Việt Nam. https://sdmd2045.ctu.edu.vn/van-de-noi-bat/kinh-te-xa-hoi/99-khoa-hoc-cong-nghe-va-tang-truong-kinh-te-bai-hoc-quoc-te-va-truong-hop-viet-nam

Vu, Khuong, & Hartley, Kris. (2021). Drivers of Growth and Catch-up in the Tourism Sector of Industrialized Economies. Journal of Travel Research, 61(5), 1156–1172. https://doi.org/10.1177/00472875211019478

Wang, Y., & Li, Y. (2023). Chinese economic growth and sustainable development: Role of artificial intelligence and natural resource management. Resources Policy, 85, 103996. https://doi.org/https://doi.org/10.1016/j.resourpol.2023.103996

Zahraee, S. M. (2016). A survey on lean manufacturing implementation in a selected manufacturing industry in Iran. International Journal of Lean Six Sigma, 7(2), 136–148. https://doi.org/10.1108/IJLSS-03-2015-0010