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IMPACT OF ARTIFICIAL INTELLIGENCE ON ECONOMIC GROWTH: EVIDENCE FROM EMERGING ECONOMIES

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Abstract
Artificial Intelligence (AI) has emerged as a transformative general-purpose technology with significant implications for productivity, innovation, employment and economic growth. While advanced economies have traditionally dominated AI investment and infrastructure, emerging economies are increasingly adopting AI across manufacturing, financial services, agriculture, healthcare, information technology and public administration. The present study examines the relationship between AI adoption and economic growth in emerging economies, with particular emphasis on the channels of productivity, technological innovation, human capital and digital infrastructure. A quantitative panel-data framework is proposed using GDP growth as the dependent variable and AI adoption, AI investment, digital infrastructure, human capital and research and development expenditure as explanatory variables. The study proposes descriptive statistics, correlation analysis and panel regression to evaluate the relationship between AI and economic growth. The illustrative regression results indicate a positive association between AI adoption and economic growth, while digital infrastructure, human capital and R&D capacity appear to strengthen the growth-enhancing effects of AI. The study argues that AI does not automatically generate inclusive economic growth; rather, its benefits depend upon complementary investments in skills, digital infrastructure, innovation ecosystems and appropriate regulatory institutions. The findings have important implications for emerging economies seeking to use AI as an instrument for productivity enhancement and sustainable economic development.

Keywords: Artificial Intelligence, Economic Growth, Emerging Economies, AI Adoption, Productivity, Human Capital, Digital Infrastructure, Innovation

1. Introduction

Artificial Intelligence has moved from being primarily a technological research domain to becoming an increasingly important component of economic activity (Chaar et al., 2025; Filippucci et al., 2025). Advances in machine learning, generative AI, robotics, natural language processing and automated decision-making are transforming how firms produce goods and services, allocate resources and interact with consumers (Acemoglu, 2024; Filippucci et al., 2024a; Filippucci et al., 2024b).

The economic significance of AI arises from its ability to perform or augment cognitive tasks, improve decision-making, reduce transaction costs, automate routine activities and facilitate innovation. Consequently, AI may influence economic growth through several channels, including labour productivity, capital productivity, technological innovation, creation of new products and services, and improvements in resource allocation (Trammell & Korinek, 2023; Brynjolfsson et al., 2021).

The OECD identifies AI as a potential general-purpose technology capable of affecting productivity, long-term growth and social welfare, while simultaneously highlighting concerns relating to unequal adoption, market concentration, employment displacement and inequality. (OECD)

The scale of AI-related economic activity has increased substantially. The Stanford AI Index reported that organizational AI use increased from 55% in 2023 to 78% in 2024, while global corporate AI investment reached $252.3 billion in 2024. The report also identifies evidence of productivity improvements associated with AI adoption. (Stanford HAI)

The importance of AI for emerging economies is particularly significant. These economies often face constraints involving low productivity, inadequate infrastructure, skill shortages and limited research capacity (Acemoglu & Restrepo, 2019; Agrawal et al., 2019; Aghion et al., 2019). AI may help overcome some of these constraints by allowing firms and governments to access advanced analytical and decision-support capabilities without requiring the same accumulation of traditional physical capital (Bessen, 2019).

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However, the impact of AI is unlikely to be uniform across emerging economies. Countries with better digital infrastructure, skilled labour, stronger institutions and greater innovation capacity may capture substantially more benefits than economies with limited technological preparedness. The International Monetary Fund's AI preparedness framework evaluates economies according to dimensions including digital infrastructure, human capital, labour-market policies, innovation and regulation (Acemoglu & Restrepo, 2018a; Acemoglu & Restrepo, 2018b; Aghion et al., 2017). Its analysis indicates that the effects of AI will vary considerably across economies. (IMF)

India provides an important example of this transformation. OECD evidence indicates that India's AI market increased from approximately US$3.2 billion in 2020 to US$6.1 billion in 2024, with increasing adoption in IT services, financial technology, manufacturing and agriculture. (OECD)

Against this background, the present study examines the relationship between AI and economic growth in emerging economies.

2. Background of the Study

AI can influence economic growth through four major mechanisms.

2.1 Productivity channel

AI can automate repetitive tasks, improve forecasting, reduce errors and assist employees in complex decision-making. Increased output from a given quantity of labour and capital translates into higher productivity.

2.2 Innovation channel

AI can accelerate research and development, product design, process innovation and technological diffusion. Firms can use AI to identify consumer preferences, optimize production processes and develop new products.

2.3 Human-capital channel

AI may complement skilled workers and increase their productivity. However, it can also reduce demand for certain routine skills. Therefore, education and reskilling become important complements to AI adoption.

2.4 Investment and infrastructure channel

AI adoption requires complementary infrastructure such as broadband connectivity, cloud computing, data centres, computing capacity and cybersecurity. Economies with inadequate digital infrastructure may therefore experience weaker economic benefits.

The OECD's recent work estimates that AI could contribute approximately 0.25–0.60 percentage points to annual total-factor productivity growth, with potential labour-productivity gains of approximately 0.4–0.9 percentage points, although the eventual magnitude remains uncertain. (OECD)

3. Review of Literature

3.1 AI and productivity

The relationship between AI and productivity has become a major research area in economics. AI can increase productivity by substituting for certain tasks while complementing human capabilities in others.

Recent evidence summarized by Stanford's AI Index suggests that AI is already producing measurable productivity benefits in several business functions. However, the magnitude of gains varies considerably across occupations, firms and applications. (Stanford HAI)

The OECD similarly argues that AI's impact depends on adoption rates, exposure of economic activities to AI and the availability of complementary inputs. (OECD)

3.2 AI and economic growth

Economic growth can be influenced by technological progress through improvements in total factor productivity. AI has characteristics associated with a general-purpose technology because it can potentially be deployed across multiple sectors.

Nevertheless, technological adoption does not automatically result in immediate aggregate productivity growth. Firms may need to redesign organizational processes, retrain workers and invest in complementary infrastructure before AI produces measurable economic gains.

3.3 AI and emerging economies

Emerging economies present a particularly interesting research environment because AI can simultaneously create opportunities and risks.

On the positive side, AI may enable developing countries to leapfrog certain stages of technological development. On the negative side, countries with inadequate infrastructure and human capital may experience slower adoption and become dependent on foreign technologies.

The IMF estimates that approximately 24% of jobs in emerging economies may be exposed to AI, compared with 33% in advanced economies and 18% in low-income economies. (IMF)

3.4 Research gap

Existing literature has extensively examined AI productivity effects at the firm and occupational levels. However, several gaps remain:

1. Limited comparative evidence exists for emerging economies.
2. AI adoption indicators are relatively new and remain difficult to standardize.
3. The interaction between AI, human capital and digital infrastructure requires further investigation.
4. The aggregate relationship between AI adoption and GDP growth remains uncertain.
5. Most AI research focuses on advanced economies.
6. The possibility of unequal AI-driven growth across emerging economies requires greater attention.

The present study addresses these gaps through a proposed cross-country panel framework.

4. Research Objectives

The study has the following objectives:

1. To examine the relationship between AI adoption and economic growth in emerging economies.
2. To analyse the effect of AI investment on economic growth.
3. To examine whether digital infrastructure facilitates AI-driven economic growth.
4. To investigate the role of human capital in enhancing the economic benefits of AI.
5. To examine the contribution of R&D expenditure to AI-enabled economic growth.
6. To provide policy recommendations for promoting inclusive AI-led economic development.

5. Research Hypotheses

H1: AI adoption has a significant positive impact on economic growth in emerging economies.
H2: AI-related investment has a significant positive impact on economic growth.
H3: Digital infrastructure has a significant positive impact on economic growth.
H4: Human capital has a significant positive impact on economic growth.
H5: Research and development expenditure has a significant positive impact on economic growth.
H6: Digital infrastructure strengthens the relationship between AI adoption and economic growth.

6. Conceptual Framework

The proposed framework is:

AI Adoption → Productivity → Innovation → Economic Growth

with:

Digital Infrastructure + Human Capital + R&D + Institutional Quality

acting as complementary factors.

Independent Variables	Mediating/Complementary Mechanisms	Dependent Variable
AI Adoption	Productivity	Economic Growth
AI Investment	Innovation	GDP Growth
Digital Infrastructure	Efficiency	
Human Capital	Skill Formation	
R&D Expenditure	Technological Progress	

7. Research Methodology

7.1 Research design

The study adopts a **quantitative, explanatory research design** based on secondary country-level data.

The preferred research design is a panel dataset covering emerging economies over 2015–2025, subject to data availability.

Possible countries include:

- India
- China
- Brazil
- Mexico
- Indonesia
- Türkiye
- South Africa
- Thailand
- Malaysia
- Philippines
- Vietnam
- Colombia
- Argentina
- Egypt

The final country selection should follow the classification adopted by the selected data source.

8. Variables and Measurement

Variable	Symbol	Measurement
Economic Growth	GDPG	Annual GDP growth (%)
AI Adoption	AI	AI adoption/readiness index
AI Investment	AINV	AI-related investment as % GDP or logarithm of AI investment
Digital Infrastructure	DIG	Internet/broadband/digital infrastructure index
Human Capital	HC	Human capital index/education indicator
R&D Expenditure	RD	R&D expenditure as % of GDP
Foreign Direct Investment	FDI	FDI inflows as % GDP
Trade Openness	TO	Exports + imports as % GDP

The IMF's AI preparedness framework can provide a useful basis for measuring AI readiness, while Stanford's AI Economic Indicators provide increasingly updated measures of AI usage and economic outcomes. (IMF)

9. Data Analysis and Results

Table 1: Descriptive Statistics

Variable	Mean	Std. Dev.	Minimum	Maximum
GDP Growth	4.21	2.38	-6.20	9.14
AI Adoption	0.48	0.19	0.14	0.86
AI Investment	1.31	1.08	0.12	5.62
Digital Infrastructure	0.61	0.17	0.25	0.91
Human Capital	0.56	0.13	0.31	0.79
R&D Expenditure	1.21	0.84	0.15	3.85
FDI	3.48	2.76	-1.02	12.42
Trade Openness	78.35	31.27	25.18	166.42

Interpretation

The illustrative results show an average GDP growth rate of 4.21%, indicating relatively strong growth among the selected emerging economies. AI adoption has a mean value of 0.48, suggesting considerable variation in technological readiness.

The standard deviation of AI investment indicates substantial differences in investment intensity across countries. Similarly, digital infrastructure and human capital display meaningful cross-country variation.

Such variation is important because it allows the econometric model to identify whether differences in AI readiness are associated with differences in economic growth.

10. Correlation Analysis

Table 2: Correlation Matrix

Variables	GDPG	AI	AINV	DIG	HC	RD
GDPG	1.000					
AI	.421**	1.000				
AINV	.386**	.612**	1.000			
DIG	.358**	.704**	.581**	1.000		
HC	.329**	.651**	.463**	.622**	1.000	
RD	.291**	.578**	.542**	.493**	.517**	1.000

Note: p < 0.01

Interpretation

The correlation matrix indicates a positive relationship between AI adoption and GDP growth (r = 0.421). AI investment also demonstrates a positive association with economic growth (r = 0.386).

Digital infrastructure exhibits a relatively strong correlation with AI adoption (r = 0.704), indicating that countries with better digital infrastructure tend to have greater AI readiness.

11. Multicollinearity Analysis

Table 3: Variance Inflation Factor

Variable	VIF
AI Adoption	2.84
AI Investment	2.41
Digital Infrastructure	2.97
Human Capital	2.38
R&D	1.92
FDI	1.31
Trade Openness	1.48
Mean VIF	**2.19**

Interpretation

The illustrative VIF values are below the commonly used threshold of 5, indicating that serious multicollinearity is not evident.

12. Panel Regression Results

Table 4: Fixed-Effects Regression

Dependent Variable: GDP Growth

Variable	Coefficient	Std. Error	t-value	p-value
Constant	1.274	0.682	1.868	.064
AI Adoption	**1.842**	0.521	3.535	**.001**
AI Investment	**0.417**	0.176	2.369	**.019**
Digital Infrastructure	**1.216**	0.482	2.522	**.013**
Human Capital	**1.734**	0.637	2.722	**.008**
R&D Expenditure	**0.528**	0.214	2.467	**.015**
FDI	0.083	0.041	2.024	.046
Trade Openness	0.011	0.006	1.833	.069

R^2 = 0.61

Adjusted R^2 = 0.56

F-statistic p-value < 0.001

Interpretation

The regression results indicate that AI adoption has a positive and statistically significant relationship with economic growth.

The coefficient of AI adoption is 1.842, suggesting that, holding other variables constant, a one-unit increase in the AI adoption index is associated with an estimated 1.842 percentage-point increase in GDP growth. This supports H1 in the illustrative model.

AI investment is also positive and statistically significant, supporting H2.

Digital infrastructure demonstrates a significant positive relationship with GDP growth. This finding highlights the importance of complementary infrastructure for translating AI capability into economic outcomes.

Human capital has a positive coefficient of 1.734 and is statistically significant, suggesting that economies with stronger human-capital foundations may be better positioned to capture AI-related productivity benefits.

R&D expenditure is also positively associated with GDP growth.

13. Random-Effects Model

Table 5: Random-Effects Regression

Variable	Coefficient	Std. Error	p-value
AI Adoption	1.613	0.493	.002
AI Investment	0.391	0.171	.023
Digital Infrastructure	1.083	0.461	.019
Human Capital	1.526	0.614	.014
R&D	0.476	0.208	.024
FDI	0.079	0.039	.044
Trade Openness	0.010	0.006	.091

Overall $R^2 = 0.58$

The random-effects results show a broadly similar direction and significance pattern to the fixed-effects estimates.

14. Hausman Test

Table 6: Hausman Specification Test

Test	Chi-square	df	p-value
Hausman Test	18.72	7	**0.009**

Interpretation

The Hausman test produces a statistically significant result ($p = 0.009$). Therefore, the fixed-effects model would be preferred over the random-effects model.

This suggests that unobserved country-specific characteristics may be correlated with the explanatory variables.

15. Moderating Effect of Digital Infrastructure

To examine H6, an interaction term can be introduced:

Table 7: Moderating Effect

Variable	Coefficient	p-value
AI Adoption	1.214	.018
Digital Infrastructure	0.982	.031
AI × Digital Infrastructure	**0.736**	**.007**
Human Capital	1.403	.012
R&D	0.431	.027
FDI	0.072	.048
Trade Openness	0.009	.103

Interpretation

The interaction between AI adoption and digital infrastructure is positive and statistically significant in the illustrative model.

This indicates that the economic benefits associated with AI adoption may be stronger in economies with better digital infrastructure.

In other words:

AI capability alone may not be sufficient to generate strong economic growth; countries need the infrastructure required to deploy AI at scale.

16. Hypothesis Testing

Table 8: Summary of Hypotheses

Hypothesis	Statement	Illustrative Result	Decision
H1	AI adoption positively affects economic growth	Significant positive	Supported
H2	AI investment positively affects economic growth	Significant positive	Supported
H3	Digital infrastructure positively affects economic growth	Significant positive	Supported
H4	Human capital positively affects economic growth	Significant positive	Supported
H5	R&D expenditure positively affects economic growth	Significant positive	Supported
H6	Digital infrastructure strengthens AI-growth relationship	Significant positive interaction	Supported

Again, these decisions are **illustrative**, based on the simulated coefficients.

17. Discussion

The analysis suggests a theoretically plausible positive relationship between AI adoption and economic growth. The finding is consistent with the argument that AI can operate as a general-purpose technology by improving productivity and facilitating innovation.

The relationship is particularly important for emerging economies because AI may allow countries to overcome certain limitations associated with traditional development pathways. For example, AI-powered agricultural systems can improve crop forecasting, financial technologies can improve credit assessment and inclusion, and intelligent manufacturing can increase production efficiency.

However, the benefits of AI are not automatic.

The significant role of digital infrastructure suggests that AI adoption requires an underlying technological ecosystem. Broadband connectivity, cloud infrastructure, data centres, cybersecurity and computing capacity are important complements.

Similarly, the positive relationship between human capital and economic growth highlights the importance of education and skills. AI can complement workers, but workers require the ability to use, supervise and critically evaluate AI systems.

This is particularly relevant because AI can also generate labour-market disruption. The IMF estimates that AI exposure is substantial even in emerging economies, although the nature of exposure differs from advanced economies. (IMF)

The findings therefore support a **complementarity perspective** rather than a purely substitution-based perspective of AI.

18. AI and Inclusive Economic Growth

Economic growth generated by AI should not be evaluated only through GDP.

A country may experience productivity gains while simultaneously experiencing:

- employment displacement;
- wage inequality;
- concentration of technology ownership;
- regional disparities;
- digital exclusion;
- increased dependence on foreign AI platforms.

Therefore, AI policy should pursue **inclusive AI-led growth**.

A useful framework is:

AI Adoption → Productivity → Innovation → GDP Growth

supported by:

Human Capital + Digital Infrastructure + R&D + Institutional Quality

and constrained by:

Inequality + Job Displacement + Digital Divide + Market Concentration

19. Policy Implications

19.1 Investment in digital infrastructure

Emerging economies should prioritize affordable broadband, cloud computing, data centres and digital public infrastructure.

19.2 Human-capital development

Governments should integrate AI literacy, data analytics and digital skills into higher education and vocational training.

19.3 AI-focused R&D

Public and private R&D investment should be encouraged to develop locally relevant AI applications in agriculture, healthcare, manufacturing and financial services.

19.4 Support for SMEs

AI adoption should not remain concentrated among large corporations. Financial incentives, shared computing infrastructure and technical support can help SMEs adopt AI.

This is an important research and policy gap because recent scholarship notes that evidence on AI's longer-term effects on SMEs remains relatively limited. (Stanford Digital Economy Lab)

19.5 Responsible AI governance

Emerging economies need regulatory frameworks addressing:

- data protection;
- algorithmic accountability;
- cybersecurity;
- competition;
- intellectual property;
- AI-related employment transitions.

19.6 Reskilling and employment transition

Rather than focusing exclusively on preventing automation, governments should invest in reskilling workers for occupations where AI and human capabilities complement each other.

20. Conclusion

Artificial Intelligence represents one of the most significant technological developments influencing the future trajectory of economic growth. Its ability to automate tasks, augment human capabilities, improve resource allocation and stimulate innovation creates substantial opportunities for emerging economies.

The proposed empirical framework suggests that AI adoption, AI investment, digital infrastructure, human capital and R&D can be important determinants of economic growth. The illustrative regression results indicate a positive and significant relationship between AI adoption and GDP growth, while the interaction analysis suggests that digital infrastructure can strengthen this relationship.

Nevertheless, AI should not be regarded as an independent engine of economic growth. Its effectiveness depends on complementary investments in skills, infrastructure, institutions and innovation. The latest Stanford AI Index evidence shows that AI adoption is expanding rapidly, with 88% of surveyed organizations reporting AI use in at least one business function in 2025, but adoption remains uneven across economies. (Stanford HAI)

For emerging economies, therefore, the central policy question is not simply whether to adopt AI, but how to build the economic ecosystem necessary to convert AI adoption into productive, inclusive and sustainable growth.

21. Limitations of the Study

The proposed study has several limitations.

1. First, measuring AI adoption at the country level is challenging because AI is a multidimensional technology.
2. Second, GDP growth is influenced by numerous macroeconomic factors, making it difficult to isolate the independent effect of AI.
3. Third, reverse causality may exist because economically advanced countries may have greater resources to invest in AI.
4. Fourth, AI adoption data are relatively recent, resulting in limited time-series observations.

5. Finally, the quantitative analysis should be complemented by firm-level and sector-level studies.

22. Suggestions for Future Research

Future research could:

1. Develop a country-level **AI Economic Growth Index**.
2. Examine sector-specific effects of AI.
3. Compare high-income and lower-income emerging economies.
4. Investigate AI's impact on employment and wages.
5. Examine the role of AI in reducing or increasing income inequality.
6. Study AI adoption among SMEs.
7. Examine AI and green economic growth.
8. Apply **dynamic panel GMM** to address endogeneity.
9. Use **Structural Equation Modelling (SEM)** to examine productivity and innovation as mediators.
10. Apply **TISM/M-TISM** to identify hierarchical drivers of AI-led economic growth.

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