Evaluating the Role of Artificial Intelligence Government Readiness in Economic Growth: An Empirical Cobb-Douglas Analysis for Developing Countries

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Abstract:

Artificial Intelligence (AI) techniques have been deployed by different sectors of the economy worldwide. These techniques are integrated in the operation of different manufactures, industries, and services which raises the need for a well-developed AI ecosystem that allows the economy to reap the benefits of these technologies. The role of the government is crucial in terms of the degree of readiness to enhance the AI implementation through processing automation in the public services which improves the efficiency and fairness of the delivery of these services. This in turn is reflected in both the economic and social aspects such as attracting more investments, higher productivity, raising the citizens' standards of living, robust the regulatory framework, providing better educational and healthcare services, and stimulating economic growth. The research examines the impact of the AI government readiness on

economic growth through the Cobb-Douglas production function by conducting a panel multiple regression model for 115 developing countries from 2020-2023. The results of the study reveal that AI government readiness has a positive and significant impact on economic growth in developing countries.

Keywords: Artificial Intelligence Readiness, Economic Growth, Developing Countries.

1. Introduction

The development of Information and Communication Technologies (ICT) in the last few decades, which is followed by the emergence of AI has introduced structural changes in different economic sectors. AI is considered one of the key technologies that emerged with the fourth industrial revolution. AI is defined as "*the ability of the software systems to carry out tasks that usually require human intelligence: vision, speech, language, knowledge, and search."* (World Bank, 2020)

The introduction of big data, robotics, the Internet of Things, blockchain technologies, 3D printing, Chatbots, and cloud computing has transformed the operations of various economic sectors. These technological innovations are affecting the productivity and economic growth in different countries of the world. However, not all countries will take the same advantage and reap the benefits of these technological advancements. This is because benefiting from such changes will be subject to the

level of development of each economy, which would reflect its readiness to implement AI techniques and integrate these technologies into different economic sectors. The obstacles that are still persistent in many developing countries such as the lack of technological infrastructure and the low percentage of technological literacy among citizens, hinder their capabilities to take full advantage of the implementation of AI.

AI can widen the gap between countries, firms, and workers through the uneven distribution of benefits that would be generated from the implementation of AI in different economic sectors. AI can increase the current digital divide among countries, in which those who will lead the AI adoption reap more economic benefits than other countries that are still retarding in the adoption of AI. This will lead to widening the gap between developed and developing countries. Developed countries are trying to heavily implement AI to stimulate productivity to overcome retarding their GDP growth momentum due to the challenge of aging populations. In addition, the wage rates are high in developed countries which increases their incentive to replace labor with high-tech capital to boost productivity. On the contrary, developing countries have low wage rates, which does not create an incentive for these countries to replace labor with capital. They tend to improve their productivity by restructuring their industries rather than depending on AI especially if they do not yet have a suitable

digital infrastructure and digital literacy which are two key drivers for the success of AI adoption (International Telecommunication Union Report, 2018).

Many governments have started to find different ways to leverage AI to improve the efficiency and quality of services provided to citizens, in addition to reducing fraud and corruption. Due to the expansion of AI adoption across different business entities, public institutions, and economic sectors, AI is expected to contribute to boosting the global economic output by around USD 13 trillion by 2030 and the global GDP by 1.2% annually (Bughin et al., 2018). However, the rate of AI adoption varies between developed and developing countries, as many developing countries are not fully ready to integrate AI in various economic sectors and are not yet at the top of the AI readiness index. To reduce these disparities, developing countries should explore opportunities by initiating AI projects in different sectors that have high economic impact. Hence, governments have to allocate investments to human capital development for enhancing their digital capabilities and to digital infrastructure to facilitate the implementation of AI in different economic sectors. In the meantime, they should adopt a concrete governance framework to identify and manage risks. This will support governments to better monitor compliance, and strengthen privacy, civil liberties, and data protection (World Bank, 2020).

The rationale of this study is to analyze and examine the impact of AI on economic growth in developing countries, by assessing the readiness of governments to implement AI which in turn would affect different economic sectors and hence the economic growth in this group of countries.

The research fills the gap in the literature by analyzing the relationship between AI and economic growth in developing countries. This analysis is conducted by empirically examining the impact of AI government readiness on economic growth and conducting a causality test to examine whether there is a bidirectional relationship between AI and economic growth to provide recommendations to policymakers regarding the potential of AI in contributing to economic growth and addressing the obstacles that may hinder these countries from benefiting from the AI implementation in the government operations.

The rest of this study is organized to present the literature review that addresses the role of AI in the economy in section two, followed by section three which will present the global trends for AI government readiness and economic growth, then, section four will present the data sources and examine the relationship between AI readiness and economic growth empirically, section five will present the empirical results and the discussion, and finally section six presents the conclusion and policy implications.

2. Literature Review

The digital technological innovations that were introduced by the fourth industrial revolution have given considerable attention to AI implementation in different economic sectors. This is expected to cause shifts from conventional production processes to more smart production techniques that would consequently affect the macroeconomic performance and the development level of many countries.

There has been a growing interest in studying the relationship between AI and economic performance. Some studies analyzed the impact of the fourth industrial revolution and AI on economic development and found that AI's contribution to economic development is not yet significant (Vyshnevskyi et al., 2019; Sarker, 2022). However, the relationship is true in the opposite direction; a high level of economic development facilitates the implementation of advanced technologies and AI. This can be justified by the fact that the economic efficiency resulting from the technological advancements of the fourth industrial revolution does not yet offset the diminishing efficiency of technologies introduced by the previous industrial revolutions (Vyshnevskyi et al., 2019). In some developing economies, AI cannot yet realize the expected economic benefits. Thus, more AI implementation is required in different economic sectors, especially manufacturing and service industries, to be more effective (Sarker, 2022). The AI has considerable effects on the

labor market and employment. In the short run, given that capital is fixed, it was found that automation negatively affects employment and reduces wages (Acemoglu and Restrepo, 2018). On the contrary, other studies found that Industry 4.0 and the implementation of AI solutions reduce waste and promote production systems optimization. This results in achieving considerable production efficiency improvement (Cavalcanti et al., 2024). Moreover, it was found that AI technologies positively affect productivity and employment. In the meantime, it alters the composition of the workforce in different firms by lowering the share of workers with lower educational qualifications (Yang, 2022). Integrating AI in vital economic sectors such as agriculture introduces innovative solutions and competent dimensions that promote the sector's sustainable development (Bhagawati et al., 2016).

Despite that AI technologies have a positive impact on economic performance, but they also involve some challenges. The AI adoption follows an S-curve pattern due to the slow adoption by many countries at the beginning, high costs, and the necessary investments of learning the technology to pave the way for the full adoption of these technologies. Thus, the contribution of AI to economic growth can be three or more times by 2030 than the years of the early adoption of AI (Bughin et al., 2018).

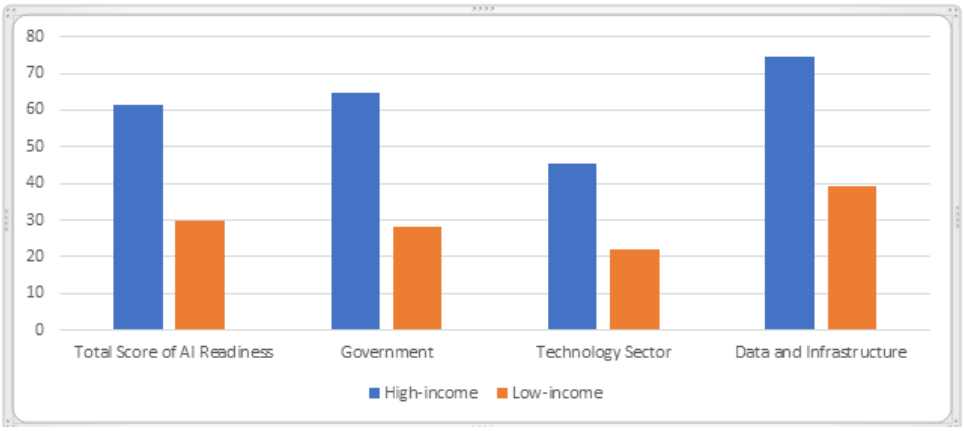
The implementation of AI technologies requires a well-developed digital infrastructure and skilled human capital, which can support its deployment. An acceleration of AI adoption is driven by the effect of high competition and improvement in the readiness of governments and businesses to take full advantage of these innovations. It was found that AI is generating new tasks which affects positively the labor share and wages, which in turn would contribute positively to economic growth (Wang et al., 2021). However, this increases inequality during the transition to automation and the generation of new tasks, while in the long run, this inequality stabilizes (Acemoglu and Restrepo, 2018). While some studies showed that it entails some challenges for many countries, given the concentration of the outcomes of the Industry 4.0 revolution and the technological know-how in the advanced economies, the developing and emerging economies could be left behind if they could not raise the skills of their workers to be complemented instead of being substituted by robots (Alonso et al. 2020). In addition, the transition to the implementation of AI technologies in various industries would strengthen the productivity in advanced countries and increase GDP considerably, in the meantime productivity and GDP levels would decline in developing countries which are endowed by unskilled labor, which in turn would widen the gap between the developed and developing countries.

Lankisch et al. (2019) introduced automation in the neoclassical growth model. The results revealed that automation has a positive effect through its potential to improve economic prosperity. In the meantime, it has a negative impact through raising wage inequality. However, this effect can be mitigated by investing in higher education because it affects the jobs of low-skilled workers more than high-skilled ones. This is because low-skilled workers can easily be replaced by robots than high-skilled ones. Moreover, Aghion et al. (2017) have speculated the utilization of AI in production technology. They found that the way in which AI is introduced can determine whether its impact on economic growth would be temporary or permanent. They suggested that AI can replace labor in generating new ideas and hence prevent the role of the growth of the population in stimulating exponential economic growth. Furthermore, Wang et al. (2021) emphasized that the implementation of AI raises productivity and raises the share of labor, and increases wages by generating new tasks. They concluded that AI stimulates economic growth in which countries that are abundant in labor adopt labor-augmenting technology, while countries with a high percentage of elderly population adopt capital-augmenting technology.

The current study contributes to the growing body of literature by analyzing the impact of AI government readiness on economic growth in developing countries.

3. Global Trends of the AI Government Readiness and Economic Growth

This section analyzes the relationship between the growth level of the economy and the AI readiness of the government to enhance the implementation of AI techniques. Since AI contributes to the development of the economy, thus governments need to be ready for its adoption and integration into the provision of public services. This would, in turn, be reflected on the different economic and social aspects and the development of the economy. The government's readiness for implementing AI technologies involves three pillars, which are the government pillar, the technology sector pillar, and the data and infrastructure pillar. The government pillar indicates that the government needs to have a well-defined plan for AI development and regulation that addresses ethical aspects. It must also develop strong digital skills to be able to cope with technological changes. For the technology sector pillar, the government counts on a powerful technology sector for developing and supplying AI tools. This sector demands a well-functioning innovation ecosystem, a favorable business environment, and high skilled workforce. In the data and infrastructure pillar, high-quality data is required to avoid bias in addition to the necessary digital infrastructure that supports the AI tools and facilitates their delivery to citizens (Hankins et al., 2023).

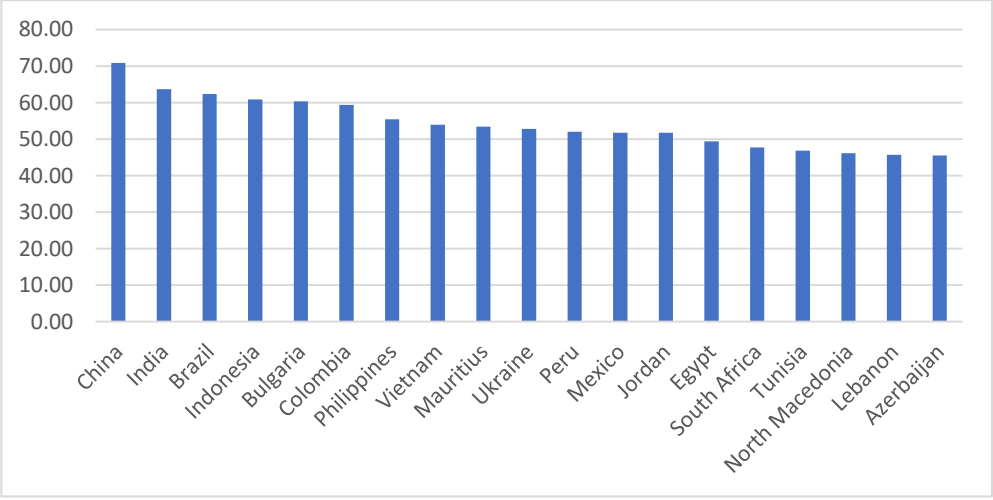


Source: Plotted by using data of the AI Government Readiness Index 2023, Oxford Insights.

Figure 1. Average AI Government Readiness Index and its Components in High and Low-Income Countries, 2023

Figure (1) shows that there is a positive correlation between the level of income of the economy and its AI readiness. The high-income countries have higher levels of AI readiness scores and all its components in terms of the government, the technology sector, and the data and infrastructure. The figure shows that there is a wide gap between high and low-income countries in terms of the three pillars, which indicates that high-income countries have a high potential for AI implementation in terms of a well-developed plan set by the government to address governance and ethical aspects. Furthermore, they have more advanced technological sectors that can develop the

required AI tools, in addition to a well-established digital infrastructure. On the contrary, the AI readiness index indicates that low-income countries need to enhance the three pillars in terms of the government integration of AI technologies in public services and strengthening the AI regulations. They also require the development of the technological sector and strengthening of the digital infrastructure to support AI implementation, and hence, they can exploit the opportunities offered by AI to raise productivity and stimulate economic growth.



Source: Plotted by using data of the AI Government Readiness Index 2023, Oxford Insights.

Figure 2. Highest 20 Developing Countries in AI Readiness Score, 2023

Figure (2) shows that the highest 20 developing countries in AI readiness score are approaching the average score of the developed countries. This indicates that some developing countries experience a high pace of progress in their governance and AI regulations, technological advancements, and digital infrastructure. For instance, Egypt, which is the first African and Arab country to adhere to the AI principles of the OECD in 2021, has initiated a robust strategy for digital transformation that advanced AI adoption. Egypt has a higher internet usage rate of around 73% for both males and females compared to its peers in Africa (average of 34%) and lower-middle-income countries (average of 52%). In addition, Egypt has formulated a council to govern and develop the implementation of the national AI strategy that has four main pillars, which are AI for the government to enhance efficiency and transparency, AI for development to support the economy in achieving the SDGs, AI for capacity building to improve the digital literacy and education among citizens, and finally, AI for international relations to integrate Egypt in the global AI activity (OECD, 2024).

4. Data and Methodology

To examine the effect of AI government readiness on economic growth, this section provides the model specification and data sources for the indicators of the variables used in the empirical research.

4.1. Data Collection

Table (1) shows the variables employed in the multiple regression model along with the indicators that are used to measure their effects, in addition to the data sources of the variables.

Table (1): Variables and Data Sources

Variable	Indicator	Source
Economic growth	Real GDP per capita in country	World Bank database
Artificial Intelligence	Artificial Intelligence Government Readiness Index	Oxford Insights Data
Labor	employment-to-population ratio, 15+, total (%)	World Bank database
Capital	gross capital formation (% of GDP)	World Bank database
Country Openness	Foreign direct investment, net inflows (% of GDP)	World Bank database
Government Expenditures	General government final consumption expenditure (% of GDP)	World Bank database

Source: Designed by the author.

4.2. Empirical Analysis

The present study examines the impact of the AI government readiness on economic growth in developing countries by conducting a multiple regression model by using the OLS method. The model is conducted by using panel data for 115 developing countries from 2020-2023. Following the studies of Seater and Peretto (2007), who introduced R&D as a proxy for technology in

the Cobb-Douglas production function, the study uses the Cobb-Douglas production function by integrating the AI component to estimate the impact of AI government readiness on economic growth. The model is estimated in log-log form for all non-negative variables. Moreover, the study conducts a Granger Causality test to determine the causality between AI and economic growth.

The multiple regression model examines the impact of AI, as measured by the AI government readiness index, on economic growth, as measured by real GDP per capita. The control variables employed in the model are labor, capital, foreign direct investment (FDI), and government expenditures.

Equation (1) is designed to express the multiple regression model as follows:

$$Log(Y_{it}) = \beta_0 + \beta_1(AI_{it}) + \beta_2(L_{it}) + \beta_3 Log(K_{it}) + \beta_4 FDI_{it} + \beta_5 Log(GE_{it}) + \varepsilon_{it} \quad (1)$$

Where:

Y_{it} = real GDP per capita in country i, year t.

AI_{it} = Artificial Intelligence Government Readiness Index in country i, year t.

L_{it} = employment-to-population ratio, 15+, total (%) in country i, year t.

K_{it} = gross capital formation (% of GDP) in country i, year t.

FDI_{it} = Foreign direct investment, net inflows (% of GDP) in country i, year t.

GE_{it} = General government final consumption expenditure (% of GDP) in country i, year t.

According to the literature review presented in section (2) of the present study which elaborates the significant contribution of AI to economic growth, ß1 is expected to be positive (ß1>0). According to the economic theory and the nature of Cobb-Douglas production function $ß_2$ and $ß_3$ are expected to be positive ($ß_2$>0 and $ß_3$>0). In addition, following the study of Borensztein et al. (1998) that confirms the positive impact of FDI on economic growth, and the studies of Reddy and Ramaiah (2020) and Aslan and Altinoz (2021) that emphasize the positive impact of government expenditures on economic growth, hence, $ß_4$ and $ß_5$ are expected to be positive ($ß_4$ >0 and $ß_5$ >0).

5. Results and Discussion:

This section presents the empirical results of estimating the multiple regression model that examines the impact of AI on economic growth in developing countries.

5.1. Unit-Root Test

A unit-root test is performed to ascertain the order of integration of each variable before the regression analysis. The Levin-Lin-Chu (LLC) test is employed following the study of Korkmaz and Korkmaz (2017) since it is more suited for evaluating the stationarity of the panel data variables. According

to the test results in Table (2), all variables are stationary at the level. The variables are, therefore, integrated of order zero, or I(0).

Table (2): Unit-Root Test Results

Variable	Statistic	Prob.	Order of Integration
Log ($Y_{i,t}$)	-12.6943	0.0000	Level, I(0)
Log(AI)	-66.5617	0.0000	Level, I(0)
Log (L)	-410.796	0.0000	Level, I(0)
Log (K)	-62.4329	0.0000	Level, I(0)
FDI	-575.741	0.0000	Level, I(0)
Log (GE)	-184.797	0.0000	Level, I(0)

Source: Author's calculation by using E-views.

5.2. Correlation Coefficients Matrix

Table (3) shows the coefficients of the correlation matrix to assess the strength and direction of relationships among variables. Following the established threshold of 0.8 (Kennedy, 2003; Memon et al., 2021), all pairwise correlations were found to be below this limit, indicating the absence of multicollinearity in the proposed regression model.

Table (3): Correlation Coefficients Matrix

	Log(Y)	Log(K)	Log(L)	Log(AI)	Log(G)	FDI
Log(Y)	1					
Log(K)	0.312	1				
Log(L)	-0.245	0.015	1			
Log(AI)	0.494	0.633	-0.081	1		
Log(GE)	0.002	-0.241	-0.030	0.048	1	
FDI	-0.038	-0.056	-0.022	0.003	-0.082	1

Source: Author's calculation by using E-views.

5.3. The Regression Model Results

According to the regression model results shown in Table (4), the Adjusted R-squared indicates that the variation in the explanatory variables that are employed in the model explains 87% of the variation in economic growth measured by the real GDP per capita. Regarding autocorrelation detection, it is important to note that the autocorrelation problem was present in the model. Thus, the autoregressive term AR(1) is used to remove it and obtain reliable estimates. The VIF values are less than 10, which confirms that there is no multicollinearity as indicated by the correlation coefficient values in Table (3).

Table (4): The Regression Model Results

Dependent Variable: Log(real GDP per Capita)				
Variable	Coefficient	t-Statistic	Prob.	VIF
C	2.675	2.992	0.0031	
Log(AI)	1.270	7.500	0.0000*	1.8285
Log (L)	-0.453	-2.595	0.0102**	1.0159
Log (K)	0.099	4.012	0.0001*	1.9353
FDI	0.002	0.245	0.8062	1.0206
Log(GE)	0.443	5.234	0.0000*	1.2166
AR(1)	0.881	24.507	0.0000	
R-squared	0.8745			
Adjusted R-squared	0.8706			
S.E. of regression	0.3014			
F-statistic	220.82			
Prob(F-statistic)	0.0000			
Durbin-Watson stat	1.8773			

Source: Author's calculation by using Eviews.

***Significance Level at 1%.**

****** Significance Level at 5%.**

The results in Table (4) reveal that AI readiness has a positive and significant impact on economic growth in developing countries, in which a 1% increase in AI government readiness leads to a 1.27% increase in economic growth. This demonstrates that the higher the level of AI government readiness in terms of governance and regulations, the technological level of the economy, and the data and infrastructure that are required for AI implementation, the higher will be the economic growth. Hence, developing countries can accelerate their growth rates through enhancing their technological base, which facilitates AI adoption.

For labor, the results reveal that it has a negative and significant impact on economic growth, in which a 1% increase in employment leads to a 0.45% decrease in economic growth. This result is inconsistent with the economic theory, as according to the analysis of Cobb-Douglas production function, labor is affecting economic growth positively. However, this result is justified by the structural challenges and inefficiencies of various economic sectors in developing countries. For instance, capital is not expanding proportionately with the increases in labor due to the investment obstacles that prevent the expansion of capital to absorb the high level of employment. Consequently, this results in diminishing returns. This is consistent with the findings of Arshed et al. (2021), who found in their study that low-income countries are experiencing lower growth rates resulting from higher levels of employment, which indicates diminishing returns that were

reversed when the knowledge and know-how are introduced to the human capital which in turn allows the low-income countries to diverge to the growth level of the advanced economies.

Moreover, a large portion of employed individuals lack access to good education, training, and digital skills that can raise their productivity and, hence, stimulate economic growth. In the endogenous growth model of Romer (1990), he argued that the higher the portion of workers who are dedicated to R&D, the higher the economic growth in the economy. Since developing economies do not have a higher proportion of employed individuals who are dedicated to the technological sectors and are lacking innovations that have increasing returns to scale, thus over-employment in unproductive economic sectors affects economic growth negatively. The study of Entekhabi (2023) has identified the challenges of human capital in developing countries, which are low levels of education and healthcare, gender inequalities, brain drain, and inadequate investments in the development of labor skills. These challenges explain the findings of the present study, which is supported by the conclusion of the studies of Korkmaz and Korkmaz (2017), who emphasized that labor productivity is higher in developed countries compared to developing countries, and Haider et al. (2023), who found that employment elasticity relative to GDP is very low in developing countries compared to developed countries.

According to capital that is measured by gross capital formation, it has a positive and significant impact on economic growth, in which a 1% increase in capital leads to a 0.099% increase in economic growth. This result is in line with Reddy and Ramaiah (2020) and Aslan and Altinoz (2021), who found in their studies that gross capital formation affects economic growth positively in India and Africa, respectively. However, this small coefficient of the capital variable indicates that capital accumulation in developing countries is not high enough to stimulate a higher percentage of economic growth. This confirms the conclusion of the negative effect of employment on economic growth in the present study due to the high increase in labor in the presence of slow expansion of capital accumulation, which in turn leads to diminishing returns in developing countries.

The FDI has an insignificant impact on economic growth in developing countries. This can be attributed to the low capital inflows to the developing economies, which weakens its impact and contribution to stimulate economic growth. While government expenditures have a positive and significant impact on economic growth in which a 1 % increase in GE leads to a 0.44% increase in economic growth. This can be attributed to the essential role that governments are playing in the economy, especially in the period of the study in which many developing countries' governments are allocating expenditures to enhancing the technological infrastructure to prepare their economies for the

digital era to cope with the global changes, as the results of the present study suggests that the AI government readiness index has a positive and significant impact on economic growth in developing countries. This positive impact of government expenditures on economic growth is consistent with the studies of Wu et al. (2010) and Shkodra et al. (2021), who confirm the positive effect of government expenditures on economic growth, and Atteh et al. (2022), who found that government spending stimulates economic growth in the Ghanian economy if it is kept to the optimal level that prevents the crowding-out effect.

5.4. Granger Causality Test

The study conducts a Granger causality test to examine the direction of the relationship between AI and economic growth, in addition to testing the relationship between the control variables employed in the model and economic growth. The estimated results of the Granger Causality test are shown in table (5).

Table (5): Granger Causality Test Results

Direction of Causality	Obs.	F-Statistic	Prob.	Results of Causality
From log(AI) to log(GDP per capita) From log(GDP per capita) to log(AI)	460	4.005 2.257	0.0199* 0.1077	Unidirectional from log(AI) to log(GDP per capita)
From log(Labor) to log(GDP per capita) From log(GDP per capita) to log(Labor)	460	0.8789 11.8408	0.4168 0.0000*	Unidirectional from log(GDP per capita) to log(Labor).
From log(Capital) to Log(GDP per capita) From log(GDP per capita) to log(Capital)	460	5.8259 1.6183	0.0037* 0.2017	Unidirectional from log(Capital) to log(GDP per capita).
From FDI to log(GDP per capita) From log(GDP per capita) to FDI	460	28.9180 1.5642	0.0000* 0.2116	Unidirectional from FDI to log(GDP per capita).
From log(Government Expenditures) to log(GDP per capita) From log(GDP per capita) to log(Government Expenditures)	460	4.91070 1.31226	0.0085* 0.2719	Unidirectional from log(Government Expenditures) to log(GDP per capita)

Source: Author's calculation by using Eviews.
***Significance Level at 1%.**

The causality test results shown in Table (5) indicate that AI government readiness affects economic growth, while there is no effect in the opposite direction. This result reveals that the level of economic growth in developing countries is not sufficient to build AI capabilities. Moreover, as indicated in the multiple regression model in section 5.3 that employment affects economic growth negatively, and this was explained by development-specific factors in developing countries. However, the causality test shows that despite employment cannot stimulate growth in developing

countries, economic growth affects the employment level as the higher the rates of growth, the more job opportunities will be created in developing countries. For capital accumulation, FDI, and government expenditures, the causality test shows that the three variables have the potential to affect economic growth in developing countries.

6. Conclusion and Policy Implications

The present study has examined the impact of AI government readiness on economic growth by integrating the AI component in Cobb-Douglas production function. The results demonstrated that AI has the potential to stimulate economic growth in developing countries. The enhancement of the three components of the government readiness index which are AI regulations and governance, technological advancement, and data and infrastructure, is essential for AI adoption in various economic sectors to motivate productivity and growth in developing countries. Despite the benefits that are created by AI implementation, there are some challenges, such as the digital divide, the lack of technological infrastructure, and the low enforcement of privacy and security regulations, which are critical issues that have to be addressed by governments in developing countries. This was confirmed by the results of the causality test, which revealed that the level of economic growth in developing countries cannot support the AI readiness and adoption.

The findings of the study indicate some policy implications. First, policymakers should initiate digitalization strategies to support and prepare the different economic sectors for the AI implementation that was brought by Industry 4 to cope with the global technological changes. Second, governments should encourage investments in the ICT sector to enhance the digital infrastructure to minimize the gap between developed and developing countries. Third, developing countries should leverage the digital literacy of citizens to develop human capital that can participate effectively in AI implementation.

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