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The Influence of Knowledge-based Economy and Accountability on Economic Growth

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

This research analyzes the influence of a knowledge-based economy and accountability on economic growth. A knowledge-based economy focuses on the importance of innovation, technological infrastructure, institutions, and quality human resources in driving productivity and competitiveness. Meanwhile, accountability involves transparency and efficiency in the management of public funds as well as reducing corruption, all of which contribute to a stable and predictable economic environment. This research finds that the synergy between a knowledge-based economy and government accountability can create conditions conducive to economic growth. Through case studies from the ten countries with the highest GDP in East Asia and Southeast Asia using a quantitative approach and the Partial Least Squares (PLS) analysis tool, the research results show that education and skills do not significantly influence economic growth. In contrast, education and skills have a significant favorable influence. Regarding innovation, IT infrastructure shows a significant adverse effect on economic growth, whereas IT infrastructure hasa considerable positive impact on innovation; institutions do not have a substantial effect on economic growth, while institutions have a considerable positive impact on innovation.

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Accountability does not show a substantial effect on economic growth. Accountability has a positive impact on innovation, and innovation has a significant positive effect on economic growth. Knowledge and technology, supported by accountable government, can increase investor confidence and encourage inclusive economic growth. In conclusion, a strategy that integrates strengthening the knowledge-based economy and increasing government accountability is essential to promote long-term economic growth in the East and Southeast Asia Region.

Keywords: Economy growth; innovation; education; institution; IT infrastructure; accountability.

JEL: *O30, O40, H11, D83*

1. INTRODUCTION

Economic growth is the foundation for the welfare and progress of a country. A growing economy indicates that there has been economic activity necessary for the sustainability of development in various sectors [1]. Economic growth is an increase in total and per capita aggregate product, without reference to changes in the economy's structure or the social and cultural value system [2]. A critical factor in achieving sustainable economic growth is the availability of resources. The resources managed by a country determine its progress.

One factor affecting the quality of human resources is the knowledge that can be obtained, absorbed, distributed, and implemented by human resources in a country. In the current era of the Industrial Revolution 4.0, the role of knowledge in economic growth is increasing, thus increasing the role of knowledge as a factor that affects economic growth. [3]. The limited natural resources make every country strive to increase its potential. All countries must strive to be more productive and more efficient in various aspects of life. More efficient and more productive use of resources can be done through a combination of knowledge that can advance multiple life processes in a country.

The condition of limited natural resources makes every country must strive to increase its potential. All countries must strive to be more productive and more efficient in various aspects of life. More efficient and more productive use of resources can be done through a combination of knowledge that can lead to the advancement of various life processes in a country.

Table 1 shows the countries with the highest GDP in East and Southeast Asia. The total GDP of a country is affected by the productivity of the population and the country's population. This means that countries with high total GDP do not necessarily have higher productivity than countries with lower total GDP; this could be due to the number of people in a country with a high total GDP far exceeding the number of people in a country with a low total GDP.

For example, Indonesia occupying the third position in total GDP does not mean that the productivity and welfare of the Indonesian people per capita is in the third position. The size of productivity and welfare must also be seen from the value of GDP per capita.

Table 1. Ten countries with the highest GDP in East and Southeast Asia

No.	Country	GDP (Million Dollars)
1	China	30.327.320
2	Japan	5.702.287
3	Indonesia	4.036.901
4	South Korea	2.585.011
5	Thailand	1.482.098
6	Vietnam	1.321.256
7	Philippines	1.170.982
8	Malaysia	1.134.677
9	Singapore	719.084
10	Hong Kong	507.244

Source: World Bank, 2023

Table 2. Ten Countries with the highest per capita income in Southeast Asia and East Asia region

No.	Country	Income per Capita (in US$)
1	Singapore	67.200
2	Japan	42.440
3	South Korea	35.990
4	Brunei Darussalam	31.410
5	China	12.850
6	Malaysia	11.780
7	Thailand	7.230
8	Indonesia	4.580
9	Mongolia	4.210
10	Vietnam	4.010

Source: World Bank, 2023

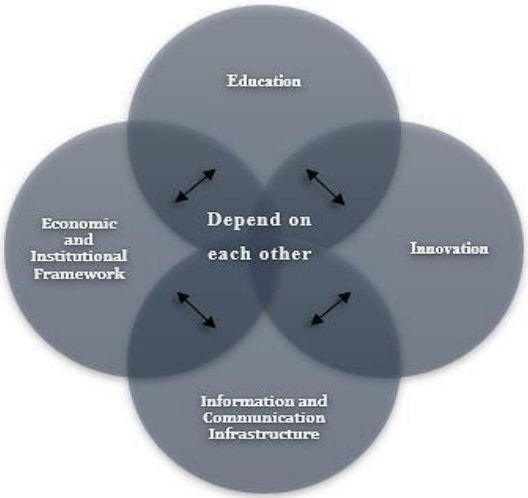

Fig. 1. Four Pillars of Knowledge-Based Economy by World Bank
Source: [3]

Based on Table 2 shows that although China is the country with the highest GDP, it does not guarantee that the population in China has a high per capita income because of China's huge population. The same thing also happened to Indonesia, which is in third place when viewed from the total value of Indonesia's GDP. However, from the value of per capita income, Indonesia is only in eighth place. Per capita income shows a measure of productivity that will have an impact on people's income, which in turn will affect the purchasing power of the people in a country; if per capita income is high, then, of course, the purchasing power of the people is good, and the ability to buy various needs will also be better which will ultimately have an impact on the welfare of the people in a country.

Productivity improvement is a fundamental factor in driving a country's economic growth. When productivity increases, output and income per capita. Productivity is strongly influenced by human capital, which is the knowledge, skills, health, and values that are inherent and inseparable from humans [4]. As Becker [4] expressed, prioritizing human capabilities in the economy is part of the central concept of the knowledge-based economy.

A knowledge-based economy demands a balance between information and communication technology infrastructure and the human capacity that oversees and utilizes such high-tech infrastructure. Therefore, education, significantly higher education, is vital, as seen from the concept Fig. 1.

The four pillars of a Knowledge-Based Economy, namely education, institutional economic framework, innovation, and information and communication infrastructure, are interdependent

and interconnected. [3]. Long-term Investment in these four elements, not only Investmentdent and interconnected, is the key to a successful transition to a knowledge-based economy by modernizing market transactions. [3]. In addition, there are several elements inherent in the concept of a knowledge-based economy, including Investment in research and development; innovation in products, production, markets, and marketing; development of entrepreneurship, especially in the field of technology; development of information and communication technology; increasing education to higher levels and improving skills and professionalism.

A knowledge-based economy relies on the quantity, quality, accessibility, and usability of creativity and information rather than material productions [5]. A knowledge-based economy involves utilizing knowledge, information, innovation, and technology as the main drivers of economic growth. The four pillars of a knowledge-based economy consisting of information and communication technology (ICT), innovation systems, education and human resource development, monetary incentives, and institutional regimes must also be supported by involvement in international programs and a development plan coordinating science and technology policies. [6].

Research by Ahmed Al-Roubaie [7], showed that innovation and technology as elements of a knowledge-based economy play an important role in supporting economic growth. They link innovation in education with adaptability to a knowledge-based economy. Furthermore, information and communication infrastructure (ICT) is also a critical factor in transforming into a knowledge-based economy, as found in the study of Kurniawati [8]. Kurniawati [8] and Pradhan et al. [9]. ICT improves communication efficiency and facilitates participation in educational decision-making, supporting economic development.

The institutional framework, also an element of the knowledge-based economy, also plays a crucial role, as described in research by Ben Hassen [10] and Yokoyama [11]. Good institutions in the form of governments play a role in developing a knowledge-based economy with education policies that support innovation and technology. Regarding education level, [12,13] showed that a high level of education in society positively impacts economic growth. Quality education is critical to creating a qualified workforce in a knowledge-based economy. Thus, these factors, namely accountability in education, innovation, ICT, institutional framework, education level, and institutions, work together to create an enabling environment for sustainable economic growth [8,7,14-17,5,18,11-13].

Of the four elements of a knowledge-based economy, innovation can be considered a moderating influence between three knowledge-based economy variables: education, and knowledge, information and communication infrastructure, and economic and institutional frameworks on economic growth variables. Innovation plays a crucial role in the knowledge-based economy as it is the primary catalyst for economic growth, job creation, and increased competitiveness [19]. J. Dempere et al., 2023; Galindo & Méndez- Picazo, 2013; Maradana et al., [20]; Omar, [21]; Singh & Siddiqui, [22]; Sinha, [17]; Thangavelu etal., [19].

Based on previous studies, some of the main factors that explain the relationship between accountability and knowledge-based economic indicators on economic growth can be detailed. Research by Smith and Benavot [23] suggests that accountability in education plays an important role. Although accountability can improve the quality of education, this study emphasizes the need to consider contextual aspects that affect the education system and expand the scope of accountability.

This shows that accountability has a role in creating and disseminating knowledge. Hence, implementing a knowledge-based economy must be supported by excellent accountability conditions. Accountability is an element of good governance closely related to institutional governance, which makes accountability instrumental in encouraging one of the elements or components of the knowledge-based economy, namely the economic framework.

Overall, this background illustrates how the *knowledge-based economy* plays a Overall, this background illustrates how the knowledge-based economy is central to economic growth through innovation, information and communication infrastructure, institutional framework, and education level. These elements work together to form an ecosystem supporting the knowledge-based economy transition. The previous studies introduced here provide a solid knowledge base for understanding the relationship between these aspects in the context of sustainable economic

growth. In the face of the demands of a modern economy that relies heavily on knowledge and technology, an in-depth understanding of the role of these factors is becoming increasingly important for countries to achieve sustainable and inclusive economic growth. This research aims to build on previous studies and investigate how these factors can be integrated and optimized to support knowledge-based economic development.

From the background above, the authors researched the knowledge-based economy in Indonesia, titled "The Influence of Knowledge-based Economy and Accountability on Economic Growth".

2. LITERATURE REVIEW

2.1 Solow's Theory of Economic Growth

Research Marquez-Ramos & Mourelle [24] examined the relationship between secondary and tertiary education on economic growth in Spain with an observation period from 1971 to 2013. Research results by Marquez-Ramos and Mourelle [24] show a positive correlation between education and economic growth, where higher education impacts higher economic growth. Other research was conducted by Valente et al. [25], which analyzed the relationship between cognitive skill-based jobs and financial performance in the European Region. Mental skills are obtained through formal education, although in the research of Valente et al. Valente et al. [25] also consider cognitive skills acquired through the work environment where there is a work environment that encourages the implementation of cognitive learning. The results of his research show that countries with workplaces that require advanced cognitive skills tend to get higher economic growth.

Research Odhiambo [26]. Odhiambo's research analyzes the relationship between education and economic growth. Odhiambo used three education related measures and combined them with investment and labour variables. The components of education used consist of education expenditure, primary education and further education. Research results in Odhiambo [26]. The results of Odhiambo's [26] research show that education expenditure affects economic growth in both the short and long term; primary education affects the short term, while further education affects the short and long term. Biasi et al. (2013) explained the importance of the relationship between education and innovation. Education has a crucial role in encouraging innovation through several mechanisms. First, Investment in education can improve individuals' skills and enable them to reach their creative potential, which in turn can generate innovations. Second, education provides better access to potential mentors and collaborators, which can strengthen one's innovative capabilities. In addition, universities and other educational institutions are often where creative teams are formed that contribute to technological advancement.

The relationship between a country's information technology (IT) infrastructure and relationship between a country's information technology (IT) infrastructure and its innovation is significant. A developed IT infrastructure can accelerate innovation by providing access to information, facilitating communication and collaboration, and improving operational efficiency. This enables researchers, developers and businesses to develop and implement new ideas faster. A robust IT infrastructure supports the innovation ecosystem by strengthening research and development capacity, education, and entrepreneurship, contributing to economic growth and social progress. Research by Jabbouri et al. [27] on the Impact of Information Technology Infrastructure on Innovation Performance: Empirical Study at Private Universities in Iraq shows that Information Technology (IT) infrastructure significantly impacts innovation performance at private universities in Iraq. This study highlights the importance of IT in driving innovation and progress in educational institutions. The results show that adopting and developing a sound IT infrastructure can improve innovation performance in higher education institutions, providing significant benefits for facing challenges and competition in this digital era.

In addition, this study also highlights the importance of subjective factors in measuring innovation performance, suggesting that internal perceptions and valuations of innovation also play an essential role in the successful implementation of information technology. As such, this article provides valuable insights into how IT infrastructure can be vital in driving innovation in educational settings and the importance of considering subjective aspects in measuring its impact.

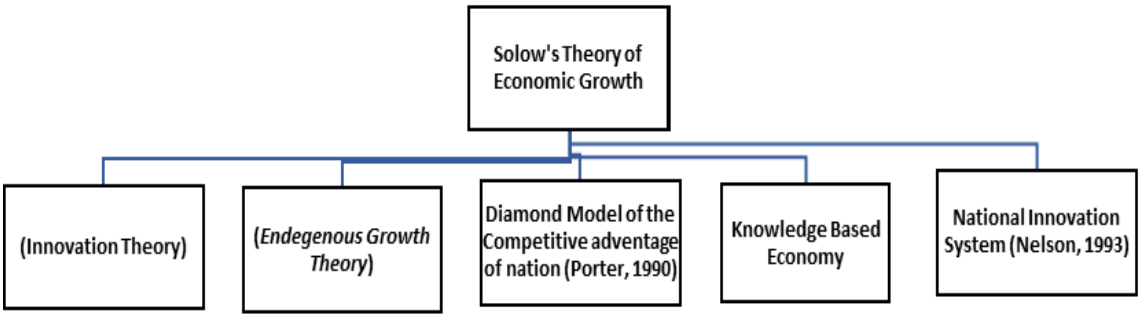

Fig. 2. Theoretical framework

The rapid growth of Information and Communication Infrastructure has made the world more connected. Other parts of the world can easily access information about various products and services from one part of the world, and interest in products and services can continue in international trade transactions through e-commerce communication media. Several studies have tried to reveal the effect of Information and Communication Infrastructure on economic growth, including research by Liu [28], which tries to study how information and communication technology development in China can encourage economic growth. By using the variable Investment in information technology, Liu [28] found that Investment in information and communication technology infrastructure impacts economic growth differently from the effect of old-fashioned infrastructure investment (Investment in transportation and utility infrastructure).

Research by Kurniawati [29] revealed the role of information and communication technology infrastructure on economic growth in OECD countries, with an observation period from 1996 to 2017. Kurniawati's research (2019) found a close relationship between Information and Communication Technology Infrastructure and economic growth. This study also reveals a close relationship between information and communication technology infrastructure and internet usage, which impacts economic growth. Pradhan et al. [9] analyzed G-20 countries and found that ICT infrastructure has a significant relationship with economic growth. Good ICT infrastructure, particularly broadband adoption and internet usage, is recognized as having the potential to accelerate economic growth.

The policy implication is the expansion and improvement of ICT infrastructure to boost economic growth. Toader et al. [30] studied European Union (EU) countries and showed that ICT infrastructure positively impacts economic growth. However,the impact can vary depending on the ICT technology used. This research emphasizes the need to focus on ICT infrastructure development to support sustainable economic growth. Bahrini Qaffas [31] examined the impact of ICT on economic growth in developing countries in the MENA and SSA regions. The results show that mobile telephony, internet usage, and broadband adoption positively impact economic growth, while fixed telephony has a negative impact. Policy implications include investing in ICT infrastructure, reducing taxes, and controlling inflation.

The economic and institutional framework plays a vital role in supporting and directing innovation in a country. Government policies, regulations, financial infrastructure, and the quality of education and research institutions all contribute to creating an environment conducive to innovation. Progressive policies, such as tax incentives for Investment in research and development (R&D), grants for innovation, and strong protection of intellectual property rights, motivate firms and individuals to invest in innovation. Donges et al. [32] found that institutional reforms significantly impact innovation. They use the period and geography of the French occupation of various German regions after the French Revolution of 1789 as an exogenous shock to institutions in those regions. Combining new county-level data with data on the number of patents per capita shows that counties with more inclusive institutions due to the French occupation were more innovative. In the article "The Impact of Institutional Strategies in the Innovation Process on the Community Behavior and Local Government in

Magelang City," the findings show that the institutional strategies implemented by the Magelang City Government significantly impact the innovations implemented [33].

Government institutions are considered to affect economic growth. The government is the authority that can regulate various policies in a country, including economic policy. Policies issued by the government can encourage or inhibit economic growth. To make the right policies, professional and qualified government institutions are needed so that the policies made will positively impact prosperity. Research by Sehrawat Giri [34] explains the integrated relationship between globalization and institutional quality with economic performance in India. Economic reforms in India since 1991 have encouraged the integration of the Indian economy into the global economy. One of the contributors to India's economic success is its open trade policy and close integration with the rest of the world. Increased trade and financial openness have resulted in increased measures for foreign exchange and foreign direct Investment volume. Research by Olaoye Aderajo, [16], also reveals empirical findings proving that the better quality of political and economic institutions impacts economicgrowth.

Accountability ensures that government policies are designed and implemented reasonably and efficiently, encouraging responsible and effective use of state resources. This is particularly important in funding and supporting research and development projects, which are crucial to innovation. In addition, accountability can improve the quality of education and research infrastructure, two other critical elements for advancing innovation. By having a transparent and accountable system, governments can more easily attract domestic and foreign Investment, which is needed to finance innovation and research. Research by Nadeem et al. [35], shows that low levels of accountability hurt innovation. Low accountability can lead to weak institutional arrangements, unhealthy connections, and unfair resource allocation policies, which can be detrimental to innovation. In other words, when accountability mechanisms are ineffective, it can create an environment that could be more conducive to innovation. Jamal Tilchin [36] also suggested that the relationship between accountability and innovation is closely related.

Accountability has a vital role in influencing a country's economic growth. Accountability can be defined as the responsibility and obligation to report, explain, and provide accountability for actions and decisions taken. Hall [37] reveals that one element of accountability, namely transparency, has an impact on economic development; this is obtained from observations made on transparency policies in the United States, showing that the government will be more careful in making economic development decisions if the community has access to information on economic development policies so that decisions taken can have more impact on society as a whole. Accountability is also closely related to controlling corruption, where corruption is considered one of the factors that significantly affects economic growth in a country [38]. The results of Mathew et al. [38], revealed that corruption control significantly affects Nigeria's economic growth. The findings of Mathew et al. [38] are in line with the research results of Ishola Mobolaji Omoteso [39], who researched the impact of corruption on the economic growth of transition countries from 1990 to 2014, which showed that there was a negative impact of corruption on the economy. This shows that accountability as a controller of corruption must be strengthened. In this dissertation, the author tries to take the upstream of the cause of corruption, namely the poor accountability of a country. So corruption is the impact of the poor condition of a country's accountability.

3. METHODOLOGY

In this study, the authors used quantitative methodology to investigate the effect of knowledge-based economy and accountability on economic growth in Southeast and East Asian countries. This approach was chosen for its ability to test causal relationships between measurable variables and provide objective results.

The author uses the Partial Least Squares (PLS) method as a data analysis tool. PLS is a suitable method for this study because of its effectiveness in dealing with complex models with many predictor variables and its ability to handle multicollinearity problems between variables. This method is beneficial in exploratory research to build or extend theories in under-researched areas, such as the relationship between knowledge-based economy, accountability, and economic growth (Joseph, et al, 1960).

The variables, types of variables, and composite indicators in this study are summarized in the Table 3.

Table 3. Variables, variable types, and composite indicators

No.	Variables	Variable Type	Composite Indicator
1	Education	Exogenous	1) Education Index 2) Tertiary higher education index 3) Knowledge worker index
2	Innovation	Endogenous	1) Innovation Linkage Index 2) Research Development Index 3) Knowledge Creation Index 4) Creative Goods and Services Index
3	Information and Communication Infrastructure	Exogenous	Information and Communication Index
4	Accountability	Exogenous	1) Voice and Accountability Index 2) Control over corruption index
5	Economic and Institutional Framework	Exogenous	1) Political Environment Index 2) Regulatory Environment Index 3) Business Environment Index 4) Investment Index 5) Trade Index, competition and market scale
6	Economic Growth	Endogenous	GDP Growth

Table 4. Data type and data scale

No.	Variables	VariableType	Composite Indicator	Data Source
1	Education	Exogenous	1) Education Index 2) Index Tertiary highereducation 3) Knowledge worker index	World Governance Indicator (Publication by The World Bank)
2	Innovation	Endogenous	1) Innovation Linkage Index 2) Research DevelopmentIndex 3) Knowledge Creation Index 4) Creative Goods andServices Index	Global Innovation Index (Publication by World Intellectual Property Organization)
3	Information and Communication Infrastructure	Exogenous	Information and Communication Index	Global Innovation Index (Publication by World Intellectual Property Organization)
4	Accountability	Exogenous	1) Voice and AccountabilityIndex 2) Control over corruptionindex	Global Innovation Index (Publication by World Intellectual Property Organization)
5	Economic and Institutional Framework	Exogenous	1) Political Environment Index 2) Regulatory EnvironmentIndex 3) Business EnvironmentIndex 4) Investment Index 5) Trade Index, competition,and market scale	Global Innovation Index (Publication by World Intellectual Property Organization)
6	Economic Growth	Endogenous	GDP Growth	World Bank

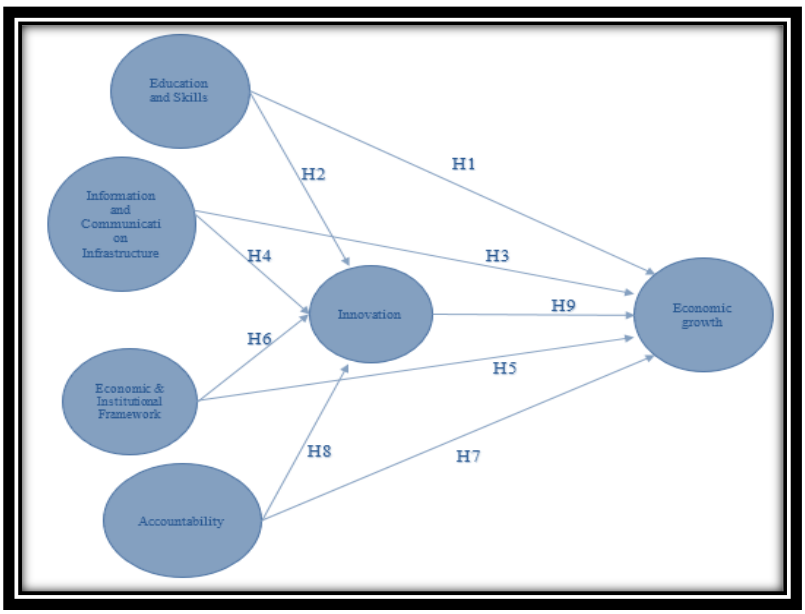

Fig. 3. Research model design

Based on the research model design in Fig. 3, the interaction between variables can be formulated as follows:

$$z = \beta 0 + \beta\ x11 + \beta\ x22 + \beta\ x33 + \beta\ x44 + e \quad (1)$$

This formula illustrates how education and skills, information and communication infrastructure, economic and institutional framework, and accountability affect innovation. The coefficients (β1, β2, β3, β4) show how much influence each independent variable has on innovation.

$$y = \alpha 0 + \alpha\ x11 + \alpha\ x22 + \alpha\ x33 + \alpha\ x44 + e \quad (2)$$

This formula shows the direct relationship between the independent variables (education and skills, information and communication infrastructure, economic

$$y = \psi 0 + \psi 1\ z + e \quad (3)$$

This formula shows the direct relationship between innovation and economic growth. It indicates how much influence innovation has on economic growth without considering other independent variables.

$$y = \gamma 0 + \gamma\ x11 + \gamma 2\ z + \gamma 3\ (x1\ .z) + e \quad (4)$$

This formula indicates the effect of education skills and innovation on economic growth, including the interaction between education skills and innovation. The interaction coefficient (γ3) shows how the impact of education and skills on economic growth changes when innovation is also considered.

$$y = \delta 0 + \delta\ x12 + \delta 2\ z + \delta 3\ (x2\ .z) + e \quad (5)$$

This formula describes the effect of information and communication infrastructure and innovation on economic growth, including the interaction between information and communication infrastructure and innovation. The interaction coefficient (δ3) shows how the effect of information and communication infrastructure on economic growth changes when innovation is also considered.

$$y = \theta 0 + \theta\ x13 + \theta 2\ z + \theta 3\ (x3\ .z) + e \quad (6)$$

This formula shows the effect of economic and institutional framework and innovation on economic growth, including the interaction between monetary and institutional framework and innovation. The interaction coefficient (θ3) shows how the effect of the financial and institutional framework on economic growth changes when innovation is also taken into account.

$$y = \varphi 0 + \varphi\ x14 + \varphi 2\ z + \varphi 3\ (x4\ .z) + e \quad (7)$$

This formula shows the effect of accountability and innovation on economic growth, including the interaction between accountability and innovation. The interaction coefficient (ϕ3) shows how the impact of accountability on economic

growth changes when innovation is also considered. The overall alternative moderation formula is asfollows:

The overall alternative moderation formula is as follows:

$$y = \lambda 0 + \lambda x11 + \lambda x22 + \lambda x33 + \lambda x + \lambda 445 z + \lambda 6 (x1 .z) + \lambda 7 (x2 .z) + \lambda 8 (x3 .z) + \lambda (x94 .z) + e \quad (8)$$

This formula provides a comprehensive picture of how all the independent variables (education and skills, information and communication infrastructure, economic and institutional framework, accountability) and innovation (individually and in interaction) affect economic growth.

4. RESULTS AND DISCUSSION

4.1 Results

In analyzing the relationship between accountability and economic growth, the path coefficient obtained is -0.189 with a t-value of 1.463 and a p-value of 0.144. These results indicate no significant relationship between accountability and economic growth, as the p-value is more significant than 0.05. In other words, an increase or decrease in the accountability variable does not significantly impact the economic growth variable in this model.

When looking at the relationship between accountability and innovation, the path coefficient obtained is -0.009 with a t-value of 0.092 and a p-value of 0.927. This means that accountability does not significantly affect innovation, as indicated by the p-value being more significant than 0.05. That is, changes in the level of accountability do not significantly affect the level of innovation in the context of this study.

In analyzing the relationship between education and economic growth, the path coefficient obtained is 0.118 with a t-value of 0.870 and a p-p-value of 0.385. These results indicate that education does not significantly affect economic growth, as the p-value is more significant than 0.05. Therefore, although education is often considered an essential factor for economic development, its effect is not statistically significant in this model.

However, in analyzing the relationship between education and innovation, the path coefficient obtained is 0.322 with a t-value of 3.189 and a p-value of 0.002. This indicates that education significantly influences innovation, as the p-value is less than 0.05. Thus, an increase in the level of education significantly increases the level of innovation, demonstrating the importance of education in driving innovation in society.

For the relationship between IT infrastructure and economic growth, the path coefficient obtained is -0.380 with a t-value of 2.410 and a p-value of 0.016. These results indicate that IT infrastructure significantly negatively affects economic growth, as the p-value is less than 0.05. This may suggest that in specific contexts, spending on IT infrastructure does not always directly contribute to economic development, andother factors may play a more significant role.

In analyzing the relationship between IT infrastructure and innovation, the path coefficient obtained is 0.226 with a t-value of 2.069 and a p-value of 0.039. This indicates that IT infrastructure significantly influences innovation, as the p-value is less than 0.05. Therefore, Investment in IT infrastructure promotes innovation, consistent with the view that information technology is a crucial driver of innovation.

Table 5. Hypothesis test results

	Original Sample (O)	T Statistics (|O/STDEV|)	P Values
Accountability -> Economic Growth	-0.189	1.463	0.144
Accountability -> Innovation	-0.009	0.092	0.927
Education -> Economic Growth	0.118	0.870	0.385
Education -> Innovation	0.322	3.189	0.002
IT Infrastructure -> Economic Growth	-0.380	2.410	0.016
IT Infrastructure -> Innovation	0.226	2.069	0.039
Innovation -> Economic Growth	0.359	3.054	0.002
Institution -> Economic Growth	-0.179	1.056	0.291
Institution -> Innovation	0.364	2.887	0.004

Source: Author's processed data (2024)

When analyzing the relationship between innovation and economic growth, the path coefficient obtained is 0.359 with a t-value of 3.054 and a p-value of 0.002. These results show that innovation significantly affects economic growth, as the p-value is less than 0.05. This indicates that an increase in innovation substantially contributes to economic growth, confirming the importance of innovation as a significant factor in economic development. In the relationship between institutions and economic growth, the path coefficient obtained is -0.179 with a t-value of 1.056 and a p-value of 0.291. These results indicate that institutions do not significantly affect economic growth, as the p-value is more significant than 0.05. This means that changes in the quality of institutions do not significantly affect economic growth in this model.

In the relationship between institutions and economic growth, the path coefficient obtained is -0.179 with a t-value of 1.056 and a p-value of 0.291. These results indicate that institutions do not have a significant effect on economic growth, as the p-value is greater than 0.05. This means that changes in the quality of institutions do not significantly affect economic growth in this model.

However, for the relationship between institutions and innovation, the path coefficient obtained is 0.364 with a t-value of 2.887 and a p-value of 0.04. This indicates that institutions significantly influence innovation, as the p-value is less than 0.05 Therefore, excellent and robust institutions play an essential role in encouraging higher levels of innovation.

From the above analysis results, the variables of education, IT infrastructure, and institutions significantly influence innovation. In addition, innovation itself has a significant positive effect on economic growth. In contrast, accountability shows no significant impact on economic growth or innovation. Interestingly, IT infrastructure negatively influences economic growth, which requires further analysis to understand this dynamic. This shows the importance of identifying and understanding the factors that support and hinder economic growth and innovation, especially in the context of the countries analyzed.

In the context of a knowledge-based economy, these findings emphasize the importance of Investment in education and IT infrastructure as critical drivers of innovation and economic growth. Robust and high-quality education equips the workforce with the necessary skills and knowledge to drive innovation. Advanced IT infrastructure enables information exchange and the development of new technologies, critical components of a knowledge-based economy. Effective and transparent institutions also support innovation by creating an environment conducive to research and development.

However, the finding that IT infrastructure negatively influences economic growth indicates that simply having technology is insufficient. Appropriate policies are needed to ensure that investments in technology translate into increased productivity and growth. This suggests that to develop an effective knowledge-based economy, countries must ensure that education, technology, and institutions go hand in hand and support each other.

Thus, for countries in Southeast Asia and East Asia looking to develop knowledge-based economies, a focus on improving the quality of education, developing IT infrastructure that supports innovation, and strengthening institutions is critical. Through this approach, these countries can achieve sustainable and inclusive economic growth driven by knowledge and innovation. The formula used to analyze the indirect interaction between variables is as follows:

$$y = \gamma_0 + \gamma\, x_{11} + \gamma_2\, z + \gamma_3\, (x_1 .z) + e \quad (9)$$

$$y = \delta_0 + \delta\, x_{12} + \delta_2\, z + \delta_3\, (x_2 .z) + e \quad (10)$$

$$y = \theta_0 + \theta\, x_{13} + \theta_2\, z + \theta_3\, (x_3 .z) + e \quad (11)$$

$$y = \varphi_0 + \varphi\, x_{14} + \varphi_2\, z + \varphi_3\, (x_4 .z) + e \quad (12)$$

or the alternative formula is as follows:

$$y = \lambda_0 + \lambda\, x_{11} + \lambda\, x_{22} + \lambda\, x_{33} + \lambda\, x + \lambda_{445}\, z + \lambda_6\, (x_1 .z) + \lambda_7\, (x_2 .z) + \lambda_8\, (x_3 .z) + \lambda\, (x_{94} .z) + e \quad (13)$$

The results of the indirect effect analysis show various dynamics between variables. First, the indirect path from accountability to economic growth through innovation has an original sample value of -0.003 with a p-value of 0.923. This shows that the indirect effect of accountability on economic growth through innovation is not statistically significant. In other words, accountability contributes little to economic development through the innovation mechanism.

Table 6. Indirect effect test results

	Original Sample (O)	T Statistics (|O/STDEV|)	P Values
Accountability -> Innovation -> Economic Growth	-0.003	0.097	0.923
Education -> Innovation -> Economic Growth	0.116	2.294	0.022
IT Infrastructure -> Innovation -> Economic Growth	0.081	1.736	0.083
Institution -> Innovation -> Economic Growth	0.131	2.118	0.035

Source: Author's processed data (2024)

Table 7. Summary of hypothesis testing results

Hypothesis	Coefficient	Value of t	P-value	Conclusion
Education and skills have a positiveeffect on economic growth in Southeast Asian and East Asian countries	0.118	0.870	0.385	H1 rejected
Education and skills have a positiveeffect on innovation in Southeast Asian and East Asian countries	0.322	3.189	0.002	H2 accepted
Information and Communication Infrastructure has a Positive Effect onEconomic Growth in countries in Southeast Asia and East Asia.	-0.380	2.410	0.016	H3 is rejected
Information and Communication Infrastructure has a Positive Effect onInnovation in countries in the Southeast Asia and East Asia region	0.226	2.069	0.039	H4 accepted
Economic and institutional frameworkshave a positive effect on economic growth in Southeast and East Asian countries.	-0.179	1.056	0.291	H5 rejected
Economic and institutional frameworkspositively affect innovation in Southeast and East Asian countries	0.364	2.887	0.004	H6 accepted
Accountability has a positive effect oneconomic growth in countries in Southeast Asia and East Asia.	-0.189	1.463	0.144	H7 is rejected
Accountability has a positive effect on innovation in countries in SoutheastAsia and East Asia.	-0.009	0.092	0.927	H8 rejected
Innovation has a positive effect oneconomic growth in countries in Southeast Asia and East Asia.	0.359	3.054	0.002	H9 accepted

Source: Author's processed data (2024)

Furthermore, the path from education to economic growth through innovation shows significant results with an original sample value of 0.116 and a p-value of 0.022. This indicates that education significantly indirectly affects economic growth through increased innovation. Better education encourages innovation, which in turn boosts economic growth. This emphasizes the importance of investing in education to promote a knowledge-based economy.

The path from IT infrastructure to economic growth through innovation shows an original sample value of 0.081 with a p-value of 0.083. While this effect is not significant at the 5% level, this result is significant, suggesting that IT

infrastructure may have an indirect positive impact on economic growth through innovation. It is essential to conduct further analysis to understand this dynamic fully and understand why significance was not reached. Finally, the path from institutions to economic growth through innovation shows an original sample value of 0.131 with a p-value of 0.035. This suggests that institutions significantly indirectly affect economic growth through innovation. Solid and effective institutions encourage innovation, contributing to economic growth. This emphasizes the importance of good governance and supportive regulations in creating a conducive environment for innovation and economic development.

Overall, these results suggest that education and institutions significantly and indirectly influence economic growth through innovation, highlighting the critical role of both factors in supporting a knowledge-based economy. On the other hand, accountability and IT infrastructure require a more holistic approach and further analysis to ensure that investments in these sectors can effectively translate into economic growth through innovation pathways.

4.2 Discussion

The effect of education and skills on economic growth in Southeast and East Asian countries: The hypothesis that education and skills positively affect economic growth in Southeast and East Asian countries was tested through path analysis in this study. The analysis results show a path coefficient of 0.118, with a t-value of 0.870 and a p-value of 0.385. Based on these results, the hypothesis is not accepted as the p-value is more significant than 0.05, which means that the effect of education on economic growth is not statistically significant. The path coefficient of 0.118 indicates a positive relationship between education and economic growth, but this relationship is fragile. The t-value of 0.870 is less than the critical value required to achieve statistical significance at conventional levels (usually 1.96 for a significance level of 0.05). The p-value of 0.385 is well above the 0.05 threshold, indicating that the probability of the effect of education on economic growth occurring by chance is very high. The results of this study are different from previous research by Marquez Ramos & Mourelle [24], Valente et al. [25], and Odhiambo [26], which states that education and skills have a positive and significant nomic growth of education and skills on innovation in Southeast and East Asian countries The hypothesis that education and skills positively affect innovation in Southeast and East Asian countries was tested using path analysis. The analysis results show a path coefficient of 0.322 with a t-value of 3.189 and a p-value of 0.002. Based on these results, the hypothesis is accepted as the p-value is less than 0.05, which means that the effect of education on innovation is statistically significant.

The path coefficient of 0.322 indicates a moderately strong positive relationship between education and innovation. The t-value of 3.189 indicates that this relationship is significant at a high statistical level. The p-value of 0.002, which is well below the 0.05 threshold, confirms that this result did not occur by chance and supports the hypothesis that education positively affects innovation. The results of this study are by the results of previous research by Biasi et al. (2013), Mir-Babayev [40], Ahmed & Al-Roubaie [7] and Alizadeh & Salami, 2015 which state that education and skills have a positive and significant influence on innovation.

The influence of education and skills on innovation in Southeast and East Asian countries: The hypothesis that information and communication (IT) infrastructure positively affects economic growth in Southeast and East Asian countries was tested using path analysis.

The analysis showed a path coefficient of -0.380 with a t-value of 2.410 and a p-value of 0.016. Based on these results, the hypothesis is rejected as the empirical data shows that IT infrastructure significantly negatively affects economic growth, as the p-value is less than 0.05.

The path coefficient of -0.380 indicates a significant negative relationship between IT infrastructure and economic growth. The t-value of 2.410 indicates that this relationship is meaningful at a high statistical level. The p-value of 0.016, less than the threshold of 0.05, confirms that this result does not occur by chance and supports the hypothesis that IT infrastructure has a significant but negative influence on economic growth.

The results of this study are not to the results of previous research by Liu [28], Kurniawati [29], Pradhan et al. [9], Toader et al. [30], Bahrini & Qaffas [31] and Kumari & Singh, [41] which states that information and communication infrastructure has a positive and significant effect on economic growth.

The Effect of Information and Communication Infrastructure on Economic Growth in Southeast Asian and East Asian Countries: The hypothesis that information and communication (IT) infrastructure has a positive effect on economic growth in countries in Southeast Asia and East Asia was tested using path analysis. The analysis showed a path coefficient of -0.380 with a t-value of 2.410 and a p-value of 0.016. Based on these results, the hypothesis is rejected as the empirical data shows that IT infrastructure has a significant negative effect on economic growth, as the p-value is less than 0.05.

The path coefficient of -0.380 indicates a significant negative relationship between IT infrastructure and economic growth. The t-value of 2.410 indicates that this relationship is significant at a high statistical level. The p-value of 0.016, which is less than the threshold of 0.05, confirms that this result does not occur by chance and supports the hypothesis that IT infrastructure has a significant, but negative, influence on economic growth.

The results of this study are not by the results of previous research by Liu [28], Kurniawati [29], Pradhan et al [9], Toader et al [30], Bahrini & Qaffas [31] and Kumari & Singh, [41] which states that information and communication infrastructure has a positive and significant effect on economic growth.

The influence of information and communication infrastructure on innovation in Southeast and East Asian countries: The hypothesis that information and communication (IT) infrastructure positively affects innovation in Southeast and East Asian countries was tested using path analysis. The analysis results show a path coefficient of 0.226 with a t-value of 2.069 and a p-value of 0.039. Based on these results, the hypothesis is accepted because the empirical data show that IT infrastructure significantly influences innovation, with a p-value of less than 0.05.

The path coefficient 0.226 indicates a significant positive relationship between IT infrastructure and innovation. The t-value of 2.069 indicates that this relationship is meaningful at a high statistical level. The p-value of 0.039, which is less than the threshold of 0.05, confirms that this result does not occur by chance and supports the hypothesis that IT infrastructure has a significant and positive influence on innovation.

The results of this study are not by the results of previous research by Jabbouri et al. [27], Widajanti & Ratnawati [42] and Karadal & Saygın [43], which states that information and communication infrastructure has a positive and significant effect on innovation.

The influence of economic and institutional frameworks on economic growth in Southeast and East Asian countries: Analyzing the relationship between the economic and institutional framework and economic growth shows that the path coefficient is -0.179 with a t-value of 1.056 and a p-value of 0.291. Based on these results,the hypothesis that economic and institutional frameworks positively affect economic growth in Southeast and East Asian countries is rejected. A p-value greater than 0.05 indicates no significant effect of institutional variables on economic development in this model. This discussion will detail why the hypothesis is rejected and the implications for economic and institutional policies in the region.

The path coefficient of -0.179 indicates a weak negative relationship between institutional quality and economic growth, although it is not statistically significant. The t-value of 1.056 and p-value of 0.291 suggest that this relationship cannot be considered important at the commonly used confidence level (5%). Therefore, changes in institutional quality have not been shown to significantly affect economic growth in Southeast and East Asian countries based on the model used in this study.

The results of this study are not by the results of previous research by Sehrawat & Giri [34], Olaoye & Aderajo [16], Nguyen et al. [44], Tran et al. [45], Acquah et al. [46] and Chandra & Yokohama [11] which state that the economic and institutional framework has a positive and significant effect on economic growth.

The influence of economic and institutional frameworks on innovation in Southeast and East Asian countries: The economic and institutional framework is an essential foundation for a country's economic and social development. Solid and sound institutions play a crucial role in creating an environment conducive to innovation and promoting sustainable economic growth. Countries in the Southeast and East Asia region, which are at various stages of economic development, can significantly benefit from effective institutions that foster innovation.

In analyzing the relationship between the economic and institutional framework and innovation, the path coefficient obtained is 0.364 with a t-value of 2.887 and a p-value of 0.004. These results indicate that institutions significantly influence innovation, as the p-value is less than 0.05. Thus, the hypothesis that "Economic and institutional frameworks have a positive effect on innovation in Southeast and East Asian countries" is accepted. The results of this study are from previous research by Jamal Tilchin [36], which states that the economic and institutional framework has a positive and significant influence on innovation.

The effect of Accountability on economic growth in Southeast and East Asian countries: In analyzing the relationship between accountability and economic growth,the path coefficient obtained is -0.189 with a t-value of 1.463 and a p-value of 0.144. These results indicate that accountability does not significantly affect economic growth because the p-value is more significant than 0.05. In other words, an increase or decrease in the accountability variable does not significantly impact the economic growth variable in this model. Therefore, the hypothesis that accountability positively affects economic growth in Southeast Asian and East Asian countries is rejected. This discussion will detail why this hypothesis is rejected and the implications for the region's accountability policy and economic growth.

The path coefficient of -0.189 with a p-value of 0.144 indicates that accountability has an insignificant negative effect on economic growth. The value of 1.463 indicates that this relationship is not statistically significant at the 5% confidence level. Thus, in this model, changes in accountability levels do not significantly affect economic growth in Southeast and East Asian countries.

This study's results are not from the results of previous research by Matthew et al. [38], which states that accountability has a positive and significant effect on economic growth.

Accountability's influence on innovation in Southeast and East Asian countries: Accountability is often considered a key element in good governance, which can promote transparency, public trust and a healthy business environment. In economics and innovation, accountability is assumed to play a role in creating a favourable climate for creativity and technological development. However, in analyzing the relationship between accountability and innovation in Southeast and East Asian countries,the results show that empirical data do not support this hypothesis.

The path coefficient of -0.009 with a p-value of 0.927 indicates that accountability has an insignificant negative influence on innovation. The tvalue of 0.092 also shows that this relationship is not statistically significant at the 5% confidence level. Thus, in this model, changes in accountability levels do not significantly affect innovation in Southeast and East Asian countries. This study's results are not from the results of previous research by Jamal Tilchin [36], which states that accountability has a positive and significant effect on innovation.

The effect of innovation on economic growth in Southeast and East Asian countries: Innovation has long been recognized as one of the critical drivers of economic growth. With the advent of the industrial and technological revolutions, innovation has played a vital role in driving productivity, creating new jobs, and improving global competitiveness. In the context of Southeast and East Asian countries, innovation becomes even more critical as these countries strive to address economic and social challenges while promoting sustainable growth. In analyzing the relationship between innovation and economic growth, the path coefficient obtained is 0.359 with a t-value of 3.054 and a p-value of 0.002. These results indicate that innovation significantly influences economic growth, as the p-value is less than 0.05. In other words, an increase in innovation substantially contributes to economic growth. Based on these results, the hypothesis that "innovation has a positive effect on economic growth in Southeast and East Asian countries" is accepted.

The results of this study are the results of previous research by Forson et al. [47], Thangavelu et al. [19], Long [48], Maradana et al. [20], and Marlinah [49], which state that innovation has a positive and significant effect on economic growth [50,51].

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Based on the analysis of the relationship between various factors and economic growth and innovation in Southeast and East Asian countries, several main conclusions can be drawn:

Education and skills have a positive effect on economic growth in countries in Southeast Asia and East Asia: This hypothesis is rejected. Education and skills show no significant impact on economic development, as indicated by a path coefficient of 0.118, a t-value of 0.870, and a p-value of 0.385. Education and skills have a positive effect on innovation in countries in Southeast Asia and East Asia: This hypothesis is accepted. Education and skills significantly positively affect innovation, with a path coefficient of 0.322, a t-value of 3.189, and a p-value of 0.002.

Information and Communication Infrastructure has a positive effect on economic growth in Southeast and East Asian countries: This hypothesis is rejected. IT infrastructure significantly negatively affects economic growth, with a path coefficient of -0.380, a t-value of 2.410, and a p-value of 0.016. Information and Communication Infrastructure has a positive effect on innovation in countries in Southeast Asia and East Asia: This hypothesis is accepted.

IT infrastructure has a significant positive impact on innovation, with a path coefficient of 0.226, a t-value of 2.069, and a p-value of 0.039. Economic and institutional frameworks positively affect economic growth in Southeast and East Asian countries: This hypothesis is rejected. Institutions have no significant effect on economic development, as indicated by the path coefficient of -0.179, t-value of 1.056, and p-value of 0.291. Financial and institutional frameworks have a positive effect on innovation in countries in Southeast Asia and East Asia: This hypothesis is accepted. Institutions have a significant favourable influence on innovation, with a path coefficient of 0.364, a t-value of 2.887, and a p-value of 0.004.

Accountability has a positive effect on economic growth in countries in Southeast Asia and East Asia: This hypothesis is rejected. Accountability shows no significant impact on economic development, with a path coefficient of -0.189, a t-value of 1.463, and a p-value of 0.144. Accountability has a positive effect on innovation in countries in Southeast Asia and East Asia: This hypothesis is rejected. Accountability has no significant impact on innovation, as indicated by a path coefficient of -0.009, a t-value of 0.092, and a p-value of 0.927.

Innovation has a positive effect on economic growth in Southeast and East Asian countries: This hypothesis is accepted. Innovation has a significant positive impact on economic development, with a path coefficient of 0.359, a value of 3.054, and a p-value of 0.002.

5.2 Recommendation

Based on the results of this study, several recommendations can be made for policymakers in Southeast Asian and East Asian countries:

1. Improving the Quality of Education Although education does not directly influence economic growth, it is essential to continuously improve the quality of teaching to encourage innovation that will ultimately impact economic growth.

2. Investment in ICT Infrastructure: The government should continue to invest in ICT infrastructure to support the innovation ecosystem, which has proven to have a positive impact.

3. Investment in ICT Infrastructure: The government should continue to invest in ICT infrastructure to support the innovation ecosystem, which has proven to have a positive impact. Strengthening Institutions: Building strong and effective institutions is critical to fostering innovation. Policies that support good governance and clear regulations will create a conducive environment for innovation.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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