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Digital policy initiatives and infrastructure in Malaysia: driving economic and financial growth through the Digital Economy Performance Indicator

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Abstract

Purpose – This study evaluates the role of digital infrastructure and policy initiatives in Malaysia's economic growth, focusing on the Digital Economy Performance Indicator (DEPI) from 2017 to 2021.
Design/methodology/approach – Through the implementation of national initiatives like the Digital Free Trade Zone (DFTZ) and the National Fiberisation and Connectivity Plan (NFCP), Malaysia has emphasized the importance of digital transformation for economic resilience and global competitiveness. The DEPI framework assesses key dimensions—connectivity, affordability, infrastructure, human capital, and digital technology integration—using the entropy weight coefficient method to ensure objectivity.
Findings – Findings suggest that while Malaysia has made notable progress in digital connectivity and infrastructure, challenges persist in affordability, especially in rural areas. The development of human capital, particularly digital literacy, also remains crucial for long-term sustainability.
Practical implications – The research concludes that further investment in digital infrastructure and skills development is essential for Malaysia to thrive in the global digital landscape.
Originality/value – This study offers insights for policymakers to address the digital divide and foster a more inclusive and competitive digital economy.
Peer review – The peer review history for this article is available at: https://publons.com/publon/10.1108/IJSE-10-2024-0826

Keywords Digital economy performance indicator, Digital infrastructure, Digital transformation, Economic growth
Paper type Research paper

1. Introduction

The rapid digital transformation occurring globally has positioned the digital economy as a critical driver of national development and economic growth. In Malaysia, the government's strategic initiatives—such as the "Malaysia Digital Economy Blueprint (MyDIGITAL)" and "National Fiberisation and Connectivity Plan (NFCP)"—underscore the importance of harnessing digital technologies to foster economic resilience, innovation, and global competitiveness (Malaysia Digital Economy Corporation, 2021a, b). MyDIGITAL is a government plan to help Malaysia grow its digital economy. It includes strategies to improve internet access, digital skills, and online businesses, making Malaysia more competitive in the digital world. NFCP is a government program to improve internet speed and coverage across Malaysia. It focuses on expanding fiber-optic networks and mobile connectivity, especially in

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rural areas, so that more people can access fast and reliable internet. These initiatives are designed to integrate digital technologies into various sectors, from business and education to healthcare and government services, thus creating an ecosystem where technology is a fundamental enabler of economic activities.

Malaysia's digital economy has grown substantially in recent years, contributing approximately 22.6% to the nation's GDP in 2021 (Department of Statistics Malaysia, 2022). Internet penetration reached 89.6% in 2021, with mobile broadband subscriptions surpassing 130% of the population (Malaysian Communications and Multimedia Commission, 2021). The government has set ambitious targets under MyDIGITAL, aiming for the digital economy to contribute 25.5% of GDP by 2025 (Economic Planning Unit, 2021). Additionally, the number of SMEs adopting digital solutions has increased due to various incentives such as the SME Digitalization Grant and the eCommerce Adoption initiative (Ministry of Finance Malaysia, 2022). Despite these advancements, challenges persist in bridging the urban-rural digital divide and improving cybersecurity measures (World Bank, 2021). These statistics provide a clearer picture of Malaysia's digital landscape and highlight the country's trajectory in digitalization.

The main objective of this research is to assess the impact of digital infrastructure and policy initiatives on Malaysia's economic growth by utilizing the Digital Economy Performance Indicator (DEPI). This tool evaluates the country's digital economy across several key dimensions—connectivity, affordability, infrastructure, human capital, and digital technology integration—offering a holistic view of how digitalization contributes to Malaysia's economic development. The study aims to determine how these factors influence national economic performance and to identify the areas in need of policy adjustments or further investment to maximize the benefits of the digital economy.

By focusing on the period from 2017 to 2021, this research seeks to capture the evolution of Malaysia's digital economy, highlighting key trends and outcomes from the implementation of major government programs, including the Digital Free Trade Zone (DFTZ) and the NFCP (MDEC, 2021a, b). DFTZ is an online trading hub that helps Malaysian businesses sell their products globally. It makes international trade easier for small businesses by providing better logistics, e-commerce support, and faster customs processing. A core goal of the study is to examine how Malaysia's digital economy measures up in international benchmarks, given the increasing global competition in digital innovation and services.

While Malaysia has made significant strides in digitalization, gaps remain in digital infrastructure, affordability, and human capital development. Existing research primarily focuses on macroeconomic outcomes without adequately addressing the effectiveness of government policies in bridging these gaps (World Economic Forum, 2022). This study aims to fill this void by assessing the real impact of digital policies on Malaysia's economy, particularly in underrepresented sectors and regions. Key issues include limited high-speed broadband accessibility in rural areas, the slow adoption of digital payment systems among traditional businesses, and disparities in digital literacy levels across different demographics (IMF, 2021). By identifying and analyzing these critical challenges, this research provides a more precise and data-driven examination of Malaysia's digital economic progress.

The motivation for this study arises from the growing recognition of the digital economy as a transformative force in modern societies. Malaysia, like many developing economies, is undergoing a shift from traditional economic activities to technology-driven sectors. Digitalization promises numerous advantages, including improved efficiency, access to global markets, and enhanced productivity across industries (Asian Development Bank, 2021). However, realizing these benefits requires not only the development of physical infrastructure but also addressing critical issues such as affordability, digital literacy, and regional disparities in access to digital services.

Despite significant investments in digital infrastructure, Malaysia still faces challenges, particularly in rural areas, where digital access and affordability lag behind urban centers (Malaysia Communications and Multimedia Commission, 2021). Moreover, the digital economy's success is intricately linked to human capital—requiring a digitally literate and

technologically skilled workforce capable of driving and sustaining innovation (World Bank, 2021). These challenges are compounded by the rapid pace of technological advancements, which require continuous adaptation of policies and strategies to ensure the inclusivity and sustainability of Malaysia's digital transformation.

This study is motivated by the need to provide an objective assessment of Malaysia's digital economy using the DEPI framework. The use of the entropy weight coefficient method ensures a data-driven, unbiased approach to evaluating the performance of various indicators, mitigating the influence of subjective human judgment. In short, this is a way to determine the importance of different factors in a study. It looks at how much information each factor provides and gives more weight to the ones that have a bigger impact, ensuring that decisions are based on real data rather than personal opinions. By identifying the strengths and weaknesses in Malaysia's digital economy, this research aims to offer actionable insights for policymakers and stakeholders, ensuring that Malaysia's digital future is inclusive, sustainable, and competitive on the global stage.

In summary, the motivation and objective of this study are rooted in understanding the evolving role of digitalization in Malaysia's economic growth, identifying barriers to progress, and offering a roadmap for future digital policies that will allow Malaysia to thrive in the global digital economy.

2. Literature review

The digital economy's transformative power has been well documented across various fields, including economics, business, and governance. Shannon's theory of information and uncertainty (Shannon and Weaver, 1949) has laid the foundation for entropy-based approaches like the entropy weight coefficient method used in assessing digital economy metrics (Zhu *et al*., 2020). These methodologies are pivotal for understanding how digital infrastructure, internet connectivity, and digital services contribute to a country's economic success (Li *et al*., 2016; Gao *et al*., 2018). However, existing research does not sufficiently address the specific challenges Malaysia faces, such as regional disparities in digital infrastructure and affordability issues.

Several studies highlight the direct correlation between digital infrastructure and economic growth. For instance, Shen *et al*. (2015) note that improvements in digital infrastructure significantly enhance productivity and international trade. Similarly, the International Telecommunication Union (ITU) and World Bank have developed frameworks emphasizing the role of digital adoption in fostering economic development, particularly in emerging economies. Zou *et al*. (2016) further highlight that regions with greater broadband penetration and robust digital policies experience faster economic recovery, especially in the wake of global disruptions like the COVID-19 pandemic. However, methodological differences exist across these studies, particularly regarding how digital contributions to economic growth are quantified. While some researchers utilize entropy-based approaches, others rely on regression analyses or composite indices, leading to variations in reported findings.

Malaysia's digital transformation journey, as outlined in the Malaysia Digital Economy Blueprint (MyDIGITAL) (2021), emphasizes the importance of human capital and digital inclusion. According to Shemshadi *et al*. (2011), countries with higher levels of digital literacy and technology integration demonstrate better economic performance. Empirical studies also indicate that Malaysia's broadband penetration increased by 12% between 2018 and 2021, directly contributing to a 3.5% rise in GDP (MDEC, 2021a, b). Malaysia's strategy aligns with global trends in developing digital skills through initiatives aimed at enhancing education, internet access, and affordability, as discussed by Zheng *et al*. (2017). Yet, despite these efforts, challenges remain in achieving widespread digital adoption due to uneven infrastructure development and affordability issues. Studies by Tan *et al*. (2022) indicate that while digital literacy and adoption rates are increasing, certain segments of the population still face barriers, limiting their participation in the digital economy.

While the Digital Free Trade Zone (DFTZ) and National Fiberisation and Connectivity Plan (NFCP) have been significant milestones in Malaysia's digital economy, several areas, such as digital affordability and human capital development, continue to lag behind, as noted by multiple reports, including those from the World Bank and OECD. Additionally, empirical studies on Malaysia's digital transformation remain scarce compared to broader global frameworks. Future research should explore Malaysia-specific case studies, particularly on the effectiveness of MyDIGITAL policies in bridging the digital divide.

2.1 Theoretical underpinnings

This study draws upon the Technology Acceptance Model (TAM) (Davis, 1989) and Diffusion of Innovations Theory (Rogers, 1962) to examine digital adoption patterns in Malaysia.

TAM posits that two key factors influence technology adoption: perceived usefulness and perceived ease of use. Perceived usefulness refers to the degree to which a person believes that using a particular system enhances their performance, while perceived ease of use reflects the effort required to utilize the system (Venkatesh and Davis, 2000). This model is highly relevant in analyzing Malaysia's digital economy, as it helps explain how businesses, consumers, and government entities embrace digital transformation. Factors such as government incentives, digital literacy programs, and infrastructure improvements all play a role in shaping perceptions of digital adoption.

The Diffusion of Innovations Theory (Rogers, 1962) provides another crucial framework for understanding how digital innovations spread throughout society. Rogers classifies adopters into five categories: innovators, early adopters, early majority, late majority, and laggards. Each group has distinct characteristics, and their adoption behavior is influenced by factors such as perceived relative advantage, compatibility with existing systems, complexity, trialability, and observability. In the context of Malaysia, this theory provides a useful lens to analyze how digital initiatives like MyDIGITAL gain traction among different societal and economic segments. The government's role in fostering innovation diffusion through policies, incentives, and awareness campaigns is critical in ensuring widespread digital transformation.

By integrating these theoretical perspectives, this study offers a comprehensive approach to assessing Malaysia's digital economy, highlighting key drivers and barriers to technology adoption and proposing strategies for enhancing digital engagement across various sectors.

2.2 Research gaps

The existing literature highlights the positive economic impact of digital transformation but lacks a focused analysis of Malaysia's unique challenges. The primary research gaps include:

(1) Limited discussion on the affordability and accessibility of digital services.

(2) Insufficient empirical studies on Malaysia-specific initiatives like MyDIGITAL and DFTZ.

(3) Lack of critical evaluation of methodological approaches used in digital economy assessments.

This study seeks to address these gaps by providing empirical insights into Malaysia's digital economy, evaluating policy effectiveness, and proposing strategic recommendations for enhanced digital inclusion.

3. Research method

The Digital Economy Performance Indicator (DEPI) measures Malaysia's progress towards a digital economy. DEPI therefore brings together a relevant set of indicators for Vietnam's current digital policy portfolio. The DEPI is developed based on the guidelines and recommendations in the OECD (2008). The data collected range from International

Telecommunication Union, World Bank, GSMA Intelligence, UNESCO, United Nations E-Government Development Database and Statista Market Insights, covering the period from 2017 to 2021. Based on the collected data, Table 1 presents the dimensions, sub-dimensions, and elements that constitute Malaysia's DEPI structure.

The choice of the period from 2017 to 2021 is particularly significant due to the rapid acceleration of digital transformation initiatives during this time. This period coincides with

Table 1. DEPI structure of Malaysia

Dimension	Sub-dimension	Element	Unit
Connectivity	Subscription	Fixed-telephone subscriptions	Per 100 inhabitants
		Fixed-broadband subscriptions	Per 100 inhabitants
		Mobile-cellular subscriptions	Per 100 inhabitants
		Mobile-broadband subscriptions	Per 100 inhabitants
	Network Coverage	2G Population Coverage	Population, %
		3G Population Coverage	Population, %
		4G Population Coverage	Population, %
	Network Performance	Average mobile broadband download speeds	%
		Average mobile broadband upload speeds	%
		Average mobile broadband latencies	%
Infrastructure	Network Transfer	International bandwidth per Internet user	kbit/s
		Number of secure internet servers	Per 1 million people
		Internet Exchange Points (IXPs)	Per 10 million people
	Spectrum	Spectrum in bands 1–3 GHz	%
		Other spectrum below 1 GHz	%
Affordability	Price Basket	Fixed-broadband basket	USD
		Data-only Mobile-broadband Basket	USD
		Mobile-cellular low-usage basket	USD
		Mobile data and voice low-consumption basket	USD
		Mobile data and voice high-consumption basket	USD
Human Capital	Accessibility	Individuals using the Internet	Population, %
		Mobile Ownership	Population, %
	Education	Adult literacy rate	Population, %
		School life expectancy	Population, %
		Mean years of schooling	Population, %
		Tertiary enrollment	Population, %
Digital Integration of Technology	Digital Media	Digital Music	Penetration rate, %
		ePublishing	Penetration rate, %
		Video Games	Penetration rate, %
		Video-on-Demand	Penetration rate, %
	Digital Commerce	Digital Commerce	Penetration rate, %
		ICT goods exports	% of Total Goods Exports
	Digital Health	Users in Digital Fitness and Well-Being	Penetration rate, %
		Users in e-Health	Penetration rate, %
	Online Security	ITU Global Cybersecurity Index	Score out of 100
	e-Government	Online Service Index score for E-Government	Score out of 100

key policy shifts, increased investments in digital infrastructure, and major advancements in e-commerce, fintech, and digital governance in Malaysia. Additionally, the timeframe allows for an assessment of digital economic resilience before and during the COVID-19 pandemic, providing valuable insights into the impact of external shocks on digital growth. Expanding or contrasting this period with other timelines may provide a broader perspective, but this particular range was selected to maintain focus on the most recent, impactful trends.

3.1 Data treatment

To treat the data effectively, it's important to handle outliers and impute any missing values. Outliers can skew the data distribution, affecting the overall index scores. For instance, a country with exceptionally low download speeds compared to others can disproportionately lower its score while making other countries appear to have higher scores with minimal variation. To identify outliers, we can assess the skewness and kurtosis of the data. Skewness measures the asymmetry of the data distribution. A skewness value greater than 2 or less than −2 indicates a high level of asymmetry. Kurtosis measures the tailedness of the data distribution. A kurtosis value above 3.5 indicates a heavy tail, suggesting the presence of outliers. These thresholds were chosen based on statistical best practices in econometric and digital economic studies, where values beyond these cut-offs typically indicate data points that significantly deviate from normality (Tabachnick and Fidell, 2013). This helps ensure the robustness of the DEPI by mitigating extreme variations that could distort the findings. This study is using the formulas as follow:

$$\text{Skewness} = \frac{\sum_{i=1}^{N}\left(Y_i - \overline{Y}\right)^3 \Big/ N}{s^3} \quad \text{Eq. (1)}$$

$$\text{Kurtosis} = \frac{\sum_{i=1}^{N}\left(Y_i - \overline{Y}\right)^4 \Big/ N}{s^4} \quad \text{Eq. (2)}$$

where i represents yearly sample by country, $i = 1, 2, 3, \ldots, N$; Y_i is the value in ith sample; $\overline{Y}$ is the mean of Y_i; and s is the standard deviation of Y_i.

If the thresholds are met, one of two treatment approaches is adopted:

(1) Winsorisation: This is a method that mitigates the effects of outliers by replacing them with less extreme values. Outlier variables are trimmed to the nearest value until the indicator is brought within the specified ranges for skewness and kurtosis. For example, the indicator "fixed telephone subscriptions per 100 inhabitants" used in this study has an outlier value of 10.3 and the next highest value is 4.2, the former value is thus trimmed to 4.2. The process stops if this gives acceptable skewness and kurtosis scores. Otherwise, the two values are continued to be trimmed to the next highest value. This process is continued until the indicator falls within the specified skewness and kurtosis ranges. In order to ensure that a large number of observations are not adjusted in the dataset, a maximum of six observations are trimmed. If this is still insufficient to reduce skewness and kurtosis, the second approach is implemented.

(2) Transformation: Since most indicators with high skewness and kurtosis are right-skewed, a logarithmic transformation is employed to bring these indicators within the specified ranges. For example, the indicator "International bandwidth per user (kbit/s)" undergoes a logarithmic transformation even if it does not exceed the skewness and kurtosis thresholds. This is due to its significantly larger values, such as

119,998.43 kbit/s, which can be adjusted to values closer to the others through logarithmic transformation.

3.2 Normalization

Normalization is required in an index to adjust for different units of measurement and varying ranges of variation across the indicators. The minimum-maximum method is used, transforming all indicators to fall within a range of 0–100 using the following formula:

$$I_q^t = \left(\frac{x_q^t}{\max\left(x_1\right)} * 99\right) + 1 \qquad \text{Eq. (3)}$$

$$I_q^t = \left(99 - \left(\frac{x_q^t}{\max\left(x_q\right)} * 99\right)\right) + 1 \qquad \text{Eq. (4)}$$

where "I" is the normalized min-max value, "x" represents the actual value, and the subscripts "q" and "c" represent the indicator and country respectively. This method has been chosen over alternatives such as rankings and categorical scales because it retains interval-level information. As part of the normalisation process, all indicators are transformed such that they have the same orientation – i.e. a higher score always represents a "better" score. When selecting data, certain criteria have been strictly adhered to. For instance, the data must be updated regularly to ensure that the resulting research remains valid and that similar research can be continued in the future. Consequently, discontinued data series, even if relevant to digital economy, have been excluded.

3.3 Determine weights based on entropy

This study employs the entropy weight coefficient method to determine the weights of various indicators for several key reasons. First, entropy serves as a measure of uncertainty, with its value being inversely related to the amount of information present. Lower entropy values indicate higher information content, which in turn reflects greater weight. By using a data-driven approach to calculate weights, this method reduces the impact of human biases, thereby improving the objectivity of the comprehensive evaluation (Zhu *et al.*, 2020).

Additionally, the entropy weight coefficient method is widely recognized due to its reliance on the dataset's inherent information and its relatively simple computational process. Rooted in information theory, entropy quantifies uncertainty or information (Shannon, 1949; Shannon and Weaver, 1949; Li *et al.*, 2016; Gao *et al.*, 2018) and has been applied in diverse fields such as water quality assessment, engineering, and economics (Zou *et al.*, 2016). It is also frequently used for regional development analysis (Shen *et al.*, 2015). According to Shemshadi *et al.* (2011), this method is effective for assigning weights to a set of indicators and evaluating development performance.

While the methodology is well-structured and appropriate for achieving the study's objectives, its grounding in a theoretical framework needs further elaboration. The entropy weight method aligns with principles of information theory (Shannon, 1949), which quantifies uncertainty and has been widely used in decision-making models, including economic and digital transformation studies. Additionally, the DEPI framework could benefit from references to established digital economy conceptual models such as the Digital Economy and Society Index (DESI) and the World Economic Forum's Network Readiness Index (NRI). These frameworks provide a broader context for interpreting the study's findings and enhance its theoretical foundation.

Although the study primarily employs a quantitative approach, some indicators, such as human capital development, have qualitative dimensions that may not be fully captured by numerical measures. Future research could incorporate qualitative validation methods, such as expert interviews or case studies, to complement the entropy-based weighting and provide

richer insights into Malaysia's digital economy performance. By integrating these additional considerations, the study strengthens its methodological rigor, enhances real-world applicability, and aligns its findings with broader theoretical frameworks.

The application of the entropy weight coefficient method generally follows three steps, as demonstrated in several studies, including Shen *et al*. (2015), Zheng *et al*. (2017), and Gao *et al*. (2018):

Step 1: Calculating the proportion of each indicator. After normalization, calculate the proportion of R_{ij}, divided by the sum of R_{ij}, as follows:

$$f_{ij} = \frac{R_{ij}}{\sum_j^m R_{ij}} \quad \text{Eq. (5)}$$

Step 2: Computing the entropy value. According to the value of f_{ij}, the formula of the entropy value is written as follows, where h_i represents the value of the entropy of each variable:

$$h_i = -k\sum_j^m f_{ij} \times \ln\left(f_{ij}\right) \quad \text{Eq. (6)}$$

$$k = \frac{1}{\ln(m)} \quad \text{Eq. (7)}$$

Step 3: Determining the weight coefficients. According to the value of entropy among the indicators, now the weight ω_i of *i*th variable can be determined as such:

$$\omega_i = \frac{1 - h_i}{\sum_i^n (1 - h_i)} \quad \text{Eq. (8)}$$

By following these steps, the entropy weight coefficient method ensures a data-driven, objective approach to determining indicator weights, thereby enhancing the reliability and validity of the Vietnam's DEPI.

4. Findings and discussions

Studies over the years have shown that Malaysia achieves satisfactory results in all aspects except affordability, which is below satisfactory. Performance on the human capital front looks positive, but also points to the need for more to be done to develop capable talent to enable Malaysia to take full advantage of the digital integration of its digital economy. Subsequently, cultivating talent has become one of the crucial drivers of the Malaysia Digital Economy Blueprint (MyDIGITAL) released in February 2021, specifying 13 strategies to be implemented over the next five years (Economic Planning Unit, 2021).

Efforts to promote the integration of digital technology in Malaysia have led to significant shifts in consumer behavior, with 70% now preferring retail stores that accept digital payments (Bank Negara Malaysia, 2022). The government, in collaboration with the central bank, Bank Negara Malaysia, has been actively fostering the development of electronic payment infrastructure and boosting public trust in digital transactions. Since 2017, Malaysia has initiated the Digital Free Trade Zone (DFTZ), aimed at facilitating cross-border trade for small and medium-sized enterprises and attracting e-commerce investment (Malaysia Digital Economy Corporation, 2018). Spearheaded by the Malaysia Digital Economy Corporation (MDEC), the DFTZ involves partnerships between government bodies, industry players, and e-commerce facilitators like Alibaba. Additionally, the Ministry of Communications and

Multimedia (KKMM) has been tasked with overseeing the National Digital Identity (NDI) initiative, seeking feedback from citizens on its potential use across various sectors such as healthcare, financial services, e-commerce, pensions, and government online services.

In 2019, the government introduced the National Fiberisation and Connectivity Plan (NFCP) to bridge the digital gap by extending coverage and enhancing the quality of both fixed and mobile broadband services. In 2020, an allocation of RM3 billion was earmarked to implement six NFCP initiatives (Ministry of Communications, 2020). These initiatives are expected to foster an ecosystem benefiting various stakeholders including communication service providers, local contractors, equipment manufacturers, and solution providers. Over the five-year implementation period, approximately 20,000 new employment opportunities are projected to be generated. Furthermore, the government has dedicated RM20 million to accelerate the digitalization of government service delivery initiatives under the National Economic Recovery Plan (PENJANA), aligning with the objectives of the Public Sector ICT Strategic Plan.

It is essential to focus on enhancing the overall affordability of digital services and further developing human capital. Despite the strides made in digital infrastructure and integration, the high cost of digital access remains a key challenge, particularly for small and medium-sized enterprises (SMEs) and low-income populations. Addressing affordability will require policy interventions such as pricing regulations, subsidies, and partnerships with private sector stakeholders to offer cost-effective digital services. Additionally, human capital development remains a critical priority, as a more digitally skilled workforce is necessary to fully capitalize on technological advancements. Upskilling and reskilling initiatives, particularly in emerging areas such as data science, artificial intelligence, and cybersecurity, will equip the workforce to drive innovation and sustain Malaysia's digital economy growth. By focusing on these areas, Malaysia can maximize the benefits of its digital economy.

Figure 1 presents a comparative analysis of Malaysia's performance across different digital economy dimensions over the period 2017–2021. The figure illustrates key trends in connectivity, infrastructure, affordability, human capital, and digital integration. Notably, while connectivity and digital integration have shown consistent improvement, affordability remains a persistent challenge. This supports the argument that targeted interventions, such as pricing regulations and affordability programs, are necessary to ensure equitable access to digital services.

4.1 Logical reasoning behind main findings and theoretical linkages

The study's main findings are closely aligned with established theoretical frameworks, particularly innovation diffusion theory (Rogers, 2003) and the digital divide theory (van Dijk, 2005).

(1) Connectivity and Infrastructure Development: According to the innovation diffusion theory, technological advancements spread in stages, requiring adequate infrastructure and early adopters to drive further expansion. The findings suggest that while Malaysia has made significant progress in expanding broadband infrastructure, disparities remain in rural connectivity. This aligns with the notion that late adopters—typically underserved populations—require targeted interventions to integrate into the digital economy.

(2) Affordability and Economic Inclusion: The digital divide theory highlights how economic disparities impact digital accessibility. The study finds that affordability remains a key challenge in Malaysia, particularly for SMEs and low-income communities. This supports the argument that government subsidies, regulatory interventions, and private-sector collaboration are necessary to bridge this gap and ensure inclusive digital participation.

(3) Human Capital and Digital Literacy: The study underscores the importance of upskilling and reskilling initiatives to meet the demands of a digitally transforming workforce. This finding is supported by human capital theory (Becker, 1964), which

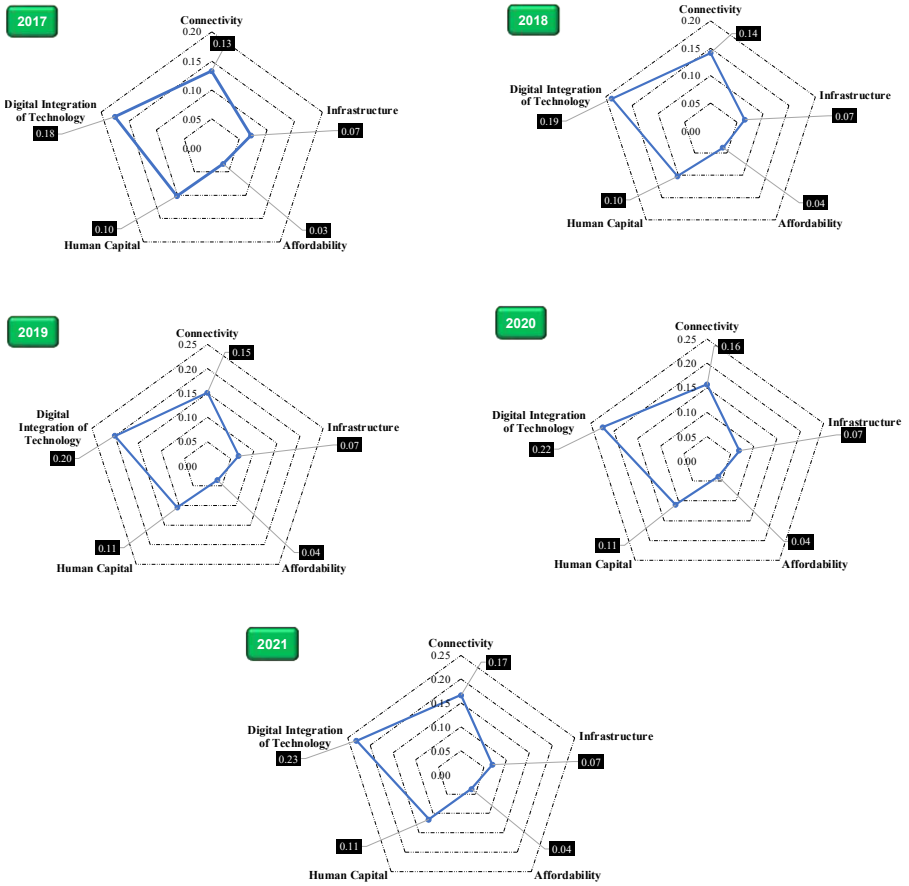

Figure 1. Dimensional score of Malaysia DEPI from 2017–2021

emphasizes that investments in education and training lead to higher economic productivity. The MyDIGITAL initiative's focus on digital education aligns with this framework, reinforcing the need for continuous workforce development.

(4) Digital Integration and Economic Growth: The network readiness framework (World Economic Forum, 2020) suggests that economies with higher digital adoption experience greater economic competitiveness. The findings show that Malaysia has made notable progress in e-commerce, fintech, and digital governance. However, further policy refinements and strategic investments are needed to enhance digital integration and sustain economic growth.

By linking these findings with theoretical perspectives, the study not only presents empirical results but also provides a structured rationale for Malaysia's digital economy trajectory. This theoretical grounding enhances the robustness of the analysis and reinforces the policy recommendations derived from the study.

4.2 Changes over the 5-year period across key dimensions

Over the five-year period (2017–2021), Malaysia has demonstrated notable progress across the five key dimensions of its digital economy, though challenges remain in some areas.

(1) Connectivity: The implementation of the NFCP has significantly improved broadband penetration and mobile network expansion, with 4G coverage surpassing 90% of populated areas. The adoption of 5G technology, although in its early stages, is expected to further enhance connectivity in the coming years. Rural connectivity has improved, yet digital disparities persist, requiring sustained investment in underserved areas.

(2) Infrastructure: Investments in digital infrastructure have resulted in an increase in secure internet servers, a rise in international bandwidth per user, and the expansion of Internet Exchange Points (IXPs). However, Malaysia still trails behind some regional counterparts in achieving seamless digital infrastructure integration, particularly in cloud computing and cybersecurity resilience.

(3) Affordability: While digital service accessibility has expanded, affordability remains a major concern. The high cost of broadband and mobile data, especially in rural areas, continues to hinder universal digital access. Government-backed subsidies and initiatives such as regulated pricing structures are being explored to address this issue.

(4) Human Capital: Digital literacy and workforce readiness have seen improvements, with MyDIGITAL initiatives integrating digital education into the national curriculum. However, gaps remain in advanced digital skills, particularly in AI, cybersecurity, and data science. The need for continuous upskilling and reskilling programs is critical to ensuring Malaysia remains competitive in the digital economy.

(5) Digital Integration of Technology: Adoption of digital platforms and services has accelerated, particularly in sectors such as e-commerce, fintech, and government services. The expansion of Malaysia's Digital Free Trade Zone (DFTZ) has facilitated broader e-commerce engagement, and public sector digitalization has improved service efficiency. However, further efforts are required to ensure equitable access to these advancements, particularly among SMEs and rural communities.

4.3 Comparative context

A brief comparison with other Southeast Asian countries provides a useful benchmark for Malaysia's progress. According to ASEAN Digital Integration Index reports, Malaysia performs competitively in digital infrastructure and human capital compared to countries like Thailand and Indonesia, but lags behind Singapore in terms of affordability and cybersecurity readiness (ASEAN, 2021). Incorporating lessons from regional best practices, such as government-subsidized broadband initiatives in Thailand or digital upskilling programs in Vietnam, could further enhance Malaysia's digital economy strategies.

By integrating these additional considerations, the study strengthens its methodological rigor, enhances real-world applicability, and aligns its findings with broader theoretical frameworks.

4.4 Impact of digital inclusion on SMEs and economic resilience

Small and medium-sized enterprises (SMEs) are a vital component of Malaysia's economic landscape, contributing to employment, innovation, and overall GDP. The introduction of initiatives like the Digital Free Trade Zone (DFTZ) has been instrumental in promoting digital inclusion among SMEs by providing easier access to international markets and encouraging the adoption of e-commerce platforms. Digital infrastructure improvements, such as expanded broadband access and improved mobile networks, have empowered SMEs to engage more effectively in online trade and digital services, increasing their resilience in the face of global disruptions such as the COVID-19 pandemic.

However, challenges remain, especially for SMEs in rural areas. Despite national initiatives, many SMEs still struggle with digital adoption due to limited access to high-speed internet, high costs of digital services, and a lack of digital literacy. Government policies aimed

at improving digital inclusivity should prioritize reducing these barriers, ensuring that SMEs in underserved regions are equipped with the tools they need to fully participate in the digital economy. Targeted programs that provide digital skills training for SME owners and employees, as well as subsidies or incentives to adopt digital technologies, could further stimulate their integration into the digital economy.

4.5 Digital affordability and social equity

Another crucial aspect highlighted in the findings is the issue of affordability in Malaysia's digital landscape. While connectivity and infrastructure have improved, affordability remains a key barrier, particularly for low-income households and rural communities. Digital affordability not only impacts individuals' access to the internet but also affects businesses, particularly SMEs, which often operate on thin margins and may struggle to afford high-quality digital services. This creates a digital divide that exacerbates economic inequalities.

To address this, Malaysia could consider policies that promote the affordability of digital services, such as reducing the cost of broadband and mobile data, especially in rural and underserved areas. Implementing price controls or offering government-backed incentives for internet service providers to offer lower-cost packages could be a way forward. Additionally, collaboration with global tech companies to provide affordable digital infrastructure or tools to low-income communities could also help bridge this gap. Ensuring that digital access is equitable will be key to maximizing the benefits of Malaysia's digital economy transformation.

4.6 Human capital and the future of work

While the Digital Economy Performance Indicator (DEPI) shows positive progress in Malaysia's human capital development, there are clear indications that more needs to be done to enhance digital literacy and prepare the workforce for the future of work. The transition to a digital economy will require not just basic digital skills but advanced technological competencies in areas like artificial intelligence (AI), data science, cybersecurity, and the Internet of Things (IoT). This creates a need for upskilling and reskilling programs that target both current workers and new entrants to the labor market.

The government's ongoing efforts, as outlined in the Malaysia Digital Economy Blueprint (MyDIGITAL), to integrate digital education into the curriculum and increase tertiary enrollment in tech-related fields are commendable. However, further efforts are needed to ensure these programs reach all segments of society, particularly in rural areas where access to higher education and digital training programs is more limited. Expanding partnerships between the public sector, educational institutions, and private tech firms can accelerate the development of a more digitally literate and tech-savvy workforce. This, in turn, will help Malaysia capitalize on the opportunities presented by emerging digital industries and enhance the country's competitiveness in the global digital economy.

4.7 E-government and digital public services

The push for e-government services in Malaysia has been significant, as indicated by the National Digital Identity (NDI) initiative and other government-led digitalization efforts. E-government services can enhance public sector efficiency, reduce bureaucracy, and make essential services more accessible to the public. However, while these efforts have improved the provision of services, particularly in urban centers, gaps remain in rural and less connected regions. The findings suggest that expanding these services, ensuring their accessibility, and improving digital literacy among citizens are critical to ensuring the full benefits of e-government initiatives.

In addition, further integration of digital technologies in sectors like healthcare, education, and financial services could lead to significant improvements in service delivery. The ongoing expansion of e-health services, for example, could revolutionize healthcare access,

particularly for remote communities. Ensuring data security and privacy, however, will be a key challenge as digital public services expand, and Malaysia must continue to invest in cybersecurity measures to protect citizens' personal information.

4.8 Emerging technologies and future prospects

Finally, Malaysia's digital economy stands at the threshold of integrating more advanced technologies such as AI, blockchain, and the IoT. These technologies hold the potential to revolutionize industries ranging from finance to manufacturing, and their adoption will be critical for Malaysia's future competitiveness. The findings suggest that Malaysia's current focus on connectivity and digital infrastructure provides a strong foundation for the adoption of these emerging technologies, but strategic investments in innovation ecosystems and research and development (R&D) are needed to take full advantage of these opportunities.

Encouraging local tech startups and fostering partnerships with global tech firms can help Malaysia tap into new technological developments. Additionally, creating innovation hubs or digital clusters that focus on AI, fintech, and advanced manufacturing could stimulate more high-value industries and position Malaysia as a leader in the Southeast Asian digital economy. Continuing to monitor and evaluate the country's progress in these areas will be crucial for shaping future policy directions.

5. Conclusion

This study has underscored the pivotal role of the digital economy in Malaysia's overall economic growth, highlighting the importance of strategic investments in digital infrastructure, human capital, and policy initiatives. Through the analysis of the Digital Economy Performance Indicator (DEPI), this research has provided a comprehensive assessment of Malaysia's digital transformation from 2017 to 2021, covering key dimensions such as connectivity, affordability, infrastructure, human capital, and the integration of digital technologies.

5.1 Implications for research, practice, and society

The findings reveal that while Malaysia has made significant strides in improving its digital infrastructure and connectivity. Initiatives like the National Fiberisation and Connectivity Plan (NFCP) and the Digital Free Trade Zone (DFTZ) have played a key role. However, challenges remain in achieving universal digital access, especially in rural areas. Affordability and digital literacy continue to be areas requiring further attention, as disparities between urban and rural regions persist. Human capital development is also a critical factor, as a more digitally skilled workforce is essential to fully leveraging the benefits of digitalization and ensuring long-term economic sustainability.

5.2 Economic impact

The study's findings have significant implications for various sectors in Malaysia's economy. The expansion of digital infrastructure has enabled the rapid growth of the e-commerce sector, fintech services, and digital entrepreneurship. For instance, the increased adoption of digital payments has accelerated financial inclusion, particularly among SMEs and micro-businesses. Additionally, the growing prominence of digital platforms has revolutionized the retail and logistics industries, streamlining supply chains and fostering cross-border trade. The continued focus on digital upskilling will also impact Malaysia's manufacturing sector, where automation and Industry 4.0 applications are expected to drive productivity gains. Moreover, the increased use of artificial intelligence and data analytics in sectors such as healthcare and finance is transforming service delivery, making operations more efficient and customer-focused.

5.3 Contribution to research

The objective assessment using the entropy weight coefficient method ensures that the analysis is data-driven and unbiased, allowing for a clearer identification of both strengths and weaknesses in Malaysia's digital economy. The study bridges theoretical frameworks such as the innovation diffusion theory and digital divide theory with real-world applications, highlighting how digital adoption spreads and the economic disparities that influence digital accessibility. By integrating these frameworks, the study offers a theoretical basis for understanding digital economy transformation in emerging markets, contributing both to theory development and empirical discourse on digital economy assessments. Additionally, this study provides an analytical foundation for future research exploring digital policy effectiveness, particularly in emerging economies undergoing rapid technological changes. The results show that while digital technologies have begun to reshape industries and services, more needs to be done to ensure that the benefits of the digital economy are inclusive and widespread. This includes addressing the digital divide, making digital services more affordable, and enhancing education and skills development to create a digitally literate workforce.

5.4 Societal impacts

Beyond economic implications, the study highlights critical societal dimensions of digital inclusion. Increased access to digital services can enhance education, healthcare, and social mobility. For example, digital learning platforms and remote education have become more accessible, particularly in rural areas where traditional educational institutions may be limited. Similarly, digital health initiatives can improve healthcare access, reducing disparities in medical services by enabling telemedicine and remote consultations. Bridging the digital divide also fosters greater civic participation, ensuring that marginalized communities have a voice in digital governance and policy-making. Furthermore, increased access to government e-services can improve public service efficiency, reducing bureaucratic barriers and enhancing citizen engagement in governance and administrative processes.

The study's findings offer several actionable insights for policymakers. First, there is a clear need for continued investment in rural digital infrastructure to bridge the digital divide and ensure equitable access to digital services. Additionally, policies aimed at improving the affordability of digital services should be prioritized to ensure that the benefits of digitalization are accessible to all citizens, regardless of income level or geographic location. Lastly, the development of digital skills and literacy programs should be intensified, ensuring that Malaysia has a workforce capable of adapting to and driving innovation in the digital economy.

5.5 Linkage to Malaysia's digital development efforts

The study's findings align closely with Malaysia's ongoing digital development initiatives. The MyDIGITAL blueprint provides a structured approach to fostering a digital economy, and the study's results reinforce the importance of its implementation. For instance, the findings on infrastructure expansion and digital literacy gaps highlight the necessity of continued investment under MyDIGITAL's strategic roadmap. Additionally, Malaysia's focus on 5G rollout and digital entrepreneurship directly supports the study's recommendation for sustained technological adoption and industry-driven digital transformation. Policymakers and industry practitioners can leverage these insights to refine current policies, ensuring that digital growth is both inclusive and sustainable. Moreover, aligning digital policies with global best practices will enhance Malaysia's competitiveness in the digital economy, attracting foreign investment and fostering innovation-driven growth.

Looking forward, Malaysia's ability to sustain and expand its digital economy will depend on a balanced approach that combines technological advancements with inclusive policies that address social and economic disparities. The ongoing initiatives such as MyDIGITAL and the

NFCP provide a solid foundation, but their success will depend on continuous monitoring, adaptation, and policy adjustments.

In conclusion, while Malaysia is on the right path towards becoming a fully digital economy, this journey is far from complete. Addressing the challenges of affordability, digital literacy, and regional inequalities will be crucial in ensuring that the digital economy becomes a true engine of inclusive and sustainable growth. This study has provided a roadmap for understanding the current state of the digital economy in Malaysia, offering valuable insights for future policy development and national strategies that will allow the country to thrive in the global digital landscape.

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