



National College of Ireland

MSc International Business Management

**Technology-Enabled International Business and Firm
Performance: A Cross-Country Comparative Analysis**

Dissertation (MSCIB1)

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Abstract

Technological advancement has gained significance as a key component facilitating firms to engage in international business. Digital tools shape communication, transactions, market access and performance of the firms. This study investigated the role of technology in international business, focusing on the variations across economic contexts and how digital infrastructure influence firm-level outcomes. Adopting a pragmatic philosophy, the research employed a convergent mixed-methods design. Quantitative analysis was conducted using datasets from World Bank and World Economic Forum. This was complemented with systematic qualitative synthesis guided by grounded theory coding of recent scholarly literature. The study operationalised technology through measures such as broadband penetration, adoption of cloud technology, presence of data governance regulatory frameworks and digital platforms. The analysis revealed a pronounced global digital divide with near-universal connectivity in high-income regions such as 97.9% internet penetration in Northern Europe. This contrasted sharply with limited access in emerging economies like Eastern Africa (28.5%). The study further determined that country-level operational ecosystems determined the ability of a firm to leverage technology for international business. For instance, with international trade efficiency score of 92.3, Singapore's environment was conducive for firms to expand globally. On the contrary, emerging economies like Pakistan (21.3) in international trade efficiency highlighted significant constraints for business to establish and expand internationally. The interconnectedness in country- and firm-level metrics implied weaknesses in one amplifies deficiencies in others which trap firms and particularly small and medium enterprises. The findings of the study implied that firms in developing economies need to navigate complex infrastructural and institutional constraints by calibrating technology adoption and market selection. Policymakers in emerging economies should implement holistic interventions such as integrated investment in both digital infrastructure and physical trade networks coupled with institutional reforms to streamline regulations. The interventions are critical in facilitating global expansion of firms.

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List of Abbreviations

AI	Artificial Intelligence
BROE	Business-Ready Operational Efficiency
E-commerce	Electronic Commerce
GDP	Gross Domestic Product
GVCs	Global Value Chains
ICT	Information and Communication Technology
IIoT	Industrial Internet of Things
IoT	Internet of Things
IT	Information Technology
ITE	International Trade Efficiency
RBV	Resource-Based View
R&D	Research & Development
SMEs	Small and Medium Enterprises
SSA	Sub-Saharan Africa
UNCTAD	United Nations Conference on Trade and Development
WEF	World Economic Forum
WTO	World Trade Organisation

Introduction

1.0 Background

Digital infrastructure has become a critical component of international business in the modern era of globalised economy. Firms are increasingly relying on digital tools to expand operations enabled by technologies ranging from broadband connectivity and cloud computing to digital trade platforms and mobile technology. The United Nations Conference on Trade and Development (UNCTAD, 2023) reported that at least 80% of businesses were digitally connected globally. According to the UNCTAD report, businesses in the advanced economies surpassed 95% internet penetration. The statistics on internet connectivity and penetration underscores how digital technology serves as a support system as well as a strategic asset in international business.

Digital technologies serve the firms engaged in international businesses in different ways. For instance, technological tools streamline communication, enhance efficiency in businesses operations, support real-time decision-making and enable participation in global value chains. As the study by Van Tulder et al. (2022) pointed out, digitalisation has transformed the structure of global businesses by compressing time and space and hence enabling efficient operations in firms, especially multinational enterprises. Another study by Meyer, Li and Brouthers (2023) highlighted that technology had established the information age and hence facilitating connection of international businesses. According to the study, technology has addressed issues such as delayed communication and inefficiencies in routine operations.

However, the capacity to leverage digital infrastructure varies significantly across countries. The literature by Yu, Bekerian and Osback (2024) and Narula and Van Tulder (2022) indicated that firms in high-income countries often enjoyed stable internet access, advanced digital tools and supportive regulatory environments. On the contrary, firms in developing economies often experienced technological challenges including limited connectivity, high costs, power outages and shortages in skills. The disparities raise fundamental questions regarding the

contribution of digital infrastructure to firm-level performance in different economic contexts.

The intersection of economic status of a country, technology, and firm performance has become even more relevant in the post-COVID-19 recovery period, where digital resilience proved essential for continuity of businesses (Chen, Niebel & Saam, 2023). However, empirical evidence remains fragmented on how digital infrastructure affects performance of firms in international businesses across varied economic settings. Therefore, this study aimed to investigate the role of technology in supporting firm-level performance in international business. The study sought to offer actionable insights into optimisation of digital strategies by comparing firms across countries with varying levels of economic development.

1.1 Research Objectives

- i. To examine how digital infrastructure enhances communication and operational efficiency in international business at the firm level.
- ii. To compare the influence of digital infrastructure on firm-level international business performance across countries with different levels of economic development.

1.2 Research Questions

- i. How does digital infrastructure enhance communication and operational efficiency for firms engaged in international business?
- ii. In what ways does the impact of infrastructure on firm-level international business performance differ between high-income and low-income countries?

1.3 Justification of the Study

This study is timely and relevant as it explores the critical role of technology, specifically the digital infrastructure in shaping the firm-level performance in the context of global business. The ability of firms to operate effectively across borders depends significantly on their ability to leverage digital technologies. This

is particularly necessary in the era when global markets are increasingly becoming interconnected. This study makes a contribution by providing a deeper understanding of how firms can harness technology to enhance competitiveness and expand globally.

Besides, the study investigates the economic and country-level factors with direct impact on global business. Empirical literature demonstrate that international businesses are critical in driving firm growth as well as stimulating national economic development, influencing trade balances and employment patterns. This implies that key stakeholders including policymakers and entrepreneurs need to understand how technology enables business growth and internationalisation. The insights will help to strengthen economic performance at both the micro and macro levels.

Literature Review

2.0 Introduction

Digital technology plays a pivotal role in global business because of the ability to facilitate connectivity and enhance efficiency in operations. However, disparities in connectivity across firms in different economies limit the ability to harness opportunities of digital technologies for business growth and internationalisation. This chapter delves into previous literature examining empirical evidence on key themes including digital infrastructure, communication across borders, operational efficiency in digital technologies, global value chains and the cross-country disparities in accessibility and use of digital technologies for business.

2.1 Theoretical Perspectives on Digital Infrastructure in International Business

A wide range of theories can be employed to analyse the concept of digital infrastructure in the global business environment. The digital infrastructure, constituting of global networks, cloud platforms and data centres, can be examined as a strategic resource using the Resource-Based View (RBV). The Resource-Based View as conceptualised by Birger Wernerfelt, Prahalad and Gary Hamel and, Jay Barney, examines the competitive advantages of a company from the perspective of unique resources and capabilities rather than the external competitive environment (Madhani, 2010). Willie (2025) observed that RBV helps to explain how firms attain advantage by leveraging internal resources that are valuable, rare, inimitable and non-substitutable (VRIN). The advanced IT systems and data assets in the digital era fit the definition of RBV. According to Willie (2025), RBV can be applied to the digital domain since technology and data are strategic assets that organisation leverage to gain competitive advantage. Therefore, robust digital infrastructure is essential to support global agility and knowledge sharing. For instance, firms operating in the global business environment can use digital platforms for real-time collaboration across subsidiaries. This implies that firms with superior digital networks and platforms have higher flexibility of deploying their capabilities in the international

markets by turning ICT and data investments into lasting competitiveness.

Another relevant theory is the Transaction Cost Economics (TCE) framework proposed by Williamson (1989). The framework holds that firms organise to economise on search, negotiation and enforcement costs. Similarly, digital platforms and online marketplaces act as new models of governance that help to cut down on operational costs. Silpachai, Siengthai and Levermore (2024) wrote that internet-based trading systems helped to reduce information asymmetries and lower the costs of transaction. The literature demonstrated that internet-based trading systems help to enhance accessibility of global markets. Therefore, it is easier and cheaper for firms, whether large or small, to enter and operate in the foreign markets. This is consistent with the Williamson's predictions that platforms would emerge to minimise frictions associated with international transactions (Williamson, 1989).

Besides, Internationalisation Theories are relevant in explaining technology in international business. For instance, Dunning's Ownership-Location-Internalisation (OLI) paradigm examines competitive advantage based on three pillars, that is, ownership of tangible assets, location advantage and internalisation which is concerned with reducing transaction costs (Kotieno, 2009). Owotemu (2025) noted that ownership advantages were traditionally rooted in tangible assets, proprietary technology and brand equity but could now include data analytics capabilities, platform algorithms and proprietary digital ecosystems. Similarly, location advantage can be expanded to incorporate the quality and reach of the digital infrastructure for expanded market base. This necessitates high-speed broadband, reliable cloud computing services and secure payment gateways to enhance international expansion (Bargoni et al., 2024). The Internalisation advantage, on the other hand, was once concerned with reducing transaction costs by keeping operations in-house. Internalisation can now be incorporated in international business by leveraging global digital platforms including e-commerce markets, cloud-based services which are relatively cheaper than establishing local subsidiaries or distribution channels

(Bargoni et al., 2024).

Closely related is the Uppsala internationalisation model, which describes international expansion as a gradual, knowledge-based process (Arvidsson & Arvidsson, 2019). Liesch and Welch (2024) observed that firms were traditionally seen as entering foreign markets incrementally by first exporting, then forming partnerships and eventually establishing physical subsidiaries. However, with the rise of robust global digital infrastructure, new category of companies bypasses the gradual learning curve. Accessibility to platforms like Amazon, Alibaba, and Shopify enable the firms to reach international customers almost instantly (Liesch & Welch, 2024). Liesch and Welch wrote that the shifts in global expansion and learning process do not imply that the underlying logic of OLI and Uppsala frameworks disappeared, but rather the mechanisms of attaining ownership, location and internalisation advantages are now mediated with the digital infrastructure.

2.2 Empirical Review on Technology and International Business

2.2.1 Digital infrastructure and international business

Digital infrastructure, including the broadband networks, cloud platforms and mobile connectivity, is widely recognised as a strategic asset in the international business. Meyer et al. (2023) observed that digitalisation lowers transaction costs and compresses time and space across the physical country borders. According to Meyer et al. reliable high-speed internet connectivity and Information and Communication Technology (ICT) tools enable firms to reach customers worldwide via websites and other digital platforms which enhance exports. A similar study by Yang and Zhang (2025) demonstrated that Industry 4.0 technologies including Internet of Things (IoT), Artificial Intelligence (AI) and data analytics, transform global operations by enhancing coordination and flow of information.

The previous studies emphasise the connection between strong digital infrastructure and innovation, creativity and productivity in firms and countries.

For instance, Zhao and Dong (2025) used the case study of “Broadband China” to show that implementation of the strategy helped to raise efficiency in innovation of firms. Zhao and Dong observed that the Broadband China strategy enabled manufacturers to deploy remote equipment control which enhanced efficiency in production as well as cutting on operational costs. Therefore, the existing literature emphasises the significance of robust and reliable digital infrastructure for effective communication and efficient operations in firms that are connected globally.

2.2.2 Digital communication in international business

Communication is a key component of the business environment, whether locally or internationally. Communication enables interactions among all the key players including company staff, clients, suppliers, shareholders, among others. However, communication in the context of global business is characterised by multidimensional and complex factors (Szkudlarek et al., 2020). For instance, one is expected to take into consideration factors such as variations in time zones, and cultural dynamics in different geographical locations before relaying a piece of information. Hazlehurst, Etter and Brothers (2023) noted that the emergence of digital communication technologies facilitated effective management of global businesses. The technologies simplify remote collaborations as well as enable the culture of learning while interacting with parties from diverse backgrounds.

Digital tools directly facilitate communication in global businesses. Lal, Dwivedi and Haag (2023) observed that tools such as video conferencing, social media, and collaborative digital platforms facilitate instant interactions across physical country borders. For instance, virtual meeting software including Zoom, Teams, Google Meet among others allow multi-country teams to coordinate seamlessly. According to Eyo-Udo et al. (2025), digital tools have played a crucial role of addressing information lags that could affect business operations. This marks a shift from the traditional analogue methods that were slow and costly. In addition, digital channels expand the global reach of a firm. Company websites and e-

commerce platforms enable the firms to tap into international markets without necessarily having local offices (Chen, Wang & Zhang, 2025). The evidence suggests that global firms save on operational costs of recruiting and renting physical offices in every country of operation by leveraging e-commerce and digital platforms (Van Tulder et al., 2023). In practice, global firms report smooth customer communication and fast pace of making decisions when digital connectivity is robust.

2.2.3 Enhancing operational efficiency with digital technologies

Digital infrastructure plays a pivotal role of enhancing operational efficiency in international business. Ajiga et al. (2024) observed that reliable networks and ICT reduced the internal operational costs as well as a facilitated automation of processes. The role of stable networks and ICT in lowering operational costs and enhancing efficiency was emphasised by Menzies et al. (2024) who observed that Industry 4.0 tools including AI, sensors, robotics and IoT enabled real-time monitoring of production as well as supply chains. This improves coordination across multinational operations. For instance, a firm-level analysis in India by Reddy and Sasidharan (2023) determined that digitalisation including using IT and facilitating internet accessibility significantly increased the integration of the business into the global value chains (GVCs). Therefore, digitalisation can be analysed as a proxy for efficiency in international business operations.

Gopalan, Reddy and Sasidharan (2022) argued that participation in GVCs was a key measure of international performance of a business. A global panel study of about 25,000 firms in 52 countries (2006-2018) indicated that efforts for digitalisation in firms positively influenced the deepening of GVC (Gopalan, Reddy & Sasidharan, 2022). The scholars noted that the effect was even stronger in firms that were constrained with resources. For instance, the digital tools which are readily available to all users enable small and financially weak firms to integrate into export networks that they could not otherwise afford to join. The literature demonstrated that connectivity enables even smaller firms and lower-technology manufacturers to participate in GVCs easily as an indication of

gains in efficiency and competitiveness.

Empirical evidence further points to enhanced operational efficiency through digital infrastructure in the supply chain digitalisation. Chen et al. (2024) argued that digital infrastructure had transformed international supply chain management by enabling real-time tracking, predictive analytics and automated coordination of systems. Chen et al. observed that digital transformation presented necessary opportunities for the manufacturing industry, especially for the developing countries. Advanced digital infrastructure is fronted as a key facilitator of global business because it supports critical technologies like IoT, blockchain technologies and AI systems which optimise the supply chain operations across international boundaries (Abdi Elghany, 2025). Liao, Lo and Pan (2023) also wrote that the integration of digital technologies in supply chains had enabled farmers to attain unprecedented levels of visibility and control over the international operations. Sensor networks, supported by reliable digital infrastructure, provide real-time data on key aspects such as inventory levels, shipment locations and quality parameters throughout the supply chain (Liao, Lo & Pan, 2023). Therefore, digital technologies enable proactive decision-making and swift response to disruptions in the supply chain. These are key factors required for efficient business operations in international business contexts.

The digital infrastructure has also been examined from the perspective of data analytics and decision-making processes in international businesses. Massa et al. (2023) acknowledged that sophisticated data analytics capabilities were critical in evidence-based decision-making in the contexts of international businesses. The researchers noted that big data analytics platforms, powered by cloud computing infrastructure, could process enormous volumes of international market data, information on consumer behaviour and operational metrics and hence generating actionable insights (Massa et al., 2023). The evidence on digital infrastructure in data analytics and decision-making presented another perspective in addition to the application of the technology for actionable insights in the supply chains of global businesses.

2.2.4 Sectoral perspectives on digital infrastructure

The impact of digital infrastructure is differentiated across the different industry sectors with manufacturing and services standing out as the most transformative domains. Alex and Johnson (2025) observed that the integration of Industrial Internet of Things (IIoT), AI, robotics and real-time analytics had fundamentally redefined operational workflows and supply chains in the manufacturing sector. The scholars noted that firms that had embedded IIoT systems including sensors and cloud platforms had attained notable gains in efficiency. For instance, energy use had dropped by at least 18%, the machine downtime by 22% and the resource utilisation had improved by 15% (Alex & Johnson, 2025). The findings demonstrated the potential of smart manufacturing frameworks to optimise performance while advancing the sustainability goals.

An analysis of IoT adoption by Microsoft Azure (2022) revealed that Asia-Pacific dominated other regions. According to the report, the high rate of IoT adoption in Asia-Pacific was attributed to the region being a strong manufacturing base. The results of IoT adoption are as shown in Figure 2.1 below.

											
	GLOBAL	US	UK	FR	DE	SP	IT	BNLX	CH	JP	AUS
% IoT ADOPTERS*	90%	94%	91%	91%	88%	89%	95%	91%	85%	88%	96%
% OF PROJECTS IN PLANNING**	LEARN > 29%	27%	31%	28%	28%	32%	29%	28%	28%	31%	32%
	TRIAL/POC > 25%	23%	23%	27%	25%	24%	24%	25%	24%	27%	27%
	PURCHASE > 22%	23%	21%	22%	21%	22%	22%	22%	23%	20%	23%
CRITICAL TO SUCCESS OF COMPANY**	90%	85%	85%	94%	93%	96%	94%	87%	99%	89%	83%
PLAN TO USE IoT MORE IN 2 YEARS**	66%	78%	69%	67%	53%	76%	69%	59%	65%	51%	56%

Figure 2.1: Asia-Pacific dominance in adoption of Internet of Things (Microsoft Azure, 2022)

The transformative potential of digital infrastructure is emphasised in the works of Jia and Li (2025) who examined how the technology was accelerating specialisation of enterprises. The study pointed out that predictive maintenance powered by IoT technology was enabling firms to reduce equipment failures by about 30%. This was critical for improving inventory accuracy and boosting real-time decision-making capabilities. A similar study by Khan, Hameed and Dahri

(2025) identified that there were dramatic trends in broader adoption of IoT technology with the global IoT manufacturing market being valued at \$209 billion as of the year 2022. The data forecasts estimated that the sector would reach at least \$172.8 billion by the year 2034 which highlighted the sustained investment in sensor networks, digital twins and private 5G. However, the gains were not likely to be experienced equally across firms and economies.

The service industry has also undergone significant transformations as a result of developments in digital infrastructure. Malik and Wosiek (2025) observed that many services had become digital and globally deliverable. According to the study, digitalisation in firms had made it possible for professional services, financial services and information technology services to be delivered across international boundaries with minimal to no infrastructure requirement. The services predominantly relied on digital connectivity and internet platforms. A similar study by Ferreira Santos (2024) noted that global service delivery models had emerged as a result of digitalisation of services. According to Ferreira, firms could easily leverage talent and resources from multiple countries to serve international clients. However, the scholar observed that the models were largely dependent on reliable digital infrastructure for effective and efficient delivery of services across different time zones.

Another key sector that has seen revolutionary changes as a result of digital infrastructure is the financial services and Fintech. Cumming, Johan and Reardon (2023) highlighted advancements such as cross-border payment systems, digital banking platforms and cryptocurrency networks as key enablers of expansion of global businesses. According to the study, the developments have resulted in significant reduction in transaction costs, acceleration in processing times and expansion in access to financial services across international boundaries. The emergence of fintech companies has been particularly enabled by developments in digital infrastructure (Kozhushko, 2023). However, the success of fintech companies in international markets both as businesses and enablers of internationalisation depends critically on availability

of reliable, secure and high-speed digital infrastructure. This implies that firms in countries with poor connectivity and unfriendly regulatory environment are disadvantaged in global expansion.

2.2.5 Cross-country disparities: high-income vs low-income contexts

Despite the fact that firms derive substantial benefits from digitalisation, the impacts vary by national contexts. The study by Hua and Zhang (2023) determined that advanced economies typically had a near-universal high-speed internet and supportive institutions. Similarly, Bhandari et al. (2023) employed the case of the United States and Western firms to emphasise the correlation between high levels of digitalisation and strong profitability. The scholars noted that firms in high-income countries enjoyed stable broadband, abundant data centres and advanced digital services. The supportive regulations, abundant skilled labour and lower costs of technology led to high levels of digital readiness (Bhandari et al., 2023). The literature demonstrated that in the contexts of high-income countries, incremental digital upgrades including AI and robotics translated into gains in efficiency and innovation. Figure 2.2 below highlights the disproportional distribution of top IoT enterprises which are concentrated in the United States, Europe and the Asia-Pacific regions.

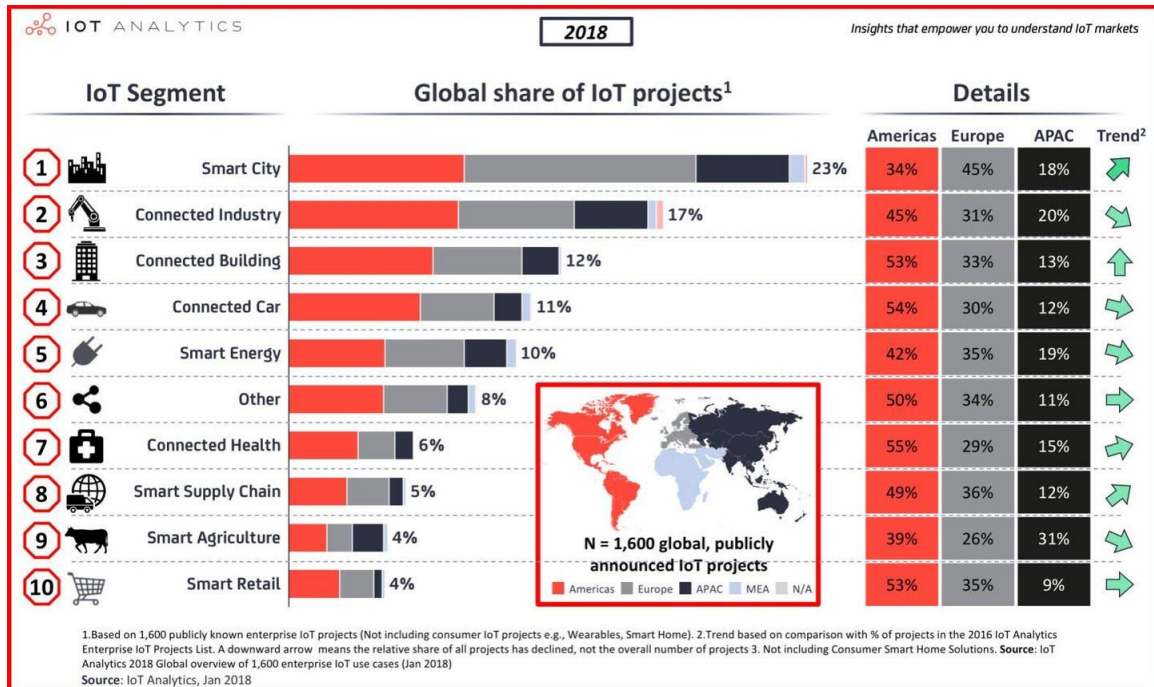


Figure 2.2: Distribution of top enterprises leveraging Internet of Things (IoT Analytics, 2018)

A country-specific analysis of digital infrastructure also highlights the disparities in connectivity between high-income and emerging economies. Pereira, Lee and Fife (2023) wrote that firms in high-income economies were characterised by ubiquitous broadband and robust regulatory frameworks. The frameworks provided the foundation for sophisticated applications that could drive international competitiveness. The research highlighted the example of Singapore where the Smart Nation Initiative by the government had resulted in provision of 5G coverage countrywide. The initiative resulted in development of centralised data exchange platforms and AI-driven business services (Pereira, Lee & Fife, 2023). Consequently, there was implementation of real-time supply chain visibility systems and automated compliance solutions which were associated with reduction of transaction costs in international businesses. Erh (2023) pointed out that the robust digital infrastructure in Singapore had resulted in firms attaining at least 30% higher export efficiency and 40% faster international payment processing than counterparts in comparable economies. The statistics demonstrated that regardless of the economic status of a country,

commitment to invest in digital infrastructure was paramount to realise the benefits of technology in international business.

In addition, innovation ecosystems facilitated by digital infrastructure are further known to enhance performance of firms in high-income economies. Budden and Murray (2025) observed that technology clusters such as Silicon Valley, Singapore and Switzerland combine world-class research institutions, venture capital networks and specialised talent pools which eventually drive innovation in the digital infrastructure. As highlighted by Fasnacht (2024), the Swiss-Singapore digital corridor illustrates the advantage of digital innovation as it enables real-time data exchange between financial institutions under harmonised regulatory frameworks. The study indicated that the infrastructure supports high-value services including blockchain-based trade finance and cross-border solutions for wealth management which generate premium margins. Despite the prevailing challenges such as cybersecurity vulnerabilities and regulatory complexities for data flows, the literature emphasised the benefits gained by firms in developed countries with robust digital infrastructure.

On the contrary, low-income countries grapple with unreliable electricity, slow internet and high costs of technology acquisition connectivity gaps affecting crucial business operations (Oughton, Amaglobeli & Moszoro, 2023). Peter, Pradhan and Mbohwa (2023) identified that even though mobile networks could be widespread, fixed broadband remained limited. A similar study by Wanof (2023) depicted that only 30-40% of businesses in low-income countries had access to reliable broadband with significant urban-rural divides. The literature demonstrated that despite the expansions in mobile communications in emerging economies, gaps and lags remained in foundational infrastructure. Consequently, firms are not able to leverage advanced digital tools. The World Bank (2024) also reported that low-income countries are disproportionately affected by poor broadband connectivity affecting digital economies. The report emphasised the significance of the disparities in internet accessibility in shaping how firms in different economies leverage digital infrastructure for growth in

operations. The World Bank, using the case study of high-speed links to rural Cambodia, acknowledged that even rudimentary connectivity projects had notable positive effects on firm exports.

The expansions in internet connectivity over the years in emerging economies is evidenced by the World Bank (2024) report using the case of sub-Saharan Africa (SSA). The report revealed that the number of individuals in SSA using internet had increased by at least 514% from the year 2011 to 2021. However, perennial challenges such as power outages were persistent and hence affecting the experience of users. The statistics on internet access trends in SSA are as shown in Figure 2.3 below.

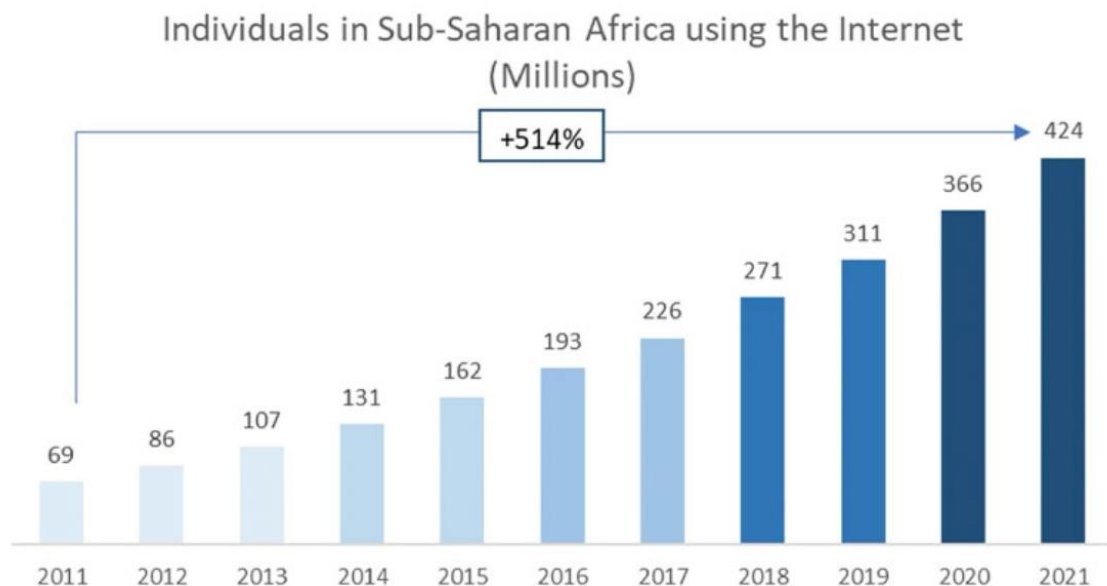


Figure 2.3: Trends in internet accessibility in sub-Saharan Africa

In addition, the same digital investment has been found to yield different returns based on the economic status of a country. Verhoogen (2023) analysed firm-level upgrading in developing countries and noted that access to internet enhanced productivity both in the businesses and overall country. However, the gains of internet access were dependent on local conditions. The World Bank (2022), through the study on technology adoption by firms in developing countries, reported that infrastructure alone was not sufficient to gain the benefits

of internet access. The report emphasised the need for complementary factors including skilled personnel, management capabilities, finance and stable policy (World Bank, 2022). Without the complementary factors, increased connectivity alone could not automatically translate to high-tech adoption. Small firms in low-income countries are likely to lack the necessary human capital and market linkages to leverage the new digital networks.

The analysis of cross-country disparities demonstrates that digital divide effects arise because high-income firms commence from a higher baseline of infrastructure and ecosystem support. In contrast, firms in developing countries often gain more marginal benefit from basic connectivity. As the World Bank (2024) report emphasised, firms in developing countries report increases in exports or incomes when rural areas get connected. However, the gains can also be constrained by local shortcomings. The literature demonstrates that even though digitalisation provides democratic opportunities, issues of digital divide are persistent. The advanced economies continue outpacing by rolling out cutting-edge technology such as 5G and AI computing, which many low-income countries cannot match. The World Economic Forum (WEF) urges the need for regional cooperation and novel solutions such as pooled data centres and specialised training for developing countries to equalise the gains of digitalisation.

An assessment of digital infrastructure can be examined using different metrics including broadband accessibility, cloud adoption, integration of e-commerce, usage of digital payment methods, cross-border data costs, fintech credit access and research and development (R&D). Azizah (2024), using a systematic review, reported that cloud adoption rate stood at more than 80% in high-income countries while less than 30% of firms in developing economies had embraced the technology. Sharma, Srivastva and Fatima (2023) also observed that integration of e-commerce in firm operations varied significantly across different economies. The study found that 75-90% and 20-40% of businesses in high-income economies and low-income economies, respectively had integrated e-

commerce. The statistics emphasised the digital divide affecting equal participation in global business.

The disparities are emphasised in fintech credit access and digitisation of research and development. Hodula (2023) utilised a rich panel of 78 countries over the 2013-2019 period and found a rise of fintech and big tech credit. However, the study indicated that high-income economies provided conducive conditions for accessibility to fintech credit with more than 25% of Small and Medium Enterprises (SMEs) accessing credit facilities. On the contrary, less than 15% of SMEs in developing economies had access to fintech credit (Hodula, 2023). The statistics were consistent with investment in research and development for digitalisation. According to Hodula, with more than 70% adoption, developed economies had embraced R&D for digitisation. A comparative summary of impact of digital infrastructure across different economic contexts is as provided in Table 2.1 below.

Table 2.1: Comparative summary of impact of digital infrastructure across economic contexts

Performance Dimension	High-Income Country Firms	Developing Economy Firms
Broadband Access	>95% business penetration	30-40% reliable access
Cloud Adoption	>80% enterprise usage	<30% enterprise usage
E-commerce Integration	75-90% of businesses	20-40% of businesses
Fintech Credit Access	25-40% of SMEs	5-15% of SMEs
R&D Digitization	70-85% adoption	15-30% adoption

2.2.6 Challenges and limitations of technology in international business

Even though the digital infrastructure presents immense benefits and opportunities for all firms in the global business, a wide range of limiting factors prevent the effective internationalisation process. Besides the highlighted issues of poor connectivity and regulatory frameworks, Chandna and Tiwari (2023) presented the challenge of cybersecurity and data protection. The scholars noted

that the increased reliance on digital infrastructure for operations in international businesses implied enhanced vulnerabilities related to cybersecurity and data protection. Firms operating in multiple jurisdictions must therefore navigate complex regulatory requirements related to privacy, cybersecurity standards and cross-border data flows. Saeed et al. (2023) wrote that the cost and complexity of implementing adequate cybersecurity measures could be prohibitive for smaller firms and hence creating extra barriers to internationalisation of the business.

Digital skills and capabilities have also been highlighted as potential challenges for participation in international business. According to Camillo et al. (2025), effective and efficient utilisation of digital infrastructure demands possession of sophisticated digital skills and organisational capabilities. However, as pointed out by Oloyede et al. (2023), developing countries have significant gaps in digital skills since education systems and training programs have not kept pace with the advancements in digital infrastructure. For the emerging economies to match up with developed countries, there is need to build digital capabilities by sustained investment in human capital development, organisational learning and technology adoption processes. Meyer, Li and Brouthers (2023) noted that firms operating in international markets were obliged to often invest in capacity development across multiple locations. This implied the firms were forced to incur additional costs and complexity in their operations.

2.3 Conclusion

This comprehensive review has established technology and digital infrastructure as a critical determinant of firm-level performance in global business. The evidence in previous literature emphasises the strong relationships between technological foundations and enhanced business performance including communication efficiency, optimisation of operations and improved capacity for creativity and innovation. However, the literature demonstrates that the relationships are neither simple nor universal since they exist in contexts with complex pathways and moderating factors.

The review has further demonstrated the disparities and promising opportunities for convergence between high-income and emerging economies in relation to leveraging digital infrastructure for business expansion. The review has shown that factors such as human capital and investment in technological capabilities mediate digital returns. This emphasises the need to prioritise digital frameworks for environments where resources are constrained. Businesses aiming to internationalise must evolve to address the emerging issues including cybersecurity governance, tensions in digital data sovereignty, distributed technologies and the regulatory environment.

Methodology

3.0 Introduction

The methodology describes the procedures and techniques that were used to identify, select and assess data and information on the subject of technology and international business. Patel and Patel (2019) wrote that the research methodology helps to establish the overall reliability and validity of the findings derived from the study. According to the scholars, the methodology provides guidelines on how to generate, analyse and report the data. Therefore, the methodology constitutes the design, approaches and methods to be employed in the research.

3.1 Philosophical Underpinning

A research philosophy describes the system of beliefs and assumptions that guide the process of conducting research. According to Mbanaso, Abrahams and Okafor (2023), a research philosophy guides the entire process of study including selection of the design to data analysis and reporting. Similarly, this study adopted a pragmatism research philosophy. As highlighted in the literature by Elgeddawy and Abouraia (2024), pragmatism allows pluralistic methods, including qualitative and quantitative, to be combined for a more comprehensive research and derivation of richer explanations. Pragmatism philosophy was appropriate for the truth to be judged by the usefulness of the findings for explaining how digital infrastructure could affect the performance of firms in the global business. In addition, within the pragmatism philosophy, the quantitative strand aligns with the positivist orientation which is necessary to test relationships by observable data and statistical inferences (Mbanaso, Abrahams & Okafor, 2023). On the other hand, the qualitative strand draws on interpretivist logic which generates context-specific insights about a subject (Mbanaso, Abrahams & Okafor, 2023). In this regard, the pragmatism philosophy allowed the use of appropriate tools from quantitative and qualitative approaches and hence strengthening the results and conclusions through triangulation.

3.2 Research Design

A research design constitutes the plan that outlines how a study is conducted (Wisenthige, 2023). Similarly, this study employed a convergent mixed-methods research design. According to Sharma et al. (2023), a convergent mixed-methods design with an option of explanatory sequence involves conducting a study by first employing quantitative analysis followed by qualitative synthesis of the findings. Therefore, quantitative component helped to assess the descriptive and statistical relationships between digital infrastructure and performance of businesses across countries and firm types. The qualitative component, on the other hand, employed grounded theory to guide the thematic analysis of targeted case studies and previous literature. The approach was crucial to provide contextual and explanatory narratives and insights to the study.

3.2 Data Sources and Sampling

Firm-level and country/digital indicators data was extracted from a wide range of sources including World Bank, World Economic Forum digital readiness indices, national statistical reports and sectoral datasets. The datasets spanned 2015-2025 to capture the most recent digital acceleration. Purposive sampling technique was employed for selection of countries to ensure variation by World Bank income groups including high, upper-middle, lower-middle and low. The sample firms were stratified by size, that is SME versus large, and sector including manufacturing vs services.

Qualitative data, on the other hand, constituted peer-reviewed articles (2018-2025), industrial reports, published firm case studies and managerial interviews from secondary sources. The selection criteria focused on relevance to firm digitalisation, documented internationalisation outcomes and explicit discussion of infrastructure or platform usage.

3.3 Data Collection and Preparation

The secondary data was imported and harmonised into the Microsoft Excel software for cleaning. Cleaning involved standardisation of key firm identifies,

removal of duplicates, formatting data shapes and handling missingness with transparent rules. Country-year panels were created and merged with firm and country indicators. The data preparation was comprehensive to ensure accurate and reliable results were derived.

Qualitative analysis employed a systematic review protocol where search strings were defined, databases selected and inclusion and exclusion criteria applied. The study focused on peer-reviewed articles published within the period (2018-2025) to derive the most recent insights about technology and internationalisation of businesses. Manual coding was used to extract concepts, quotes and contexts from the qualitative data.

3.4 Ethical Considerations

Ethical considerations were prioritised in the study despite most datasets being derived from secondary sources. McGregor (2023) emphasised the need for ethical considerations to guarantee validity and reliability of a study. This study used publicly accessible secondary datasets with appropriate licences. In addition, any sensitive data was anonymised and citations provided for the relevant sources. The researcher provided the data sources to ensure reproducibility of the results in similar studies.

3.5 Limitations of the Study

This study relied on quantitative secondary data derived from reliable platforms including World Bank and qualitative information from previous literature. The quantitative data was crucial in providing the descriptive analysis of the role of technology in international study. However, absence of primary quantitative and qualitative data implied that the study could not provide first-hand in-depth analysis of the subject. However, as a delimitation, this study used secondary data from reliable platforms and recent peer-reviewed research articles to complement the findings.

Findings and Analysis

4.0 Introduction

This section presents the results of the study on role of technology in international businesses. The section covers key specific areas of technology and international business focusing on digital infrastructure and country level metrics. The country-level digital infrastructure was based on the following metrics: internet use (% of population), fixed broadband subscriptions (per 100 people), mobile cellular subscriptions (per 100 people) secure internet services (per 1 million people), and ICT goods exports/high-tech exports.

4.1 Country-Level Digital Infrastructure

4.1.1 Connectivity and number of individuals using the Internet

Internet connectivity was examined across different regions comprising both developed and emerging economies. The analysis was crucial to conceptualise the user count and share of people connected to the internet. The study identified that as of February 2025, the highest penetration rates were found in Northern Europe (97.9%), Western Europe (95.1%) and Northern America (93.3%). The statistics highlighted an almost universal internet accessibility rate. The findings also demonstrated that the top regions benefited from advanced infrastructure, high incomes, strong digital literacy and policies that supported widespread connectivity. The almost complete internet coverage was crucial for supporting sophisticated e-commerce ecosystems, cross-border digital trade, and rapid adoption of emerging technologies.

The disparities became more pronounced in regions like the Caribbean (69.8%), Western Africa (42.5%) and Eastern Africa (28.5%). The statistics revealed that internet access remained limited for large proportions of the population. In particular, the significantly low rate in Eastern Africa implied that more than two-thirds of the population was offline. The results highlighted the significant challenges for businesses seeking to engage digitally with consumers both locally and globally. The statistics on internet penetration rate across regions are shown in table 4.1 below.

Table 4.1: Internet penetration across regions

Region	Penetration rate as of February 2025
Northern Europe	97.9%
Western Europe	95.1%
Northern America	93.3%
Southern Europe	91.6%
South-Eastern Asia	78.2%
Southern Africa	77.0%
Caribbean	69.8%
Western Africa	42.5%
Eastern Africa	28.5%

The study further investigated the proportion of the population using the internet across high- and low-income countries. This metric was considered as a proxy for the level of digital readiness within a country which could influence how firms operate internationally. According to the World Bank, the proportion of the population using the Internet can help to assess the maturity of the digital infrastructure. Besides, internet usage rates indicate how reachable a population is through the digital platforms. Therefore, the rate of internet usage can be examined as a facilitator of firm-level operations.

A comparison of Ireland (high-income) with low-income countries revealed stark contrasts. The trend chart illustrated the differences with the curve of internet adoption in Ireland having started to rise sharply in the mid-1990s. The study identified significant acceleration after 2000. This reflected early broadband rollout and sustained investment in ICT. On the contrary, trajectories for Bangladesh, Ghana, Nepal and Mozambique remained relatively flat until the mid-2000s. Ghana report a sharp rise in the year 2015 suggesting a rapid scaling of mobile data networks and a surge in smartphone availability. On the other hand, Nepal and Bangladesh had a gradual but steady increase in internet use which could be an indication of infrastructural upgrades and expanding network coverage. However, Mozambique, although showing improvements in recent years, still lags far behind other countries employed in this study. This highlights

structural barriers and potential challenges with policy-driven development of the digital infrastructure. The trajectories in internet adoption across the different countries is as shown in Figure 4.1 below.

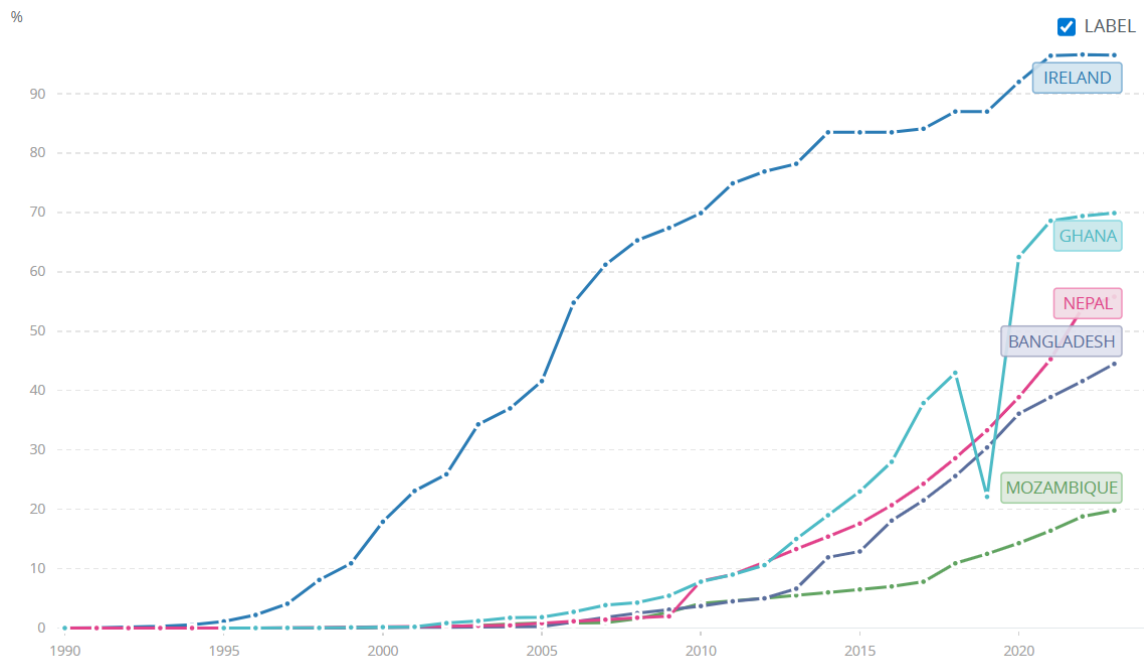


Figure 4.1: Trends in proportion of individuals using Internet in the population

The study delved specifically on the percentage of the population using the internet in the year 2023, according to the World Bank latest statistics. Ireland stood at the top with an impressive 97% internet penetration which reflected the new-universal access and a mature digital ecosystem. Ghana followed among the selected countries with 70% which indicated substantial progress in digital adoption over the past decade. Mozambique remained the lowest among the selected cases, with only 20% of its population using internet in 2023. The statistics emphasised the persistent challenges that prevented the population in Mozambique from accessing and using internet services. The significant variations revealed how factors such as early infrastructure investment and competitive digital markets enabled high-income countries to attain near-universal connectivity. The statistics on percentage of the population using internet (2023) are as shown in Figure 4.2 below.

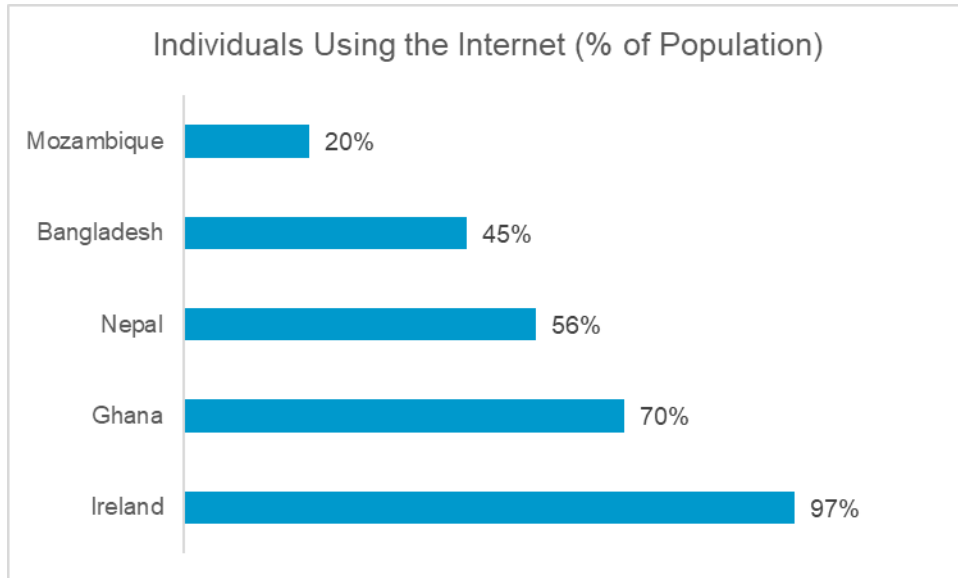


Figure 4.2: Proportion of population using the Internet (2023)

4.1.2 Fixed broadband subscriptions

Fixed broadband subscriptions measure the availability and take-up of wired internet connections relative to the size of the population. According to the World Bank, the wired internet connections are typically higher-bandwidth such as fiber and cable. In the context of technology and international business, the metric matters because fixed broadband is often the backbone for firm-level digital capabilities. The digital capabilities include reliable access to cloud services, resources for enterprise resource planning (ERP), transfer of large files, video conferencing without latency issues, hosting of e-commerce platforms among others. High rates of fixed broadband are associated with greater capacity for advanced digital services, lower costs of transaction and coordination and the strong ability to meet the technical requirements of international clients.

This analysis determined that about 31.9 people per 100 in Ireland had a fixed broadband subscription in the year 2023. On the contrary, only 0.56 and 0.2 people per 100 in Ghana and Mozambique, respectively had a fixed broadband subscription. A comparison with emerging economies revealed that Ireland had about 4.0 times the fixed-broadband subscriptions of Bangladesh, 6.6 times the subscriptions of Nepal, 57 times the subscriptions of Ghana and 159 times the subscriptions of Mozambique. The statistics implied that Ireland had a mature

fixed broadband environment and hence firms could reliably deploy bandwidth-intensive services. The statistics on fixed broadband subscriptions across the countries as of the year 2023 are as shown in Figure 4.3 below.

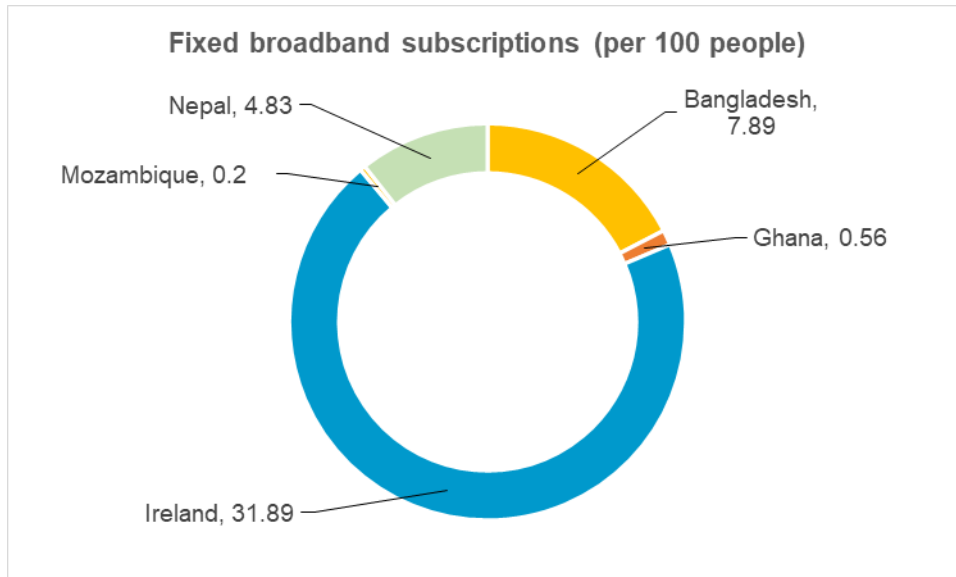


Figure 4.3: Cross-country fixed broadband subscriptions (per 100 people) in 2023

4.1.3 Cross-country secure internet servers

Besides assessing internet adoption and number of fixed broadband subscriptions, this study delved into the aspect of secure internet servers across high- and low-income countries. According to the World Bank, the secure internet server indicator measures the number of servers that support encrypted transactions per one million people. The metric is a useful proxy to measure different aspects of digital infrastructure including the capacity for local hosting, readiness for e-commerce and the baseline capacity to run secure online services domestically. Using a comparison of the United States and Ireland (high-income) with low-income nations in the sub-Saharan Africa and Southeast Asia, the analysis identified significant disparities in the use of secure internet servers. In the United States, the number of secure servers per million people increased from 46,678,110 in the year 2020 to 52,122,869 in 2021. As of the year 2024, the United States reported 66,850,221 secure servers per million people. Similar trends were reported with Ireland despite having a marginally

lower rate of secure servers per million people as of 2024 (655,415).

On the contrary, an analysis of emerging economies revealed that most countries have less than 10,000 secure internet servers per 1 million people. Low-income countries in the sub-Saharan Africa, each reported less than 2,000 secure internet servers per million people in 2024. For instance, Angola (1,838), Benin (295), Burkina Faso (679), Botswana (1,188), Central Africa Republic (9) depicted the low rate of secure internet servers in SSA. Similar low trends were reported in South East Asia, even though with higher penetration rate as compared to SSA. This is illustrated by countries such as Nepal reported which reported 16,048 secure internet servers in 2024, Cambodia (14,416), and Brunei (7,463). Statistics on the number of secure internet servers per million people in selected SSA and Southeast Asia countries is as shown in Table 4.2 below.

Table 4.2: Number of secure internet servers per 1 million people in selected emerging economies 2024

Country	Number of secure internet servers (per 1 million people)
Angola	1,838
Benin	295
Burkina Faso	679
Botswana	1,188
Central Africa Republic	9
Cambodia	14,416
Brunei	7,463

A deeper analysis of the trends between developed and emerging economies shows a striking disparity in the growth of secure internet servers. High-income countries including the United Kingdom, United States, Singapore and Ireland, have experienced exponential growth since around 2010. On the other hand, many developing countries have recorded much slower progress, where growth is reflected in hundreds and thousands rather millions. For example, Botswana's

number of secure internet servers rose from just 20 in 2012 to 1,188 in 2024. Even though this was a notable increase, it was modest compared to high-income nations. Similarly, Nepal expanded from 4,372 secure servers in 2017 to 16,048 in 2024. While these increases are significant in relative terms, they underscore the persistent digital divide between wealthier and less-developed economies. The contrasting trajectories of secure internet server growth in high- and low-income countries are illustrated in Figure 4.4 below.

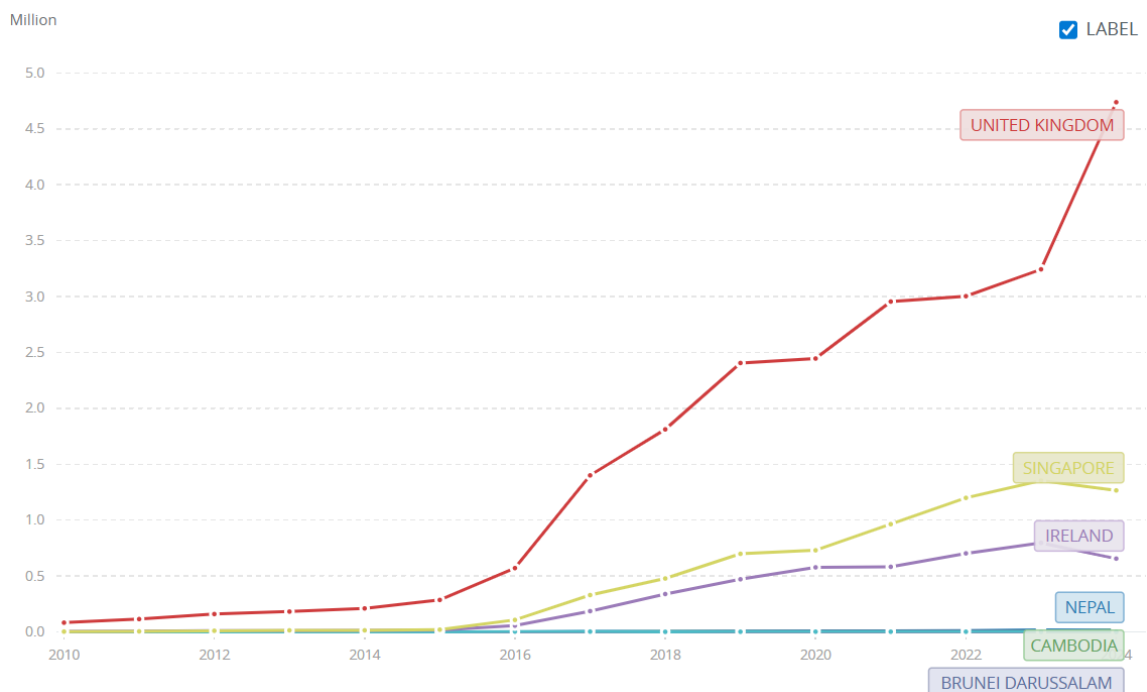


Figure 4.4: Contrasting trajectories of secure server growth in high- and low-income countries

Overall, the statistics highlight the pronounced digital infrastructure gap between developed and low-income countries. While the high-income countries have attained world-leading levels of secure server penetration, emerging economies in other regions including the sub-Saharan Africa and Southeast Asia remain far behind. This has a direct implication on aspects of cybersecurity, data sovereignty, and economic competitiveness which are crucial factors for firms aiming to participate in international businesses.

4.2 Country-Level Metrics

4.2.1 Business-ready operational efficiency

The country scores for Business-Ready Operational Efficiency (BROE) paints a practical picture of how easy or hard it is for firms to operate and trade across borders. This study analysed cross-country business-ready operational efficiency to assess the support provided for firms to expand globally. Singapore (high-income country) was compared with emerging economies including Bangladesh, Botswana, Cambodia, Ghana, Nepal and Pakistan. Singapore reported a score of 87.3 which highlighted that the systems, logistics and institutional supported running and scaling businesses at the global level. The results demonstrated that firms in Singapore faced fewer uncertainties, could meet standards for international clients reliably and were naturally well-positioned to take advantage of digital tools and hence multiplying returns.

In contrast, emerging economies were either in the mid or lower band. Nepal (72.2), Bangladesh (70.5) and Botswana (67.7) indicated reasonably strong operational environments. The scores provided enough predictability to allow many firms to export and use digital systems to improve efficiency. However, Pakistan, Cambodia and Ghana with scores of 65.9, 60.7 and 54.4 portrayed a picture of somewhat constrained business environment. The statistics are as shown in Table 4.2 below.

Table 4.3: Business-ready operational efficiency in 2024

Country	Business Ready Operational Efficiency in 2024
Bangladesh	70.5
Botswana	67.7
Cambodia	60.7
Ghana	54.4
Nepal	72.2
Pakistan	65.9
Singapore	87.3

4.2.2 International trade efficiency

The study analysed World Bank's International Trade Pillar 3 on efficiency of importing and exporting goods and engaging in digital trade across countries. The study established that as of the year 2024, efficiency in international trade varied across the selected countries which reflected the diverse capabilities in facilitating cross-border commerce. Singapore led with an exceptional score of 92.3 which signalled a world-class trade ecosystem where both physical and goods and digital transactions flow with minimal friction. Nepal followed with a strong 83% which indicated the capacity to manage trade processes efficiently despite being a landlocked country. This reflected investment in trade facilitation and digital platforms for international trade.

Bangladesh (80.5) and Botswana (76.2) also performed strongly, suggesting that firms in these markets could access relatively smooth customs procedures, logistics services and supportive digital trade infrastructure. Ghana, at 49.9 implied firms faced more substantial barriers with inefficiencies in movement of goods and slower adoption of digital trade which could potentially hamper competitiveness. At the lowest extreme, Pakistan with a score of 21.3 indicated major constraints in both physical and digital trade capabilities, from cumbersome custom clearance to weak digital trade readiness. The results implied that firms were significantly constrained from pursuing export-oriented or digital integrated business models. The statistics on efficiency of international trade and digital infrastructure are shown in Table 4.4 below.

Table 4.4: International trade efficiency score

Country	International Trade Efficiency Score
Bangladesh	80.5
Botswana	76.2
Cambodia	56
Ghana	48.9
Nepal	83
Pakistan	21.3
Singapore	92.3

4.2.3 Logistics and infrastructure

The study also examined the competence and quality of logistics services in different countries comparing high and low-income nations. The metric on competence and quality of logistics services was considered critical for understanding the readiness of a country to engage effectively in both domestic and international trade. High-quality logistics was particularly important due to its ability to support effective integration into global operations such as supply chains and in e-commerce. However, poor quality of logistics competence may result in high operational costs, and erode the competitiveness of a firm.

The 2022 scores revealed a substantial variation in logistics service quality among the selected countries. Singapore led decisively with a score of 4.4 which reflected its efficient logistics infrastructure, advanced technology integration and professional workforce. Botswana followed with a score of 3.4 which indicated strong capabilities compared to other emerging economies in the group. However, Bangladesh (2.7), Pakistan (2.59), Ghana (2.5) and Nepal (2.46) all clustered in the lower-middle range which reflected functional logistics systems but with notable gaps in efficiency, reliability and technological integration. At the lowest extreme was Cambodia with a 2.4 score which highlighted significant challenges in quality of services, potentially from limited infrastructure, capacity constraints and inefficiencies in regulatory framework. The results on competence and quality of logistics services across the selected countries is as shown in Figure 4.5 below.



Figure 4.5: Competence and quality of logistics services (2022) across high- and low-income countries

4.3.3 Education and human capital

Finally, the study examined tertiary school enrolment, that is, the proportion of the population enrolled in universities, colleges, or equivalent higher education institutions. The component was considered as an important indicator for assessing the capacity of a country to cultivate advanced skills, innovation and research capability. In the context of technology adoption and international business, higher education is essential in producing the human capital needed to drive digital transformation, manage complex trade processes and compete in global markets. The analysis was based on the assumption that a more educated workforce was generally better-equipped to adopt and adapt to new technologies, engage in high-value services and participate in knowledge-intensive industries.

The latest statistics from World Bank (2023) revealed stark contrasts among the countries examined. Singapore recorded a remarkable tertiary enrolment rate of 98% which reflected a strong commitment to higher education and the cultivation of a highly skilled workforce. The high enrolment rate supported Singapore's position as a global hub for innovation and digital trade as well as advanced logistics. By contrast, countries in low-income categories recorded considerably

lower enrolment rates ranging from 11% to 24%. Cambodia and Nepal, both at 18% and Pakistan's rate of 11% indicated more limited tertiary participation which constrained their ability to scale digital infrastructure adoption and manage complex international trade processes without significant external skills input. The statistics on tertiary school enrolment are as presented in Figure 4.6 below.

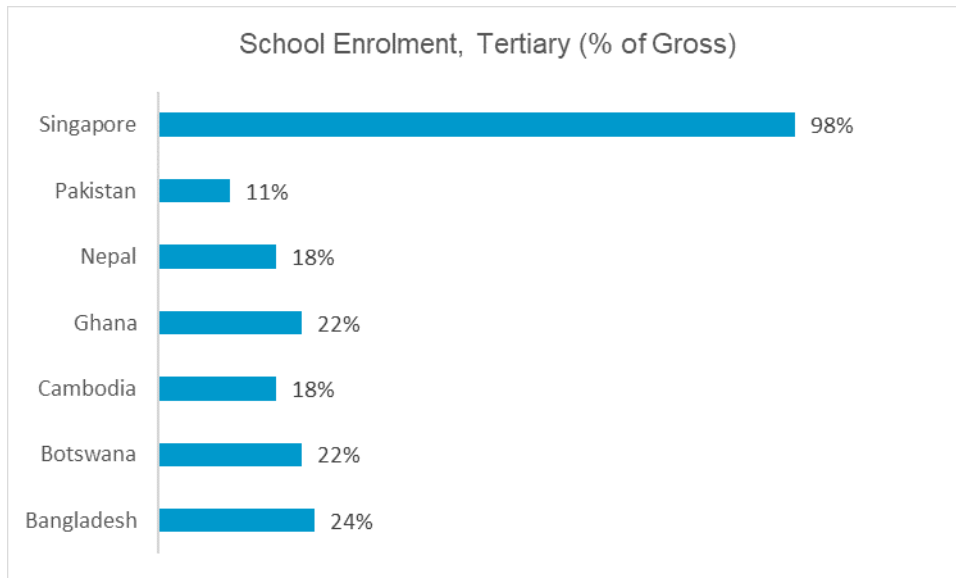


Figure 4.6: Tertiary school enrolment

4.3 Summary of the Results

This chapter explored the varying levels of digital infrastructure across high- and low-income economies and their impact on firm-level outcomes and engagement in international business. The analysis revealed significant disparities between high- and low-income countries in terms of internet connectivity, broadband access, secure internet servers and digital trade readiness.

In investigating internet penetration, the study discovered near-universal access in developed regions including Northern Europe and North America while emerging economies, particularly in sub-Saharan Africa and parts of Asia, lagged far behind, with Eastern Africa at just 28.5%. This gap extends to fixed broadband adoption, where high-income countries like Ireland (31.9 subscriptions per 100 people) significantly outperformed low-income nations such as Mozambique (0.2 per 100). The results implied that firms in low-income

countries could not take advantage of high-bandwidth services to conduct digital services. Similarly, the study identified that secure internet servers, which are critical for e-commerce and cybersecurity, were concentrated in advanced economies. These disparities underscore the challenges experienced by firms in developing economies in accessing reliable digital infrastructure.

The results further highlighted that the infrastructural gaps translate into real-world business constraints. Countries with strong digital ecosystems such as Singapore, scored highly in business-ready operational efficiency (87.3) and international trade efficiency (92.3). In contrast, weaker digital infrastructure in countries like Pakistan (trade efficiency score: 21.3) and Ghana (54.4) created barriers to export growth and digital integration. The logistics quality further reinforced the divides, with Singapore leading in efficiency (4.4) while emerging economies like Cambodia (2.4) struggled with reliability and technological integration.

Finally, the analysis highlighted the aspect of human capital with a focus on tertiary education enrolment. Tertiary education enrolment was considered a key driver of digital skills and innovation. The enrolment rate was markedly higher in advanced economies (Singapore, 98%) than in low-income countries (Pakistan, 11%). This skill in skilled labour further compounds the challenges that firms face in adopting digital tools and competing in knowledge-intensive industries.

4.4 Conclusion

This study has demonstrated that the digital divide across high- and low-income countries directly influence the ability of a firm to operate efficiently, engage in cross-border trade and adopt advanced digital technologies. The study has shown that that the persistent digital divide between developed and developing economies have profound implications on competitiveness in global business. Firms in high-income countries benefit from robust digital infrastructure, efficient trade systems and a skilled workforce and hence able to capitalise on opportunities in global market. In contrast, businesses in emerging economies

face structural constraints that hinder digital adoption and the ability to participate in the global market.

5.0 Discussion

5.1 Introduction

This section presents the discussion of the findings in relation to empirical literature on the subject of technology and international business. The chapter examines the key themes that emerged from analysis of data on how technology facilitates global business at the firm level. The discussion further undertakes a comparative assessment of firms in high- and low-income countries with respect to technology and international business.

5.2 Global digital divide and its implications for international business

5.2.1 Variations in internet penetration

Technological advancements have revolutionised how businesses operate, compete and engage in global trade. Aithal (2023) noted that new technologies had emerged enabling firms to operate effectively with all stakeholders in the business value chain. However, as the data in this study reveals, access to digital infrastructure remains deeply uneven across high- and low-income countries. The study identified significant disparities in internet penetration, adoption of broadband, number of internet users and the secure digital ecosystems required to create a robust global marketplace. The findings on fragmentations in the digital ecosystems for international business were consistent with the literature by Ateeq (2024). Ateeq presented that firms in advanced economies enjoyed near-universal connectivity while those in emerging regions continued to struggle with issues such as limited access, slower speeds and high costs.

Haini and Pang (2022) observed that the global internet penetration rate was more than just a measure of connectivity. The scholars argued that the penetration rate reflected the readiness of a country to participate in the digital economy including financial access, transactions and business formation as well as expansion. This study identified that as of early 2025, Northern Europe,

Western Europe and Northern America had reached near-universal internet adoption. This was a testament to decades of sustained investment in digital infrastructure, strong policy frameworks and high digital literacy levels (Oughton, Amaglobeli & Moszoro, 2023). As a result, these regions benefit from robust broadband networks, competitive telecommunications markets and government initiatives that prioritise digital inclusion (Wiley & Goulding, 2023). According to Bauer et al. (2023) significant investment in digital infrastructure implies highly connected consumer base, seamless e-commerce transactions and the ability to leverage emerging technologies such as AI and cloud computing with minimal friction.

In contrast, regions such as Eastern Africa with internet penetration rate of 28.5% and Western Africa (42.5%) continue to lag far behind in digital infrastructure. Kouladoum (2023) highlighted the multifaceted nature of reasons for the slow digital adoption in the developing economies with a specific focus on the sub-Saharan Africa. According to the study, there was limited infrastructure in rural areas, and the costs of data were high relative to the levels of income. The study further identified weak institutional support for digital expansion. As a result, a significant proportion of the population remained offline and businesses faced hurdles in reaching customers digitally. Matyushenko et al. (2024) emphasised the challenge of digital gaps in developing countries as major hindrance to their equal participation in international trade. Matyushenko et al. noted that businesses could not scale online services or integrate into global supply chains. The World Bank (2023) reported that even in regions with moderate penetration, such as South-Eastern Asia (78.2%) and the Caribbean (69.8%), the gaps often reflected urban-rural divides with underserved communities being excluded from the benefits of the digital economy.

5.2.2 Progress in mobile technology amid constraints

Mobile technology plays a critical bridging role in internet adoption in the emerging economies. The study by van Zanden (2023) identified that mobile broadband has been a game-changer in regions struggling with digital adoption.

According to the study, the technology had facilitated millions to come online for the first time. Similarly, Asongu and Odhiambo (2024) and Lim et al. (2023) highlighted that mobile internet has allowed the developing economies to leapfrog the traditional fixed-line infrastructure and hence bypassing the costly landline deployments in favour of the wireless networks. For instance, the sharp rise in connectivity in Ghana after 2015 aligned with the proliferation of affordable smartphones and the competitive pricing for mobile data (Aker & Cariolle, 2023).

However, mobile-based connectivity has associated limitations and challenges. Putrevu and Mertzanis (2024) observed that even though mobile-only connectivity provided basic access, it often lacked speed, reliability and bandwidth required for advanced digital services. Chikhun and Romanov (2023) emphasised the constraints experienced by a small proportion of the population who have access to internet services in emerging economies. The study demonstrated that the population was constrained by poor coverage outside urban centres and high costs of data. This created a second-tier digital experience where even though users could have intermittent access, they struggled with activities such as video conferencing, large file transfers and secure online transactions. According to Chikhun and Romanov (2023), factors such as secure online transactions are key for businesses operating internationally.

5.2.3 Fixed broadband and secure internet servers for global business

This study further identified that fixed broadband subscriptions exacerbate the digital divide. For instance, Ireland with 31.9 subscriptions per 100 people implied high-speed wired connections supported bandwidth-intensive activities such as cloud computing, enterprise software and high-definition virtual collaboration (Janevski, 2024). Rattenet al (2024) wrote that such digital capabilities are critical for firms engaging in global trade where seamless communication and data exchange are required. By contrast, Mozambique with 0.2 subscriptions per 100 indicates near-absence of fixed broadband which forces the businesses to rely on mobile networks. The mobile networks are ill-suited for high-volume data need

which hampers operational efficiency as well as limits participation in key sectors such as IT outsourcing, digital finance and e-commerce (Clifford & Logan, 2024).

The vast gap in secure internet servers revealed another layer of inequality. The U.S. with 66.8 million secure servers per million people and Ireland (655,415) highlighted presence of infrastructure to host domestic e-commerce platforms, safeguard sensitive data and comply with international standards for cybersecurity. On the contrary, countries like Central African Republic (9 secure servers per million) indicated lack of basic capacity to secure online transactions (Bhuiyan, Akter & Islam, 2025). According to Bhuiyan, Akter and Islam, the disparity has dire implications for digital trade since businesses in low-server environments are vulnerable to cyberthreats.

5.3 Country-level metrics for technology and international business

The profound disparities revealed in digital infrastructure create an uneven foundation for international business. However, digital access alone is insufficient for firms to thrive in the global business. Therefore, this study examined country-level metrics including business-ready operational efficiency, international trade efficiency, and logistics quality and competence. These factors collectively determine how effectively firms can leverage digital tools to compete in the international marketplace.

5.3.1 Business-ready operational efficiency for predictable commerce in global business

Business-ready operational efficiency (BROE) measures the foundational ecosystem that enable firms to operate and scale in a predictable manner (McCann & Lee, 2025). Singapore's exceptional score of 87.3 epitomised a mature environment characterised by streamlined regulations, strong enforcement of contract, efficient resolution of disputes and reliable digital government services (World Bank, 2024; Cirera et al., 2021). According to World Bank (2024), such a robust ecosystem drastically reduces transaction costs and uncertainties for business operations. This implies that firms in Singapore can

confidently invest in complex digital technologies such as AI-driven supply chain management or blockchain for contracts, with full knowledge that institutional frameworks support their implementation and enforcement (Autio, Mudambi & Yoo, 2021). According to the World Bank (2020), the high BROE score directly translates to a lower cost of running business and hence freeing resources for innovation and international expansion.

The mid-tier performance including Nepal (72.2), Bangladesh (70.5), and Botswana (67.7) represented environments with functional but imperfect operational systems. According to the study by Hilmersson et al. (2022), the mid-tier scores could suggest reasonable predictability for established forms but significant hurdles for SMEs. In another study, Suchek, Ferreira and Fernandes (2024) observed that bureaucratic delays, inconsistency in interpretation of regulatory frameworks and gaps in digital public services could impede efficiency and increase compliance burdens for firms. The challenges were particularly more pronounced for firms attempting to integrate complex digital tools and cross-border e-commerce.

The constrained environments of Pakistan (65.9), Cambodia (60.7) and Ghana (54.4) reflected a different picture. The results indicated that operational efficiency was hampered by more significant institutional weaknesses including cumbersome licensing processes, weaker protection of property rights, inefficiency in judicial system and unreliable infrastructure and less developed digital government platforms (Serangi & Pradhan, 2020; Meyer, Li & Brouthers, 2023). Another study by Zheng, Guo and Yan (2025) established that such factors create high levels of uncertainty and transaction costs for a business. As the literature demonstrated, firms operating in uncertain environments are obliged to invest substantially in mechanisms aimed at navigating bureaucracy and operational risks. As a result, the firms do not have the opportunity to focus on the core business activities and expansion beyond the local markets.

5.3.2 International trade efficiency

International trade efficiency (ITE) measures the ease of importing, exporting and engaging in digital trade (Khan, 2024). Singapore's leading score of 92.3 among countries selected for analysis in this study reflected seamless integration of physical and digital trade infrastructure. This is consistent with UNCTAD (2024) report that trade infrastructure in developed economies including Singapore was highly automated, constituted paperless customs clearance, robust digital payment systems and supportive regulatory frameworks for e-commerce. Therefore, there is deep integration into the global logistics networks since it minimises friction, time and costs for moving goods and data across borders.

The strong performance of Nepal (83.0) and Bangladesh (80.5) was also noteworthy in this study. The high score of Nepal despite being a landlocked country highlighted the effectiveness of targeted investments in infrastructure for trade facilitation (World Bank, 2023). Bangladesh's score also reflected significant improvements in business efficiency although challenges were persistent. The study by Beverelli et al. (2021) highlighted that adoption of digital systems such as the Automated System for Customs Data (ASYCUDA) was beneficial to exporters and hence facilitating international business.

However, Cambodia with a score of 56.0, Ghana (48.9) and Pakistan (21.3) revealed significant deficiencies in international trade participation. According to Hasan and Aqil (2023), deficiencies in international trade low-income countries disproportionately hurt SMEs and perishable goods exporters. Hasan and Aqil demonstrated that firms experiencing deficiencies encounter significant difficulties in taking part in global business. The findings imply that digital connectivity alone cannot overcome the logistical and procedural obstacles experienced in emerging economies.

5.3.3 Logistics competence and quality for global commerce

Logistics competency describes the reliability, timeliness and technological sophistication of moving goods (Bilgin, 2023). Bilgin (2023) noted that logistics

competence was a physical counterpart to digital connectivity and trade procedures in business. This implies that Singapore's score of 4.4 reflected world-class infrastructure, advanced use of technology, highly skilled workforce and seamless integration between the different transport modes (Notteboom, Pallis & Rodrigue, 2022). The results emphasised efficiency in global distribution and reliability of e-commerce in Singapore.

The relatively strong performance of some of the emerging economies including Botswana (3.4) highlighted strategic investments in logistics which facilitated regional trade. Arvis et al. (2023) observed that improvements in developing countries such as better road infrastructure and more professional logistics service providers facilitated global trade. However, the clustering of Bangladesh (2.7), Pakistan (2.59), Ghana (2.5), Nepal (2.46) and Cambodia (2.4) in the lower-middle range revealed widespread challenges that could affect logistics in international business. For instance, according to Rodrigue (2023), unpredictable transit times could lead to congestions, breakdowns or administrative delays. Wieland and Durach (2021) also wrote that underuse of tracking systems, warehouse management software or data analytics for route optimisation could affect the efficiency of international logistics.

The results from both high-income and emerging economies demonstrated that country-level metrics are deeply interconnected in international business. As Mumin and Yakubu (2023) noted, logistics and trade efficiency are interconnected. The scholars stated that efficient ports and transport networks were prerequisites for smooth customs clearance and fast movement of goods across borders. Shevchenko et al. (2023) and Ha (2023) further described digital infrastructure as an enabler of sophisticated logistics management systems. The scholars noted that logistics management systems such as tracking and optimisation, as well as digital trade platforms were entirely dependent on robust digital infrastructure.

5.4 Study Implications

5.4.1 Implications for Firms

This study has demonstrated that country-level metrics are critical in shaping firm-level capabilities and strategic choices and particularly on internationalisation. The study has shown that high international trade efficiency and logistics scores significantly lower the barriers and costs to foreign market entry. Therefore, countries with higher ITE and logistics quality scores have fewer hurdles to engaging in global business. Therefore, firms should assess the ITE and logistics scores before making realistic targets regarding global business.

Similarly, this study has shown that operational costs and efficiency are crucial in daily operations of businesses. Countries with high business-ready operational efficiency have minimal friction in business operations since less time is spent on compliance, with lower transport costs and fewer delays. Therefore, the firms in such environments have the opportunity to invest resources in productive processes, innovation, marketing and overall global expansion (Bloom et al, 2018).

In addition, technology adoption and sophistication are essential in international business. This study identified that firms operating in high business-ready operational efficiency and international business efficiency are likely and able to adopt advanced digital technologies including AI, IoT, blockchain and analytics. This is based on the fact that the ecosystem supports integration and use of technology in business operations.

5.4.2 Policy Implications

This study emphasises the need to bridge the digital gaps for inclusive participation and expansion of firms in global business. There is a significant need for targeted trade facilitation. This implies that both digital connectivity and investments in physical trade infrastructure should be undertaken in emerging economies to enhance ITE. Simplifying the regulations and reducing

requirements for documentation can yield significant gains in trade efficiency.

The study has demonstrated the significance of modernising logistics management sectors for the emerging economies. The modernisation may focus on key aspects such as corridors of transport and warehousing. Integration of technology can also play a crucial role to improve processes of logistics management including tracking and fleet optimisation. However, the findings of the study indicate that integration of technology should be implemented alongside the development of skills to build a workforce with the necessary expertise.

6.0Conclusions

This study conclusively shows the transformative power of technology for international business. According to the study, disparities in foundational digital infrastructure including internet access, broadband reliability and secure digital ecosystems, have been demonstrated to establish fragmentations in the global marketplace. The results indicate that firms in high-income economies take advantage of the near-universal connectivity to conduct global operations. On the contrary, firms in low-income regions remain hampered by issues such as limited and unreliable internet access. As a result, users rely heavily on mobile technology which has inherent constraints for international business. As the study demonstrated, key metrics such as business-ready operational efficiency, logistics quality and competence and international trade efficiency are deeply interconnected. Weakness in one area amplifies deficiencies in other sectors which creates vicious cycles that trap firms and particularly SMEs.

The implications of the study demand urgent and coordinated action for equal representation of the firms in global business. Firms in developing economies should focus on navigating the constraints through approaches such as careful assessment of the market, and calibrated adoption of technology. Policymakers can also facilitate bridging the digital divide through holistic approaches beyond mere expansion of internet connectivity. This may involve integrated investment

in both digital and physical trade infrastructure together with undertaking institutional reforms for supportive regulatory frameworks. Modernisation of logistics through technology and skills is also crucial to address barriers to business internationalisation.

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Appendix

Analyses

Global Internet Penetration rate as of February 2025

Statista: <https://www.statista.com/statistics/269329/penetration-rate-of-the-internet-by-region/>

Region	Penetration rate as of February 2025
Northern Europe	97.90%
Western Europe	95.10%
Northern America	93.30%
Southern Europe	91.60%
South-Eastern Asia	78.20%
Southern Africa	77%
Caribbean	69.80%
Western Africa	42.50%
Eastern Africa	28.50%

Secure Internet Servers

World

Bank: https://data.worldbank.org/indicator/IT.NET.SECR?end=2024&locations=NP-KH-BN-BW-GH-IE-SG-GB&most_recent_year_desc=false&start=2010&view=chart

Country - 2024	Secure Internet Servers (per 1 million people)
Ireland	655,415
United States	66,850,221
Singapore	1,265,721
Country - 2024	Secure Internet Servers (per 1 million people)
Malawi	703
Ghana	1,684
Afghanistan	1,751
Mozambique	1,287
Cambodia	14,416

Fixed Broadband Subscriptions: World Bank:

<https://data.worldbank.org/indicator/IT.NET.BBND.P2?locations=IE-MZ-BD-NP-GH>

Fixed Broadband Subscriptions	Subscriptions (per 100 people)
Bangladesh	7.89
Ghana	0.56
Ireland	31.89
Mozambique	0.2
Nepal	4.83

Logistics Performance and Quality: World Bank:

<https://data.worldbank.org/indicator/LP.LPI.LOGS.XQ?end=2024&locations=SG-PK-NP-GH-BW-BD-KH&start=2024&view=chart>

Competence and Quality of Logistics Services as of 2022**Source (World Bank, 2024)**

Bangladesh	2.7
Botswana	3.4
Cambodia	2.4
Ghana	2.5
Nepal	2.46
Pakistan	2.59
Singapore	4.4

Business-Ready: International Trade Pillar 3 – Efficiency of Importing Goods, Exporting Goods, and Engaging in Digital Trade

World Bank:

<https://data.worldbank.org/indicator/IC.BRE.IT.P3?end=2024&locations=SG-PK-NP-GH-BW-BD-KH&start=2024&view=chart&year=2017>

Country	2024 Percent
Bangladesh	80.5
Botswana	76.2
Cambodia	56
Ghana	48.9
Nepal	83
Pakistan	21.3
Singapore	92.3