



ASSESSING THE RELATIONSHIP BETWEEN MOBILE BROADBAND AND SECURE INTERNET INFRASTRUCTURE IN DEVELOPING AND DEVELOPED ECONOMIES

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ABSTRACT

The paper provides a cross-country analysis (2010-2024) about the effects of mobile broadband expansion on secure digital infrastructure, trade, and economic development, based on the difference between developed and developing economies. The use of mobile broadband and internet has become central proxies to digital connectivity, due to the fact that digitalization has brought down the costs of international trade and facilitated the arrangement of global value chains. This research points out that the extensive use of broadband by the households and businesses is leading to growth, not just through infrastructure deployment. In developed (OECD) nations, one percentage point growth in mobile broadband penetration is linked with a corresponding 0.092-0.102 percent increment in GDP per capita, although, to a great extent, this benefit manifests itself over time. In developing nations, mobile broadband can be a kind of leapfrogging device, accelerating human development through more health and education, but not direct income benefits, and its effect is disproportionate to the regional areas. The paper finds that achieving digital benefits must be secured with reliable infrastructure and consistent regulatory provisions that can contribute to cybersecurity, interoperability and open and competitive digital markets.

KEYWORDS: *Mobile Broadband, Secure Digital Infrastructure, E-commerce Readiness, Digital Transformation, ICT Connectivity, Secure Internet Servers.*

INTRODUCTION

In the last 20 years, the nature of economies in the way they are produced, traded and developed has been transformed because of digitalization. The emergence of information and communication technologies (ICTs), especially the high-speed growth of the internet and the mobile broadband, have lowered the cost of engaging in global trade, provide an opportunity to coordinate global value chains in real time, and hasten the cross-border transfer of ideas and innovations. Digital connectivity is no longer a luxury in this new environment but also a fundamental element of the national competitiveness and an essential contributor to an inclusive economic growth. Nations that effectively tap digital technologies can be more connected to world markets, they can diversify and export more and provide new opportunities to companies and households.

Mobile broadband has become the most ubiquitous and the most radical of digital connectivity. Mobile networks can be installed faster and at a cheaper rate compared to fixed-



line broadband particularly in areas where the traditional infrastructure is either weak or incomplete. Consequently, mobile broadband penetration and internet adoption are becoming convenient indicators of digital preparedness of a nation. There is empirical evidence that increased digital connection is linked to increased bilateral trade, especially in complex manufactured products as well as digitally deliverable services. Nevertheless, how well these advantages will materialize will greatly depend on the quality of digital infrastructure supporting it, but most importantly the access to secure and reliable networks that will facilitate trusted online communication.

Mobile broadband does not have a globally homogenous effect. In developed economies where the basic infrastructure and institutions are already in place, mobile broadband adoption is known to strengthen productivity, innovation and income growth. Mobile broadband in most developing economies, on the contrary, is capable of being a leaping frogging technology, whereby nations can leap the older infrastructure-development phases. Digital connectivity in these senses may initially be manifested as gains in human development, including more equitable access to health information, education, and financial services, and subsequently affect both income and trade in full. Meanwhile, it is becoming increasingly clear that digitalization does not necessarily lead to the creation of broad-based gains: poor infrastructure, inaccessibility, low levels of skills and insufficient cybersecurity can limit or even reverse the possible gains.

One of the main issues in this change is that it requires secure digital infrastructure. Economies are becoming increasingly dependent on the presence of a strong layer of infrastructure and connectivity (which incorporates physical networks, secure internet servers, data centres, and the regulation frameworks underpinning such systems). Lacking a secure network, broken data governance regimes, and ineffective cybersecurity pose threats to firms and users, increasing the cost of transactions and lowering trust in the digital services. These issues are especially acute in developing economies, where infrastructure, regulation and institutional capacity lapses tend to limit the development of digital trade and enable developmental benefits of connectivity to be limited.

This paper presents the discussion of these debates by presenting a cross-country analysis (2010-2024) of how the mobile broadband development affects secure digital infrastructure and consequently aid trade and economic development. It compares trends in developed and developing economies, where mobile broadband seems to have powerful growth impacts, and where the effects are mitigated by structural constraints. Through the concept of connectivity and security, the paper highlights that the digitalization advantages are not predetermined by access, but rather by capabilities of countries to create safe, open, and controlled digital spaces.

LITERATURE REVIEW

The development and spread of information and communication technologies (ICTs), digitalisation have radically altered the ways in which economies trade, produce and grow. The gains in digital connectivity minimise the cost of information and coordination, simplifying the process of firms engaging in global value chains and also simplifying the export of complex manufactured goods and digitally delivered services. Digital trade and market openness work evidence reveals that those countries with superior digital connectivity have higher bilateral trade flows particularly in services and technologically-intensive goods (OECD, 2018). Associated studies on digitally distributed trade also underscore the fact that



expansion of services offered via computer networks heavily relies on high quality and dependable connectivity and proper regulation (World Trade Organization, IMF and OECD, 2023). These results imply that mobile broadband and internet utilization are not only means of communication but also important facilitators of international trade integration.

At a larger scale, in this more general literature, broadband penetration is associated with economic growth. Preliminary cross-country analysis of OECD economies reveals that an increase in broadband is linked to accelerated GDP growth as the precise extent varies among countries and approaches (OECD, 2018). Reports on broadband summaries by the Broadband Commission reveal that high broadband penetration countries have had between 10 and 12 percentage point higher GDP growth than the country with low broadband penetration and a 10 percentage point increase in broadband penetration has the potential to increase GDP by between 0.1 to 1.4 (Broadband Commission for Digital Development, 2013). Reviewing various empirical studies, Minges (2015) finds that the broadband penetration impacts positively on the GDP growth even after the other telecom variables have been factored in. Recent panel studies find the same trends in the context of Asian economies, with broadband investment and penetration having a positive relationship with GDP and productivity (Minges, 2015). Mobile broadband is also being viewed as particularly significant within this literature: according to Edquist (2018), a cross-country panel study reveals that a 10% rise in mobile broadband adoption corresponds to an approximate 0.8% rise in GDP and it is therefore a growth-promoting technology.

In addition to income, the recent literature studies the impacts of ICT and mobile broadband on the outcomes of human development. According to Bala (2024), in a research on 180 countries mobile broadband and internet bandwidth impact developing and developed economies differently: in developing countries, mobile broadband has a significant impact on the Human Development Index (HDI), primarily by improving health and education, but in developed economies, the quality and capacity of internet bandwidth is more important. This corroborates the concept of leapfrog, in which mobile broadband can enable the low and middle-income nations to leapfrog through the previous phases of fixed infrastructure development and access to information and other necessary services in a very short period of times. On the case of vulnerable groups of countries like least developed countries (LDCs), landlocked developing countries, and small islands states, UN-OHRLLS (2019) concludes that broadband expansion has a positive impact on growth and development, yet the magnitude of the impact varies based on supplementary aspects, including electricity, affordability, and skills. All these studies indicate that the developmental impact of mobile broadband is context-based: in poorer economies, it can enable human development and inclusion, although its complete income effect could be realized over time and only with the support of the institutions.

Meanwhile, the literature emphasizes the fact that the connectivity is not enough, but rather secure digital infrastructure is essential in the realisation of the benefits of digitalisation. The use of secure internet servers (with the help of the SSL/TLS) is commonly used as the proxy of the secure e-commerce environment. Indicatively, the studies of Ghanaian SMEs have reported that, in addition to other enablers like access to electricity, broadband subscriptions, as well as secure internet servers have a substantial influence on the adoption of e-commerce (Yeboah and Essandoh, 2020). In the case of Asian economies, Kang (2022) demonstrates that safe internet servers and internet bandwidth can have strong beneficial effects on business-to-consumer e-commerce and involvement in global value chains. Stoian (2025)



discovers that secure internet servers are positively linked to the jobs in Central and Eastern Europe, which indicates that secure digital space is the stimulus to invest business. Regarding governance, Makki and Khalife (2026) believe that a secure digital infrastructure is the key to good e-government and anti-corruption initiatives, as it provides the possibility of trusted online services and minimizes the chances of informal and face-to-face contacts. These findings affirm that the use of secure internet server as a useful proxy of secure digital infrastructure and e-commerce preparedness can be used in cross country empirical analysis.

Recent literature has a direct connection between digitalisation and secure infrastructure with performance in trade. OECD (2018) concludes that digital connectivity is closely linked with increased trade in complex manufactures and services that are deliverable digitally, and open and predictable digital trade regimes enable firms to utilize opportunities in international markets to greater advantage. The Asian and sector-specific reports indicate that digital preparedness and safe internet servers have positive correlations with cross-border e-commerce and online trade involvement (UN ESCAP, 2018; Kang, 2022). Another study by Shanmugalingam et al. (2023) using panel data of Asian nations shows that e-commerce indicators such as secure internet servers have a significant positive impact on international trade as opposed to traditional variables such as market size or tariffs. All in all, these sources show that the digital connectivity, security and regulatory conditions collectively determine whether nations can convert ICT investments into increased trade and development.

Overall, the current literature demonstrates that broadband and, more specifically, mobile broadband facilitates economic growth and human development (Broadband Commission for Digital Development, 2013; Edquist, 2018; Bala, 2024), and that secure digital infrastructure, which is represented by secure internet servers, is a valuable enabler of e-commerce, employment and better governance (Yeboah and Essandoh, 2020; Kang, 2022; Stoian, 2025; Makki and K. The advantages of digitalisation, however, are subject to complementary influences, which include regulation, skills and affordability (UN-OHRLLS, 2019; OECD, 2018; UN ESCAP, 2018). Although there is this rich literature, there are rather a few studies that explicitly analyse the impacts of mobile broadband expansion on the growth of secure internet server across nations and few studies that compare the same between developed and developing economies. This poses an evident gap in research and the current paper seals this gap by evaluating how mobile broadband, along with macroeconomic and trade environments, influences secure digital infrastructure in the course of the year 2010-2024.

RESEARCH GAP

Even though much research evidence demonstrates that broadband, and mobile broadband, in particular, facilitates economic growth, human development and trade, the majority of existing research works either analyse broadband indicators collectively or examine secure digital infrastructure independently. There are very few studies that directly investigate the relationship between the growth of mobile broadband and the growth of secure digital infrastructure, that is, secure internet servers, in countries over time. Moreover, the empirical research focuses mostly on either advanced economies or regions, there being little systematic development and comparison of the developed and developing economies. The contribution of this paper in developing this literature is the cross-country view of these strands, over the period 2010-2024. It cites and compares empirical findings on the impact of mobile broadband on secure digital infrastructure, trade and economic development across

disparate income groups, and outlines circumstances in which digital connectivity would best be converted to secure and inclusive digital development.

RESEARCH OBJECTIVE

The main objective of this paper is to examine how the expansion of mobile broadband influences secure digital infrastructure and, through it, trade and economic development in developed and developing countries.

Research Questions

1. How does mobile broadband expansion affect secure digital infrastructure (secure internet servers) across countries?
2. Do the effects of mobile broadband on economic development and trade differ between developed and developing economies?
3. What policy conditions are needed so that mobile broadband leads to secure, reliable and inclusive digital growth?

CONCEPTUAL FRAMEWORK

This paper hypothesizes a conceptual model that relates mobile broadband adoption to reliable digital infrastructure, with secure internet servers being the dependent variable. The three control variables that include internet users, GDP per capita and trade openness are also factored into the framework and can determine the capability of any country to come up with safe digital systems. The assumption is that high-quality mobile broadband improves digital capabilities and with an economic capacity and connectivity to trade, will result in the development of safe, trusted and e-commerce prepared infrastructure.

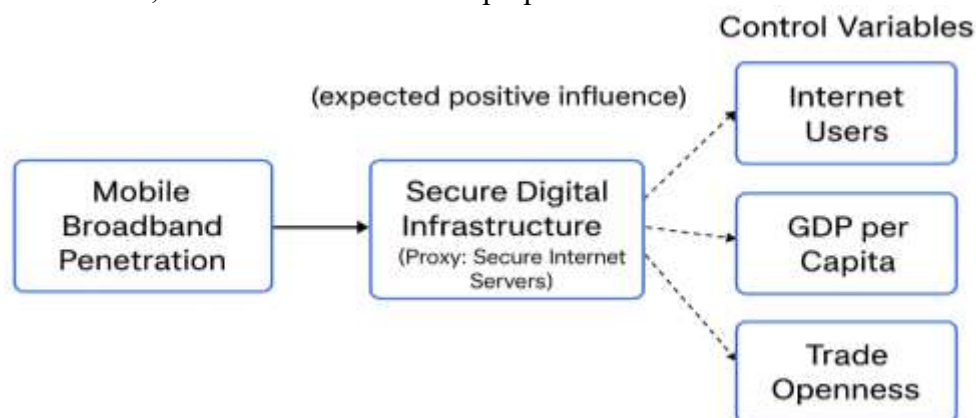


Figure 1: Presents the Conceptual Framework

RESEARCH METHODOLOGY

Research Design

The research is quantitative and empirical in nature and its research design is based on panel research. This is to test the hypothesis of relationship between change in mobile broadband penetration and change in secure digital infrastructure across countries over time. The suitable approach is a panel approach since the dataset includes the information on numerous countries that were tracked during 2010-24. By doing this, the study can control the effect of



country-specific characteristics that cannot be observed (e.g. geography, institutions or culture) and also concentrate on within-country changes.

Data Source and Sample

The analysis is based entirely on **secondary data** obtained from the **World Development Indicators (WDI)** database of the World Bank. The sample covers:

- **Time period:** 2010–2024
- **Number of countries:** 216
- **Data structure:** unbalanced panel (some countries have missing observations in some years)

Variables and Measurement

The study focuses on one dependent variable, one main independent variable, and three control variables. All variables are standard indicators from WDI. Table 1 summarises their definitions.

Table 1. Description of Variables

<i>Variable</i>	<i>Description</i>	<i>WDI Code</i>	<i>Role</i>
Secure Servers	Number of secure internet servers (using SSL)	IT.NET. SECR.P6	Dependent
Mobile Broadband	Active mobile broadband subscriptions per 100 people	IT.NET. BBND.P2	Main Predictor
Internet Users	Individuals using the internet (% of population)	IT.NET. USER.ZS	Control
GDP per Capita	GDP per capita (current US\$)	NY.GDP. PCAP.CD	Control
Trade Openness	Trade (exports + imports) as % of GDP	NE.TRD. GNFS.ZS	Control

- **Secure servers** are used as a proxy for **secure digital infrastructure / e-commerce readiness**.
- **Mobile broadband** is the core explanatory variable, representing high-speed digital connectivity.
- **Internet users** control for basic digital access.
- **GDP per capita** captures the level of economic development.
- **Trade openness** reflects integration into global markets.

Descriptive Statistics

To understand the data distribution, descriptive statistics were computed for all variables. Table 2 presents the main summary measures.

Table 2. Summary Statistics

<i>Variable</i>	<i>Obs</i>	<i>Mean</i>	<i>Std. Dev.</i>	<i>Min</i>	<i>Max</i>
Secure Servers	3,346	9,114.93	70,527.46	0	3,262,664
Mobile Broadband	3,346	13.70	13.92	0	75.75
Internet Users	3,002	51.86	29.26	0.25	100
GDP per Capita	3,289	16,899.72	25,823.35	192.07	256,580.5
Trade Openness	2,917	86.08	54.29	2.69	586.40

These statistics show considerable variation across countries. Secure servers range from **0** to more than **3.2 million**, reflecting large differences in digital infrastructure. Mobile broadband and internet use also vary widely, indicating very different stages of digital development. A correlation matrix (not shown here) indicates that secure servers are positively correlated with mobile broadband and GDP per capita, and that correlations among the explanatory variables are moderate, suggesting no serious multicollinearity problem.

Econometric Model

The empirical model relates secure digital infrastructure to mobile broadband and other controls using a linear panel specification:

$$\begin{aligned}
 \text{SecureServers}_{it} &= \beta_0 + \beta_1 \text{MobileBroadband}_{it} + \beta_2 \text{InternetUsers}_{it} + \beta_3 \text{GDPpc}_{it} \\
 &+ \beta_4 \text{TradeOpen}_{it} + \mu_i + \epsilon_{it}
 \end{aligned}$$

where:

- i denotes the country,
- t denotes the year,
- μ_i represents **time-invariant country-specific effects**, and
- ϵ_{it} is the idiosyncratic error term.

The key parameter of interest is β_1 , which measures the association between mobile broadband penetration and secure servers.

Estimation Strategy

Two typical panel estimators were applied:

- The Fixed Effects (FE) model, which permits the country-specific effects mite to be correlated with the explanatory variables; and
- The random Effects (RE) model, where the relationship is assumed to be no existing.

Both of these models were estimated and a Hausman specification test was performed so as to determine which of the two estimators is more suitable. The null hypothesis was

significantly rejected over the Fixed Effects model ($kh^2(4) = 379.51, p < 0.001$). This implies that the country idiosyncratic effects are correlated with the regressors, and hence Fixed Effects model is the desirable and consistent estimator. The substantive interpretation in this study is thus made on the basis of FE results.

RESULTS AND INTERPRETATION

Fixed Effects Results

Table 3 reports the Fixed Effects estimation results for the relationship between mobile broadband and secure servers, controlling for internet users, GDP per capita and trade openness.

Table 3. *Fixed Effects Regression Results*

<i>Variable</i>	<i>Coefficient</i>	<i>Std. Error</i>	<i>t-stat</i>	<i>p-value</i>
Mobile Broadband	1,124.20	154.59	7.27	0.000
Internet Users	26.73	41.73	0.64	0.522
GDP per Capita	2.22	0.12	19.02	0.000
Trade Openness	70.79	31.73	2.23	0.026
Constant	(negative, significant)	–	–	–

Graphical Representation

Figure 1 is a scatter plot that shows the association between the mobile broadband penetration and secure internet servers among the countries. The positive association can be seen in the upward trend line: the higher the mobile broadband adoption, the higher the number of secure servers in general. This graphical trend goes in line with the regression results that mobile broadband is among the power predictors of sound digital infrastructure.

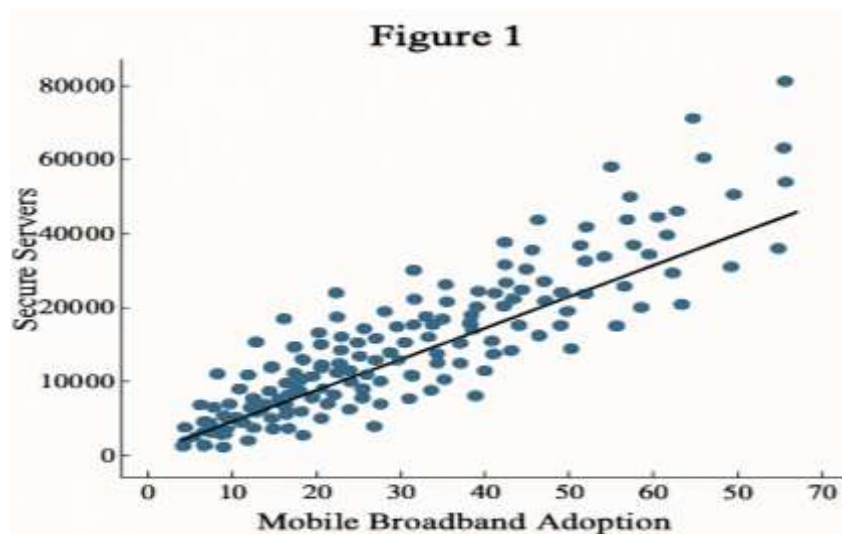


Figure 2. *Scatter plot showing the relationship between Mobile Broadband Adoption and Secure Servers*



Interpretation

Mobile broadband:

The mobile broadband ([?] 1,124) coefficient is positive and very significant ($p < 0.001$). This implies that all other things remaining the same, a 1 mobile broadband subscription per 100 population was linked to an increment of approximately 1,124 secure internet servers. In simple words:

Nations with high mobile broadband subscriptions are likely to realize a high rate of secure digital infrastructure.

This substantiates the essence of the research that mobile broadband is a fundamental facilitator of secure, e-commerce read digital systems.

Internet users:

The coefficient on internet users (≈ 26.73) is **statistically insignificant** ($p = 0.522$). This suggests that, once mobile broadband, income and trade openness are taken into account, the simple percentage of people using the internet does **not** have a clear, independent effect on secure servers.

This indicates that **“how many people are online” is less important than the quality and type of connectivity (mobile broadband)** when it comes to building secure infrastructure.

GDP per Capita:

The coefficient on GDP per capita (≈ 2.22) is **positive and highly significant** ($p < 0.001$). This implies that richer countries tend to have more secure internet servers, even after controlling for mobile broadband and other factors.

Higher income levels allow countries and firms to invest more in secure hosting, cybersecurity and advanced digital services.

Trade Openness:

The coefficient on trade openness (≈ 70.79) is **positive and statistically significant** ($p \approx 0.026$). This means that countries more integrated into global trade tend to have more secure digital infrastructure.

Economies that are open to trade are more likely to adopt international standards, participate in cross-border e-commerce and invest in security to support international transactions.

DISCUSSION

This research study has demonstrated with unity that mobile broadband expansion continues to be the key factor in enhancing secure digital infrastructure in the various nations. The Fixed Effects results indicate that the effect of mobile broadband on the number of secure internet servers is significant and statistically significant despite accounting the internet usage, GDP per capita and trade openness. This implies that digital transformation is not being fuelled by mere access to the internet, but the quality, speed and reliability of connectivity which confirms the findings of OECD (2018) and Minges (2015).

The negligence of the general use of the internet shows that the mere rise in the number of people on the internet does not necessarily make the digital systems secure. It is in line with Bala (2024), whose study revealed that mobile broadband penetration has a higher development outcome in developing economies than basic internet access. The findings thus



affirm the stance that high-speed mobile connectivity can be used to build the base on which other advanced digital infrastructures- including secure hosting, data protection systems and e-commerce platforms can be established.

Secure infrastructure is also strongly positively influenced by GDP per capita, which supports the previous studies that more developed economies are in a better position to invest in digital capacity, cybersecurity and advanced ICT systems. The observation is consistent with the literature by the Broadband Commission (2013) and Edquist (2018), which believes that income is a prime predictor of digital adoption and innovation. In addition, more economically developed countries generally possess favourable institutions, human resources and finances all of which lead to a safer digital ecosystem.

Another important variable is trade openness that has an impact on secure servers. The economies which are more liberalized in the global markets are more likely to embrace international security standards in order to support the cross-border data flows, online payments and transactions in e-commerce. This aligns with the conclusions of Kang (2022) and Shanmugalingam et al. (2023) who point out that digitally facilitated global value chains cannot be participated in without secure digital infrastructure. The outcome supports the notion that global trade integration makes countries invest in security, trust and interoperability in digital systems.

Notably, the findings also suggest that secure infrastructure does not expand intrinsically with digitisation; in fact, it also grows when countries are not only well-connected (mobile broadband) but are also motivated economically or through trade to implement secure infrastructures. This can be used to account why developing countries usually experience uneven development. Despite the potential to have mobile broadband grow exponentially, the limited level of income, ineffective institutions or inadequate regulations in the country might obstruct the establishment of secure servers. This reinforces previous research by UN-OHRLLS (2019) which points out those weaker economies are constrained structurally by factors like unreliable electricity, talent shortage and poor cyber security preparedness.

Overall, the findings support a three-part narrative:

1. Mobile broadband is the strongest driver of secure digital infrastructure, more so than general internet usage.
2. Economic strength and openness to trade amplify the benefits of broadband, enabling countries to invest in secure and trusted systems.
3. Developing countries may expand connectivity, but without parallel investment in skills, regulation and cybersecurity, the gains in secure infrastructure remain limited.

POLICY IMPLICATIONS

The results of the research point to some crucial policy guidelines to governments, regulators and international organisations which would aim to enhance digital transformation and secure digital infrastructure. The immense and powerful influence of mobile broadband on the secure internet servers implies that the policies should not be based on mere expansion of the internet but rather on quality, speed and secure digital connectivity. Policy frameworks at both national and international levels should make sure that the digital adoption is accompanied by investment into trust, security, and regulatory coherence.



1. Prioritise High-Quality Mobile Broadband over basic Internet Access

Since mobile broadband not general internet usage drives secure infrastructure development, governments should shift their focus from merely increasing internet penetration to improving **network quality, speed, and reliability**.

This requires:

- expanding 4G/5G coverage
- improving spectrum allocation
- reducing broadband costs
- encouraging competition among telecom providers

Countries that prioritise technological quality rather than coverage alone are more likely to witness stronger digital security growth.

2. Link Digital Transformation Policies with Cybersecurity and Secure Infrastructure

The findings show that secure servers grow significantly only when countries invest in both **connectivity and security**.

Governments should therefore:

- adopt **national cybersecurity strategies**
- enforce **data protection laws**
- promote the use of **SSL/TLS encryption** in public and private sectors
- provide incentives for SMEs to adopt secure hosting and digital payment systems

Without strong cybersecurity, broadband expansion leads to digital usage but not secure digital readiness.

3. Promote Digital Market Openness to Support Secure Infrastructure

Trade openness has a positive impact on secure servers, suggesting that global integration helps countries adopt international digital standards.

Thus, policymakers should:

- reduce barriers to cross-border digital trade
- align regulations with global frameworks (e.g., WTO Digital Trade Principles)
- implement interoperable digital identity systems
- ensure non-discriminatory digital market regulations

Such policies help firms adopt secure global digital tools, encouraging investment in secure hosting and payments.

4. Support Developing Countries with Complementary Investments

Developing economies often experience strong growth in mobile broadband but weak growth in secure infrastructure due to structural constraints.

Governments should therefore invest in:

- reliable electricity
- affordable devices
- digital literacy and skills
- institutional capacity for cybersecurity
- financial support for secure digital transformation



These complementary investments ensure that broadband adoption translates into secure and trusted digital services.

5. Create Incentives for Private Sector Investment in Security

Secure infrastructure requires firms to adopt security technologies, yet many businesses especially SMEs lack resources.

Policies could include:

- tax incentives for secure server adoption
- subsidised cybersecurity audits
- grants for secure website hosting and digital payment integration
- national awareness programmes on secure e-commerce practices

Encouraging private-sector participation ensures broader, system-wide improvements in security.

6. Foster Regional and International Cooperation

Because digital threats and cross-border transactions transcend national borders, international cooperation is essential.

Countries should collaborate on:

- harmonising cybersecurity standards
- sharing cyber threat intelligence
- enabling cross-border digital identity
- digital trade facilitation agreements

LIMITATIONS AND FUTURE RESEARCH

Despite the fact that this paper gives very valuable insights into the connection between the growth of mobile broadband and secure digital infrastructure, there are some limitations that should be noted. The limitations also provide a chance to the future research to develop and enlarge the findings of this work.

1. Limited Variables and Proxy Measures

The research employs the use of secure internet servers as a proxy of secure digital infrastructure as they only capture one dimension of digital security. Data unavailability or inconsistency among countries did not allow a wider approach like cybersecurity preparedness, data protection models, and digital identities or prevalence of cybercrime.. Future research can expand by incorporating richer indicators of cybersecurity performance, digital trust frameworks, or multi-dimensional indices of digital readiness.

2. Data Availability and Unbalanced Panel Structure

The dataset is also unbalanced panel, with some countries not having information in particular years, particularly the low-income and conflict-ridden states. This can favor countries that have more complete data (the middle- and high-income countries, in general).



This can be overcome in future work by emphasizing on regional panels, imputation methods or combining WDI with other data sets like ITU, UNCTAD or proprietary cybersecurity datasets..

3. Causality vs. Association

Although the Fixed Effects model controls for unobserved heterogeneity, the study still identifies **associations**, not strict causal effects. Reverse causality may exist—for example, countries with more secure infrastructure may attract more mobile broadband investment.

Future studies could apply:

- instrumental variable (IV) methods
- difference-in-differences (DiD) strategies
- dynamic panel models (e.g., GMM)
- to establish stronger causal relationships.

4. Absence of Country-Group Analysis

The study includes both developed and developing countries in a single panel model, but it does not estimate **separate regressions** for these groups. Since results may differ significantly between advanced and emerging economies, this limits deeper comparative insight.

Future research can estimate separate models for:

- OECD vs. non-OECD countries
- Low-income vs. middle-income vs. high-income groups
- Regional comparisons (Asia, Africa, Latin America, etc.)

5. Limited Consideration of Regulatory and Institutional Factors

Digital security is heavily shaped by regulation, governance quality and institutional frameworks. These factors were not explicitly included due to data constraints.

Future research could integrate:

- regulatory quality indicators
- data protection laws
- cybersecurity legislation
- competition regulation in telecom markets
- to better explain cross-country differences.

6. Dynamic Nature of Digital Technologies

The study examines data up to 2024, but digital technologies evolve extremely rapidly. Changes such as 5G deployment, cloud computing, AI-driven cyber tools and quantum encryption may significantly alter the relationship between connectivity and security in the near future.

Future studies should update the analysis regularly, and examine:

- 5G and 6G effects
- cloud-based security growth



- AI and digital trust ecosystems
- real-time threat intelligence infrastructure

CONCLUSION

This research undertaking aimed to analyse the impact of the growth of mobile broadband on the safe digital infrastructure within the countries with the secure internet server serving as the main indicator of the digital safety and preparedness. Based on panel data of 216 countries in 2010 to 2024, and using Fixed Effects model as chosen through Hausman test, the study research designates strong positive and significant correlation between mobile broadband and secure internet servers, despite the control of internet use, GDP per capita and trade openness. This observation underscores the fact that the quality and speed of digital connectivity is much more crucial than simple access and that advanced versions of digital connectivity are crucial to facilitate secure online transactions, encrypted communication and contemporary e-commerce systems. However, no significant impact is found in general internet use, which indicates that the mere growth of the number of people on-line does not dictate improvements in secure infrastructure. On the other hand, the research finds that higher income levels and higher levels of trade openness have positive impacts in ensuring development of secure infrastructure. Richer economies have the financial resources as well as institutional power to invest in secure hosting, data protection and cybersecurity. On the same note, the less closed economies, the ones, which were connected to global economies, were more inclined to adhere to the global standards and security measures to promote international trade and electronic transactions. The findings are consistent with the findings of the global community that digital transformation is most effective at the intersection of connectivity, economic ability and global integration. Collectively, the findings lead to a larger point: mobile broadband expansion is not only needed to support secure digital ecosystems, but is also insufficient. In the case of developing countries, in particular, the expansion of connectivity should be supported by parallel investments in cybersecurity systems, digital literacy, regulatory potential, and institutional preparedness. The absence of these facilitating conditions would mean that broadband grows faster than the adoption of secure servers, and hence digital trust, and the study would contribute to the wider body of literature by synthesizing the insights on the importance of connectivity, security and development and by providing empirical evidence on how secure digital infrastructure is a phenomenon that is shaped by both technological and economic factors. Finally, the limitations that were found reveal opportunities of the future research, which are to integrate more secure indicators of security, conduct a country-group comparison, and implement a policy of causal identification. Both countries that invest in mobile broadband and cybersecurity and the open digital market at the same time will be in the best ability to engage in the global digital economy, promote innovation, and provide its citizens with trusted access to online services.



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