Impact of digital transformation on Vietnam's economic growth

Nguyen Thi Anh Tuyet

Vietnam Institute of Economics, 1 Lieu Giai Street, Ba Dinh, Hanoi, Vietnam

Abstract

This research examines the impact of digital transformation on Vietnam's economic growth. The findings reveal that digital transformation positively influences economic growth through the improvement of digital infrastructure. Nevertheless, this research did not identify the impact of digital transformation on economic growth when viewed from the perspective of information technology application and human resource infrastructure. The author believes that reviewing and assessing information technology applications and human resource infrastructure must be practical and effective to improve economic growth.

Keywords: Digital transformation, economic growth, ICT index, digital infrastructure, IT applications, human resource infrastructure.

JEL classification: E01, J21, J24, L16, L86.

1. Introduction

Digital transformation is considered a driving force for economic growth and improving the competitiveness of countries. The contribution of digital transformation to economic growth and job creation in countries is becoming more evident. According to a study by Microsoft (2018) in the Asia-Pacific region, the impact of digital transformation on GDP was about 6 percent in 2017, rising to around 25 percent in 2019 and reaching 60 percent in 2021. Digital transformation contributed to a 15 percent increase in labor productivity in 2017, which grew to approximately 21 percent in 2020. Likewise, McKinsey's research (2018) suggested that by 2025, digital transformation is projected to account for 25 percent of GDP growth in the United States, 35 percent in Brazil, and about 36 percent in European countries.

In recent years, especially after the COVID-19 pandemic, the impact of digital transformation on the economy has become increasingly pronounced. Digital transformation has fundamentally altered business models, market approaches, production processes, and enterprise management practices. The widespread adoption of the internet and social media platforms such as Facebook, Zalo, and Skype has disrupted the traditional business model by lowering market entry costs and intensifying competition among businesses.

Research and assessment of the impact of digital transformation on global economic growth are both vibrant and diverse. Most studies have highlighted the positive effects of digital transformation on economic growth, productivity, and employment. However, some studies indicate adverse effects on employment in some countries. The impact of digital transformation on economic growth varies across different nations and regions. In the context of current economic integration, Vietnam is also undergoing a significant digital transformation. However, the study of digital transformation's impact on economic growth remains relatively new and underexplored. Studies are still limited in scope, particularly concerning time frames, methodology, data, and the approaches used to measure digital transformation and assess the effects of digital transformation on economic growth.

2. Methodology

2.1. Theoretical basis

To date, the concept of digital transformation and its associated measures have not been universally defined. Brown et al. (2014) argued that digital transformation encompasses everything from necessary cultural and organizational changes to adopting relevant new digital technologies to drive significant improvements (such as enhancing user services,

streamlining operations, or creating entirely new services). Horlacher and Hess (2016) argued that digital transformation involves using emerging digital technologies, such as social media, mobile devices, analytics tools, or embedded devices, to facilitate significant business improvements, including enhancing customer experience, streamlining operations, or creating new business models. In Vietnam, digital transformation is understood as the integration and application of technology to improve the efficiency of management, business and competitiveness of enterprises, thereby generating new values (Decision No. 749/QD-TTg of the Vietnam's Prime Minister approving the "National Digital Transformation Program to 2025, orientation to 2030").

Due to the lack of a unified definition of digital transformation, the quantitative indicators of digital transformation vary across countries and regions. Studies examining the impact of digital transformation on economic growth are therefore also considered in various dimensions and levels. Some studies look at digital transformation from the perspective of investment in information and communication technology (ICT). Some other studies assess digital transformation based on ICT usage - measured by the number of internet users, fixed broadband subscribers, and mobile subscribers per 100 residents using social media platforms like Facebook, YouTube, and Zalo). Other studies evaluate digital transformation using indicators that represent the level of digital transformation (e.g., the Digital Adoption Index (DAI) (WB, 2016); the Digital Economy and Society Index (DESI) (EC, 2018); E-Government Development Index (EGDI) (Hermes, 2018).

Colecchia and Schreyer (2002) assessed the impact of ICT capital accumulation on output growth in Australia, Canada, Finland, France, Germany, Italy, Japan, the United Kingdom, and the United States. Their findings showed that ICTs contributed between 0.2 and 0.5 percentage points per year to economic growth, with variations across countries. In the second half of the 1990s, this contribution increased to between 0.3 and 0.9 percentage points per year. Jalava and Pohjola (2002) assert that the production and utilization of ICTs were key drivers of the economic efficiency of the United States in the 1990s. The authors also observed that ICT drove growth in Finland from 0.3 percent to 0.7 percent in the 1990s. However, unlike in the United States, ICTs did not contribute to accelerating labor productivity in Finland. Similar to the above conclusions, Cette et al. (2001) found that the average contribution of ICTs to GDP growth in France between 1969 and 1999 was approximately 0.2 percent per year. From 1995 to 1999, the contribution of ICTs to output growth increased by 0.3 percent per year, although it remained lower than the contributions observed in countries such as the United Kingdom and the United States.

Aly (2020) employed the Digital Development Index (DEI) to investigate the relationship between digital transformation and economic development and productivity in developing countries in 2017 using the general least squares (FGLS) method. The findings revealed a positive relationship between the digital transformation index and economic growth, labor productivity, and employment. The authors did not find a relationship between digital transformation and vulnerable employment. They argued that more evidence is needed to examine whether digital transformation impacts vulnerable workers in the economy. Assessing the impact of digital transformation through evaluating the impact of the digital economy has also become a prevalent approach among researchers. In this direction, Jiao and Sun (2021) found that the development of the digital economy in China positively influences urban economic growth, with varying impacts across different cities. They identified urban employment as the "mechanism of impact" through which digital economic growth promotes urban economic growth. As defined by the authors, the level of digital economy development includes internet development, digital literacy, and industrial efficiency. Other control variables include urbanization level, fiscal decentralization, FDI, financial development, and industrial structure. Zhang et al. (2021) examined the effects of the digital economy on high-quality economic development in 30 cities in China from 2015 to 2019, employing a panel data model. Unlike Jiao and Sun (2021), Zhang et al. (2021) considered the digital economy from three dimensions: digital infrastructure, digital industry, and digital integration. Despite the different methodological approaches, the results echoed a consistent conclusion: the digital economy significantly positively impacts economic growth, specifically the productivity of aggregate factors.

Research on digital transformation and economic growth in Vietnam remains relatively modest. Dang et al. (2018) used the 2007 and 2012 I-O tables to analyze the contribution of the ICT sector to the economy. Their findings showed that ICT's contribution was relatively low compared to other industries. The ICT sector exhibited stronger linkages with industries providing inputs that with those utilizing ICT outputs. Supplementing the research data (I-O table in 2016), Dang and Dang (2020) pointed out that ICT's contribution to the economy's output grew over time. However, they noted that the contribution remained modest compared to other industries. The backward linkage and forward linkage coefficients revealed that while the ICT manufacturing sector stimulates imports, it contributes less to domestic added value in the economy.

2.2. Selection of indices representing digital transformation

As analyzed, there are numerous approaches to assess the impact of digital transformation on economic growth. Like other studies, the author chose an index representing digital transformation in Vietnam to study and evaluate the effect on economic growth. The index selected here is the readiness index for developing and applying information and communication technology in Vietnam (ICT_index). This index is modeled after the United Nations' E-Government Development Index (EGDI). ICT_index provides information on the current status of information and communication technology development and application in Vietnam, alongside pffering assessments and ratings on the readiness for information and communication technology development and application. ICT_index consists of three component indicators: (i) technical infrastructure, (ii) information technology human resource infrastructure, and (iii) application of information technology. Each component index comprises a small group of indicators with many different criteria. The structure of the ICT_index indicator system is as follows:

Here, the study selects an index representing Vietnam's current digital transformation and implements a panel data regression model to assess its impact. The index representing digital transformation that the author chooses here is the readiness index for developing and applying information and communication technology in Vietnam's ICT index. This index is similar to the e-Government index used by some other studies.

FIGURE 1: **Structure of the ICT_index indicator system for provinces and centrally-governed municipalities**
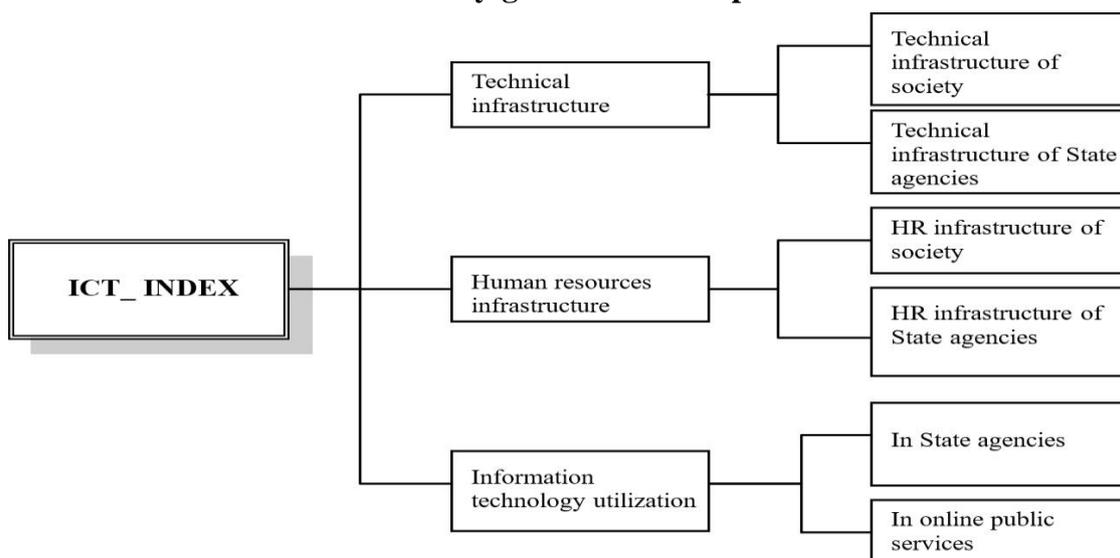
Source: Vietnam ICT index 2017 report.

2.3. Test model

In terms of economic growth, like some other studies, this study chose the per capita income growth variable as the representative variable.

Other independent variables that can affect growth that many other studies have pointed out include FDI investment, urbanization level, industrialization level, financial development level, population size, human capital index, etc. Given the context of Vietnam and the availability of the provincial database, the authors propose a set of independent variables, including the following variables: total investment capital implemented by the whole society representing investment capital; the total number of employees aged 15 years or older, the average total population of the year; the proportion of trained workers (representing human capital); the proportion of industry in the overall economy (representing the level of industrial development) and the proportion of the service industry in the overall economy (the level of development of the service industry). Although FDI is often considered a critical driver of economic growth in Vietnam, the availability of annual and provincial-level FDI data is limited. Therefore, this study uses the total realized investment variable of the whole society to replace the FDI variable.

The regression model expected to apply to this study can be expressed as:

$$lnIN_{i,t} = \beta_0 + \beta_1 * lnIV_{i,t} + \beta_2 * lnE_{i,t} + \beta_3 * lnP_{i,t} + \beta_4 * lnTL_{i,t} + \beta_5 * lnPI_{i,t} + \beta_6 * lnPE_{i,t} + \beta_7 * DT\_index_{i,t} + u_{i,t} \qquad (1)$$

In which:

ln: natural logarithmic;

i: the province i;

t: the year t;

IN: per capita income at 2010 prices;

IV: total investment capital for the whole economy;

E: workforce size (total number of workers aged 15 years and over);

P: average population;

TL: the proportion of trained workers;

PI: the proportion of industry in the whole economy;

PE: the proportion of the service industry in the whole economy;

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DT_index: the digital transformation level index is represented by the readiness index for the development and application of information and communication technology in Vietnam ICTindex; technical infrastructure index (Inf), human resource infrastructure (HRI), and information technology application (IT).

Due to the multicollinearity found in this expected model, some of the variables have been removed from the model. The last model can be expressed as:

$$lnIN_{i,t} = \alpha_0 + \alpha_1 * lnIV_{i,t} + \alpha_2 * lnE_{i,t} + \alpha_3 * lnTL_{i,t} + \alpha_4 * lnPI_{i,t} + \alpha_5 * lnPE_{i,t}$$
$$+ \alpha_6 * DT\_index_{i,t} + u_{i,t} \qquad (2)$$

Here, with the panel data model, the author will first choose between the ordinary least squares, fixed-effect, and random-effect methods. The selection results show that the fixed-effect method is the most suitable. However, with this regression method, heteroskedasticity and serial correlation are present in this model. Hence, the author uses the generalized least squares method instead, aiming to overcome the above phenomena.

2.4. Data

The data on income, investment, labor, trained workforce, and the proportion of workers in industrial and service sectors for 63 provinces and municipalities are sourced from the statistical yearbooks of provinces. Index of readiness for the development and application of information and communication technology in Vietnam (ICTindex); the technical infrastructure index, human resource infrastructure, and information technology application (IT) are obtained from the "Vietnam ICT Index Report" published by the Ministry of Information and Communications. The data spans the period from 2016 to 2020.

Regarding the reliability of the data, it is noteworthy that GDP, investment, and labor data are annual statistics collected and compiled by the General Statistics Office, with official annual publication for provinces, municipalities, and the nation as a whole. The ICT and its component indicators are reliable, having been collected, surveyed, and published annually by the Ministry of Information and Communications since 2005. These indicators adhere to the United Nations' assessment practices. The data utilized are both objective and authoritative, making them suitable for rigorous analysis and evaluation for research.

3. Results and discussion

3.1. Correlation of per capita income growth and indicators representing the level of digital transformation in Vietnam

The study identifies the relationship between digital transformation and economic growth through graphs of per capita income growth variables and indicators representing the level of digital transformation in Vietnam.

FIGURE 2: **Per capita income and indicators representing the level of digital transformation**
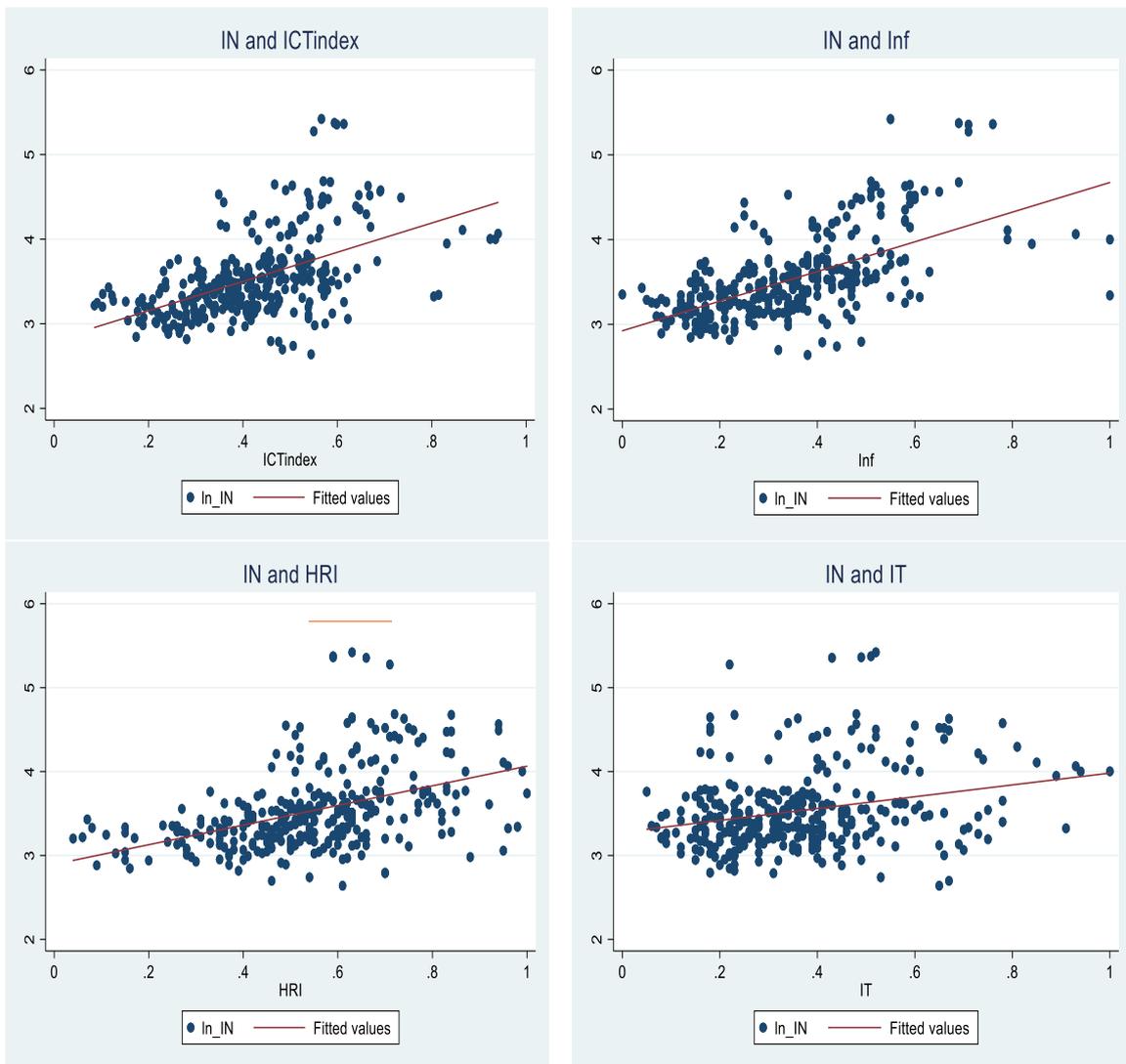
Source: Results of the study.

Figure 2 shows the initial visual relationship of the positive correlation between per capita income growth and the following indicators: ICT index, technical infrastructure index (Inf), human resource infrastructure (HRI), and information technology application (IT).

3.2. Regression model results

TABLE 1: **Results of the regression model to assess the impact of digital transformation on Vietnam's economic growth in the period 2016-2020**

	ln_IN	ln_ IN	ln_ IN	ln_ IN
lnIV	0.376***	0.377***	0.376***	0.372***
lnE	-0.179***	-0.180***	-0.200***	-0.175***
lnTL	0.168***	0.158***	0.211***	0.157***
lnPI	0.069*	0.068*	0.031	0.071*
lnPE	-0.466***	-0.468***	-0.496***	-0.464***
HRI	-0.013			
IT		0.022		
Inf			0.127***	
ICTindex				0.057
Constant	1.846***	1.872***	2.042***	1.852***
N	315	315	315	315

Note: ***, **, * correspond to the meaning level of 1 percent, 5 percent and 10 percent, respectively.

Source: Calculated by the author.

First, regarding the impact of digital transformation on economic growth, three out of four indicators, namely ICT_index, human resource infrastructure (HRI), and information technology (IT), do not affect per capita income growth; only the technical infrastructure index (Inf) exhibits a positive impact on per capita income growth. The regression coefficient of the Inf variable is statistically significant at 0 percent, with a value of 0.127. In other words, improving technical infrastructure will increase per capita income growth.

Secondly, the realized development investment capital has a positive impact on the per capita income growth of the people. When compared to other factors such as total number of workers, labor quality, the proportion of industries, etc. the proportion of the service industry and digital transformation, the impact of realized development investment capital is the most substantial. The regression coefficient of variable IV is the largest compared to the other variables. Income growth is still highly dependent on the growth of realized investment capital. And this is still a manifestation of the broad growth model in Vietnam's provinces and municipalities.

Thirdly, workforce size has a negative impact on per capita income growth. As the workforce scale increases, per capita income growth diminishes. Meanwhile, the rate of trained workers positively impacts per capita income growth. Current economic growth is increasingly determined by worker qualifications rather than workforce size. Vietnam has begun to lose its competitive advantage of cheap labor compared to many other countries. An increase in unskilled workers heightens job competition.

Moreover, as development progresses, higher skill levels are required. Workers aiming for high-income positions must meet the rising demands of enterprises. In a labor market with an abundance of workers, those with higher competence but no qualifications may struggle to secure well-paid formal jobs and may be compelled to seek lower-income positions in the informal sector.

Fourthly, the proportion of workers in the industrial sector positively impacts income growth. An increase in industrial sector labor and a corresponding decrease in labor in other sectors contribute to a rise in per capita income growth. However, the impact of this variable is the lowest among the variables in the model, as indicated by its relatively low regression coefficients.

Fifthly, the proportion of workers in the service sector has a negative impact on income growth. An increase in the proportion of workers in the service sector is associated with lower the per capita income growth. Vietnam is a low-middle-income country; the service sector is expanding and overwhelms the industrial sector. However, the service sector is an area with low development quality; most workers in this area are low-skilled workers. Therefore, the expansion of the service sector leads to a more substantial level of competition in the industry. Low quality and increased competition will reduce entities' revenue in the service sector; the salary and income level of service industry workers will also decrease.

The regression model's results affirm the role of digital transformation in economic growth. They reinforce and complement other studies on the positive impact that digital transformation has on economic growth. However, digital transformation in Vietnam impacts economic growth only in terms of technical infrastructure. Human resource infrastructure and information technology applications have no impact on economic growth.

A closer look at the human resource infrastructure reveals why it does not impact economic growth. Vietnam's measure of human capital focuses on literacy rate, school attendance, and the number of schools teaching informatics. Meanwhile, the quality of

human resources reflected in some other indicators, such as the Digital Economy and Society Index (DESI) by the European Commission, is measured as the digital skills of labor, specifically the digital skills according to the following levels: basic, medium, and high. Besides, the human capital in State agencies has not yet gone into quality but has only been mentioned in quantity: the proportion of full-time officials in information technology. From the author's point of view, such a human resource component index is not a good measure of human resource infrastructure for digital transformation. Therefore, the result of human resource infrastructure not impacting growth is understandable.

Regarding the application of information technology, the criteria used to build this component index primarily refer to the presence of software, e-mail, and the like within State agencies. However, the effectiveness of this application in facilitating inter-agency operations and improving online public services is not considered. Given the substantial capital invested in information technology, ineffective spending can result in economic inefficiencies.

4. Conclusions and policy suggestions

Thus, digital transformation exerts a positive impact on Vietnam's economic growth. Strengthening digital infrastructure is essential for leveraging digital transformation to foster economic growth.

To ensure successful digital transformation, human resources must be aligned with the digital skills requirements of the workforce. These are specific skills that directly affect the success of digital transformation in all subjects of the economy. While literacy is foundational, inadequate digital skills can impede the rapid and efficient progress of digital transformation. Despite Vietnam's emphasis on the improving of industry 4.0 policy, the nation saw a decline in digital skills ranking, falling four positions to 96th in the Global Talent Competitiveness Index (GTCI) 2020. This places Vietnam at a significant distance from other countries, such as Singapore (3rd), Myanmar (26th), Thailand (67th), and India (65th). Thus, the quality of human resources in general and human resources for digital transformation in Vietnam is an urgent issue that needs immediate attention. A thorough review of the education and training system is necessary to ensure human resources meet the demands of development and growth in the context of digital transformation that is taking place firmly around the world.

Another critical area of focus is the enhancement of online public service quality. Currently, the quality of online public services in Vietnam is divided into four levels (level 1, level 2, level 3, and level 4), with level 4 representing the highest quality and efficiency. However, as of 2019, the proportion of public services classified at levels 3 and 4 was less than 29 percent of the total public services provided (Vietnam Information and Communication Technology White Paper 2020). The low efficiency and quality of public services will directly affect the costs incurred by individuals and businesses in settling administrative procedures related to production and business activities.

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Article history