The relationships between some macro indicators and digitalization process: A study in the Southeast region in Vietnam

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ARTICLE INFO	**ABSTRACT**

This study aims to investigate the relationships between some macro indicators and the digitalization process in the Southeast region of Vietnam. The panel Fully Modified Ordinary Least Squares (FMOLS) has been employed with the data of 2005 - 2021 to capture the long-run relationship of the variables in the digitalization model. Income (GRDP), Foreign Direct Investment (FDI), and education (WQ) have a positive relationship with the digitalization with significant level of 1% while the role of institutional factor (PED) has not been found. The negative coefficient of the squared terms of both GRDP and FDI in the digitalization model indicates that a higher level of GRDP and FDI may not always lead to a higher level of digitalization, meaning that the region may not have the necessary resources or capacity to fully utilize the benefits of digital technologies. The findings have important practical implications for policymakers in developing human capital to fully capture the benefits of GRDP and FDI on digitalization.

1. Introduction

Currently, digitalization serves as the main engine of economic expansion for any country and is of the significant focus in the national economy (Yu & Zhou, 2021). Many countries have developed a national digital strategy to improve policy coordination at the highest levels of government, typically led by the prime minister or a specialized ministry or body. Especially, several Organization for Economic Cooperation and Development (OECD) countries have recently introduced national 5G strategies (OECD, 2020). The effects of digitalization can be observed in various aspects such as government and civil society institutions, social and economic spheres, education and science, lifestyle and culture (Mulaydinov, 2021). This is because communication services provide opportunities for maximizing potential and contribute significantly to achieving sustainable economic growth, democracy, peace, stability, and prosperity (Ahmed, 2021; Wang et al., 2022).

Digitalization has been described as the utilization of digital technologies in day-to-day operations (Legner et al., 2017). More specifically, Napiórkowski (2019) proposed the digitalization model based on three dimensions: digital infrastructure, digital readiness, and digital economy. This is associated with the advent of Information and Communication Technologies (ICT). The International Telecommunication Union (ITU), a United Nations (UN) specialized agency for ICT, has developed and published the ICT development index (ICTI) to measure and compare the development of ICT across the world countries. ICTI can be used as a proxy for national digitalization (Özsoy, Ergüzel, Ersoy, & Saygili, 2022).

Diversified empirical studies predicted that digital transformation could contribute from 1.5% to 2.5% of GDP in G20 countries in 2025 (Manyika et al., 2015). Optimistic forecasts have helped to attract the attention of the research community to this topic globally (Adeleye & Eboagu, 2019; Toader, Firtescu, Roman, & Anton, 2018).

In Vietnam, realizing the importance of digitalization, ICTI reports have been jointly developed by the Vietnam Association for Information Processing (VAIP) and the Ministry of Information and Communication (MIC) since 2005 (Le, Ngo, Ho, & Nguyen, 2022). A growing body of literature on the role of digitalization has been explored with various outcomes such as economic growth (Huynh & Truong, 2023; Lo, Guzikova, & Nguyen, 2022), sustainability (Ngo, 2023), efficient bank performance (Le et al., 2022), business diversification (Nguyen, Nguyen, Ho, & To, 2021), green technology and energy efficient (Nguyen, Le, & Bui, 2023), improved business outcomes (Le & Le, 2023; Nguyen, 2023). However, the relationships between some macro indicators and the digitalization process at the regional level have not been fully investigated, with several research gaps that should be addressed. Firstly, previous literature focused on either micro (firm level) or macro (country level) while the regional heterogeneity was ignored (Lo et al., 2022). Secondly, the outcomes of digitalization have been confirmed (Le et al., 2022; Ngo, 2023; Nguyen et al., 2021; Nguyen et al., 2023), while the roadmap to reach the digitalization goal via the role of some macro indicators has not been well analyzed. Finally, there is a need to examine the long-term relationship between digitalization and its antecedents for the evolution policy of digitalization over time.

The southeast region is among the economic regions of Vietnam, starting with the government's policy to promote the national economy based on the regional advantages of geographical location, natural conditions, resources, and socioeconomic status, consisting of five provinces and one city, including Ba Ria - Vung Tau, Binh Duong, Binh Phuoc, Dong Nai, Tay Ninh, and Ho Chi Minh City. Resolution 24/NQ-TW clearly identified it as a dynamic and innovative economy that contributes to 32% of GDP, 44.7% of state budget revenue, and 44.1% FDI of the country (Political Bureau, 2022). In the transition from industry 4.0 to 5.0, the digital and sharing economy is among the top priorities to drive regional and national development. Except for Ho Chi Minh, Binh Duong, and Ba Ria - Vung Tau, ICTI of Tay Ninh, Binh Phuoc, and Dong Nai were lower than the average of 0.5 (Ministry of Information and Communications, 2023), implying the low digitalization of the region. This study aims at investigating the relationship between some macro indicators and the digitalization process in the region in the long term so that proper policies can be recommended to boost regional digitalization. This study is expected to theoretically and practically contribute to the literature in fourfolds. Firstly, the study integrates several theories: i) digital divide, ii) diffusion of innovation, and iii) knowledge spillover into the framework of the digitalization model. While the digital divide theory explained economic and social factors as drivers of digitalization, the role of the institutions and foreign investment can be interpreted via diffusion of innovation and knowledge spillover theories. Secondly, this study provides empirical evidence on the positive coefficients of GRDP (2.1), FDI (0.09), and education (0.02) in digitalization in the Southeast region. Thirdly, diminishing returns of income and FDI have empirically confirmed with negative coefficients of -0.19 and -0.04 respectively. Finally, the results imply the regional limitation of absorptive capacity when finding that higher GRDP and FDI do not always lead to higher digitalization. This is an important implication for the priority policy in advancing regional digitalization.

The article is structured into five sections. After the introduction, section 2 is dedicated to the theoretical framework and presents the research hypotheses. Section 3 provides an overview of the research methodology. The research findings are analyzed and discussed in section 4. Finally, section 5 presents the conclusions.

2. Literature review

2.1. Theories on digitalization

The drivers of digitalization are complex and multifaceted, with several theories that can be employed to explain why certain countries or regions are more digitally advanced. Digital divide theory explains the economic and social drivers of digitalization (Van Dijk, 2006). The concept of digital divide gained wide recognition after the publication of the 1995 report titled "Falling through the Net," which examined the disparity in access to ICTs (Yu, 2011). In general, the digital divide encompasses disparities in four consecutive forms of access: motivation, physical access, digital skills, and diverse usage. It is argued that over the past decade, the divide has transitioned from the initial types of access to the later ones (Van Dijk, 2006). Katz and Rice (2002) have explored the antecedents of the gap between those who have access to digital technologies and those who do not and found that income and education inequalities were the drivers of the digital divide. Households with lower incomes were less likely to engage in online communities and commerce. Similar findings with digital skills have been concluded. Individuals with lower levels of education and digital literacy have struggled to navigate and make effective use of digital technologies.

Institutional factor also influences digitalization under the diffusion of innovations theory, which, initially introduced in 1962, was further refined by Rogers (2003). This theory primarily aims to comprehend the process, reasons, and speed at which innovative ideas and technologies disseminate within a social system (Rogers, 2003). Government policies and regulations can shape the diffusion and use of new technologies and digitalization is not exceptional (Nasi et al., 2015). The availability and affordability of digital infrastructure, such as broadband internet, support and resources for training, research and development, and collaboration among stakeholders can promote the development of digital skills and knowledge among the population.

The theory of knowledge spillover implies that a country's technological advancement is significantly influenced by its own Research and Development (R&D) endeavors, coupled with external R&D activities conducted by other nations, which are subsequently disseminated through knowledge spillovers (Coe & Helpman, 1995). International trade is recognized as a crucial avenue through which external knowledge sources can be transferred between countries. However, within the literature, inward Foreign Direct Investment (FDI) is considered an alternative conduit for spillovers, facilitating the transfer and adaptation of technological innovations and the associated knowledge to meet domestic requirements (Branstetter, 2006). The knowledge spillover implies that Foreign Direct Investment (FDI) can play an important role in enhancing the country's digital competitiveness by bringing in new technologies, knowledge, and expertise to the recipient country (Acs, Audretsch, & Lehmann, 2013; Napiórkowski, 2019). In terms of digital infrastructure, FDI can provide funding for the development of broadband, a critical foundation for the deployment of advanced digital technologies. Relating to digital readiness, a highly skilled and innovative workforce trained by FDI firms can benefit the host country. Finally, FDI can contribute to the digital economy by investing in digital startups and increasing digital exports.

In short, three major theories including digital divide, diffusion of innovation and knowledge spillover have explicitly support the role of income, education, institutions and foreign direct investment in explaining the digitalization model.

2.2. Empirical evidences and hypotheses on the relationships between macro indicators and digitalization

The literature has highlighted the role of economic development in explaining the adoption of some technologies, such as the Internet (Quibria, Ahmed, Tschang, & Reyes-Macasaquit, 2003),

personal computers (Chakraborty & Bosman, 2005; Quibria et al., 2003), and broadband (Reddick, Enriquez, Harris, & Sharma, 2020). Gross Domestic Product (GDP) is a measure of a country's economic output and is often used as an indicator of its overall level of development. Countries with higher GDP tend to have higher levels of digitalization. This is because wealthier countries are often better equipped to invest in digital infrastructure, such as high-speed internet and advanced telecommunications networks. Additionally, higher levels of income may increase demand for digital products and services, driving further innovation in the digital sector. It can finance a comprehensive and synchronized national digital infrastructure system that covers all regions, localities, businesses, agencies, organizations, and households. The impact magnitude of income on digitalization varies among different country groups but its role has been more significant in middle-digitalization countries (Billon, Lera-Lopez, & Marco, 2010). Quibria et al. (2003) have undertaken the regression of more than 100 countries and found that computer usage is strongly correlated with GDP per capita, with an income elasticity of computer usage exceeding unity. Similarly, internet use is highly correlated with income, with income elasticity being nearly 2. Based on the discussed empirical evidence, hypothesis 1 is proposed;

H1: Economic growth has a positive relationship with digitalization

Nevertheless, the relevance of non-economic factors, such as education, has been demonstrated (Quibria et al., 2003; Semyachkov, 2019). According to Quibria et al. (2003), education can narrow the digital divide between developed and developing countries by fostering the individuals to acquire the effective use of digital technologies. The lack of educational infrastructure and resources in many developing countries creates a significant barrier to the adoption and effective use of digital technologies, particularly for those in low-income and rural areas. In fact, skills play a critical role in the diffusion and efficient utilization of technology (Andrews, Nicoletti, & Timiliotis, 2018). Nguyen et al. (2022) found that promoting digital literacy and improving digital skills through education can facilitate the widespread adoption of digitalization. The prosperity of companies in the digital era is reliant on having employees with proficient literacy, numeracy, problem-solving and basic ICT skills used in their job. Furthermore, having specialists in ICT and data is increasingly important. To be successful, organizations also need complementary skills and competencies that are necessary for new organizational forms and sectors heavily reliant on digital technology. This necessitates investments in education and training. Basic education must include a strong foundation in literacy and numeracy. As students progress, they need opportunities to acquire ICT and complementary skills, including social, communication, and management skills. Additionally, digital technologies can be used to enhance various forms of learning (OECD, 2019). The proposed hypothesis 2 is as follows;

H2: Education has a positive relationship with digitalization

Cruz-Jesus, Oliveira, Bacao, and Irani (2017) find a non-linear correlation between economic growth and digitalization, a non-commonly seen result in the literature when employing the data of 110 countries. Gallant (1975) also proposed non-linear regression by plotting the data to discover its nature. Napiórkowski (2019) provides empirical evidence on the non-linear digital competitiveness growth with FDI stock. With an increase in FDI, digital competitiveness grows, but the marginal effect of the relationship is characterized by a negative trend, and in the case of resources, such as economic growth, it even takes negative values. Such results suggest that the absorptive capacity of the recipient country, which can be nurtured via education, is necessary. In the age of digitalization, wireless sensor networks in the cyber-physical environment gather real-time information to facilitate machines on the shop floor in making independent decisions (Telukdarie, Buhulaiga, Bag, Gupta, & Luo, 2018). As a result, fewer human interventions but

experts with skilled big data and digital technology will be required to operate in the new age (Bag, 2016; Bag, Pretorius, Gupta, & Dwivedi, 2021). Similar results have been found with SMEs in Vietnam. FDI enterprises exhibit a higher level of digitalization compared to non-state enterprises in general. Vietnam's enterprises, when assessed on a scale of 1 to 5, currently have a digitalization readiness score of 2.04. The lowest score, standing at 1.907, is attributed to non-state enterprises as a collective (Nguyen & Nguyen, 2021).

The discussion ends with hypotheses 3,4 and 5;

H3: FDI has a positive relationship with digitalization

H4: Square FDI has a negative relationship with digitalization

H5: Square GRDP has a negative relationship with digitalization

In the same vein, the differing combinations of ICT that shape diverse models of digitalization may be explained by institutional factors (Aghimien, Aigbavboa, Oke, & Aghimien, 2022; Rogers, 2003). Alpidovskaya and Stompeleva (2020) discovered that the unfavorable institutional environment is the primary reason why digitalization in the Russian economy and the development of digital technologies by businesses are slow. By analyzing Russia's present institutional environment, particular factors like insecure property rights and low institutional trust in authorities contribute to the creation of alternative economic and behavioural rules that impede digitalization. Liu, Ke, Wei, Gu, and Chen (2010) confirmed that the external environment creates certain pressure on the firms' intention to adopt digital innovation. Furthermore, the institutional environment dictates the rules necessary for organizations to have the right structure and behavior as well as the right operations and practices (Kuo, Chen, & Yang, 2022; Powell & DiMaggio, 1983). Therefore, in deciding whether to adopt innovations or not, organizations will first consider the institutional expectations and norms of their industry. Thus, hypothesis 6 is as follows;

H6: Favorable institutions can boost the digitalization

3. Research methodology

3.1. Research model

Based on the theoretical framework of the digital divide (Van Dijk, 2006), innovation diffusion (Rogers, 2003), knowledge spillover (Branstetter, 2006; Coe & Helpman, 1995), and previous empirical model discussed in section 2, the digitalization model of Southeast region was defined in equation (1). Non-linear relationships of FDI and GRDP with digitalization have been included on the basis of empirical evidence provided by Napiórkowski (2019).

$$\text{ICTI}_{it} = \beta_0 + \beta_1 \text{LnFDI}_{it} + \beta_2 \text{LnFDI}_{it}^2 + \beta_3 \text{LnGRDP}_{it} + \beta_4 \text{LnGRDP}_{it}^2 + \beta_5 \text{WQ}_{it}$$
$$+ \beta_6 \text{PED}_{it} + \varepsilon_{it} \quad (1)$$

Legend:

ICTI_{it}: ICT index (Z-score);

LnGRDP_{it}: Ln of Gross Regional Domestic Products (GRDP) based on the price of 2010 (billion dong);

LnFDI_{it}: Ln of Foreign Direct Investment (FDI) (million USD);

WQ_{it}: workforce with a college degree and over/total labor force (%);

PED_{it}: private economic development policy.

3.2. Data sources

The dataset of Vietnam's macro indicators for the period of 2005 - 2021 was generated from annual statistical yearbooks of six provinces and cities in the Southeast region, including Dong Nai, Tay Ninh, Binh Duong, Binh Phuoc, Ba Ria - Vung Tau and Ho Chi Minh City has been employed in this study. ICTIs were extracted from the annual ICTI reports published by MIC. Details of the data are described in Table 1.

Table 1

List of variables in the model of digitalization determinants

Variables	Description	Unit	Source	Expected sign
Dependent variable				
ICTI	Information Communication Technology Index of the provinces and city in the Southeast region.	Z-score	Annual ICTI reports published by MIC	
Independent variables				
lnFDI	The natural logarithm of Foreign Direct Investment. This is the total value of granted investment projects annually.	Million USD	Annual Year books of 2005 - 2021 of provinces and city in the Southeast region	+
lnFDI^2	Square of the natural logarithm of Foreign Direct Investment.			-
lnGRDP	The natural logarithm of GRDP for 2005 - 2021 based on the price of 2010 published in the annual year books of 2005 - 2021.	Billion dong	Annual Year books of 2005 - 2021 of provinces and city in the Southeast region	+
lnGRDP^2	Square of the natural logarithm of GRDP.			-
WQ	Ratio of workforce with college degree and over in the labor force.	%	Labor and employment survey made by General Statistics Office of Vietnam in the period of 2005 - 2021	+
PED	Private economic development policy.		Component index of Provincial Competitiveness Index (PCI)	+

3.3. Data analysis

When analyzing panel data, several regression techniques are employed, including Pooled Ordinary Least Squares (Pooled OLS), Fixed Effects Model (FEM), Random Effects Model (REM), and Panel Fully Ordinary Modified Least Squares (FMOLS). Pooled OLS assumes that the coefficients of the independent variables are the same for all-time cross-sectional observations. However, this assumption may not hold in reality, particularly in the presence of unobserved heterogeneity, which can lead to biased and inconsistent estimates (Pesaran, 2004). FEM controls for time-invariant unobserved heterogeneity by including a set of dummy variables to account for that heterogeneity. While this method is useful in controlling for omitted variable bias, it cannot handle time-varying unobserved heterogeneity, potentially resulting in biased estimates (Wooldridge, 2010). REM assumes that unobserved heterogeneity is uncorrelated with the independent variables, which is helpful in controlling for omitted variable bias. However, this method assumes that unobserved heterogeneity is random, which may not hold true, leading to inconsistent estimates (Greene, 2012). The discussion of the empirical model in section 2 implies the relationship between variables in the digitalization determinants model, where both the dependent and independent variables are potentially endogenous (Myovella, Karacuka, & Haucap, 2020). FMOLS is a statistical method used to estimate the long-term relationship between variables in the panel data. The method involves adding lagged values of the dependent variable and lagged differences of the independent variable as additional explanatory variables in the regression model to control for potential endogeneity of the independent variable, as the lagged differences capture the unobserved factors that may be driving the change in the independent variable over time (Chakrabarti, 2003; Sahoo & Sethi, 2020).

4. Research findings and discussion

4.1. The cross-sectional dependence test

Cross-Sectional Dependence (CSD) arises when the error terms of the panel data are not independent across individual units but instead exhibit some degree of correlation or interdependence (De Hoyos & Sarafidis, 2006). CSD can lead to biased estimates and invalid inferences in panel data analysis (Hsiao & Tahmiscioglu, 2008). Given the serious consequence of CDS, the Pesaran CD test, which is robust to a wide range of error structures, is applied in the study (Pesaran, 2021). Table 2 confirms the CSD presence, which led to the application of CIPS (Cross-Sectionally Augmented IPS) (Pesaran, 2007).

Table 2

Cross-sectional dependence test

Variables	ICTI	LnGRDP	LnFDI	WQ	PED
CD-test	22.77	27.06	23.11	27.90	9.52
p-value	0.000	0.000	0.000	0.000	0.000

4.2. The panel unit root test

The subsequent step of our empirical analysis involves assessing the integration order and stationarity level of all variables. CIPS test (Pesaran, 2007) is utilized with the results in Table 3. The findings confirm the variables' stationary at the I(0) level with significance of 1%, 5% and 10%.

Table 3

Panel unit root test

Variables	CIPS	Integration order
	Level	
ICT Index	-2.597***	I(0)
lnGRDP	-5.044***	I(0)
lnFDI	-3.097***	I(0)
WQ	-2.181*	I(0)
PED	-2.315**	I(0)

Note: (***), (**), (*): significant levels at 1%, 5% and 10% respectively

4.3. The panel cointegration test

The testing results proposed by Pedroni (1999) and Kao (1999); in Table 4 indicate that 06 out of 08 criteria accept the hypothesis of long-term cointegration among variables in the model at a significant level of 1%. Therefore, the variables are found to be both short-term and long-term cointegrated.

Table 4

Panel cointegration test

Descriptions	t-statistics	p-value
Pedroni		
Modified Phillips-Perron t	7.0706	0.0000
Phillips-Perron t	-1.2347	0.1085
Augmented Dickey-Fuller t	-14.6177	0.0000
Kao		
Modified Dickey-Fuller t	2.7727	0.0028
Dickey-Fuller t	0.0863	0.4656
Augmented Dickey-Fuller t	2.1077	0.0175
Unadjusted modified Dickey-Fuller t	-2.3932	0.0084
Unadjusted Dickey-Fuller t	-5.7227	0.0000

4.4. Empirical findings and discussion

The results of the long-run regression model (FMOLS) for a model of digitalization are shown in Table 5. The positive relationships of GRDP, FDI, and WQ with digitalization at a 1% significant level have been empirically confirmed with coefficients of 2.1, 0.08, and 0.01 respectively. Non-linear impacts of GRDP (square lnGRDP) and FDI (square LnFDI) on digitalization with negative trend imply the shortage of absorptive capacity in the Southeast region.

Table 5

Empirical findings on the determinants of digitalization

Variables	Coefficients	Prob.
LnFDI	0.0891	0.0110
LnFDI^2	-0.0358	0.0000
LnGRDP	2.1007	0.0000
LnGRDP^2	-0.1919	0.0000
WQ	0.0152	0.0000
PEQ	-0.0059	0.1874
R-squared: 0.7539 Adjusted R-squared: 0.7217		

The impressive role of GRDP in digitalization can be explained as the resources for investment in digital infrastructure and technology (Quibria et al., 2003). This finding supports the theory of the digital divide about the role of the economic factors in the digitalization model (Van Dijk, 2006; Yu, 2011). Hussain et al. (2023) further provided empirical evidence on the negative relationship between poverty and the digital development index in China. Katz and Rice (2002) also confirmed the less engagement in Internet assessment and use of lower-income households. The positive link between economic growth and developments of telecommunications infrastructure has been proven by Röller and Waverman (2001), suggesting that regions with higher levels of economic growth are more likely to adopt digital technologies.

FDI is widely recognized as a significant driver of digitalization. In this study, the role of FDI was ranked second. This empirical result confirms the finding of Nguyen and Nguyen (2021) and clarifies the reason for the higher digitalization levels experienced by FDI enterprises compared to the other SMEs in Vietnam.FDI can bring economic growth and new technology, know-how, managerial expertise, and access to international markets, which can help accelerate the process of digitalization (Campos & Kinoshita, 2002; Hysa & Hodo, 2016). At the micro level, FDI can provide firms with access to new technologies and knowledge, including those related to digitalization (Sugiharti, Yasin, Purwono, Esquivias, & Pane, 2022). Additionally, FDI can increase the demand for skilled labor, which can lead to an improvement in the human capital base, a crucial factor for digitalization (Jauhari & Mohammed, 2021; Lall, 2003).

However, the empirical results also emphasize the shortage of absorptive capacity in the Southeast region. The negative impact of the squared term of both GRDP and FDI in the digitalization determinants model indicates that a higher level of GRDP and FDI may not always lead to a higher level of digitalization, meaning that the region may not have the necessary resources or capacity to fully utilize the benefits of digital technologies. This finding supports the non-linear approach of Napiórkowski (2019) when studying the relationship between square FDI stock and digitalization. Similar quadratic patterns have been explored by Cruz-Jesus et al. (2017). Blomström and Kokko (2002) found a complex nexus of FDI and human capital. As FDI inflows offer the potential for knowledge spillovers to the local labor force, but the host country's level of human capital determines the extent to which it can attract FDI and benefit from spillover effects. The relationship between FDI and human capital is likely highly non-linear, and multiple equilibria may exist. Host economies with higher levels of human capital may attract technology-intensive

foreign companies, which can significantly contribute to the development of labor skills. Conversely, economies with weaker initial conditions are likely to attract less FDI, and foreign firms entering these markets may use simpler technologies that only marginally contribute to local learning and skills development.

Human capital reflected by the number of trained workers is among prominent limited feature. Statistics from the General Statistics Office (2022) has shown the proportion of the trained labor force has slightly increased over the years, from 21.6% (2017) to 26.13% (2021). The southeast region has experienced the 2nd rank nationally in terms of the trained labor force, but the ratios are quite moderate, with a small increase over time (27.5% - 2017 and 28.34% - 2021). This actual picture of the labor force implicitly explains the shortage of absorptive capacity, as evidenced in the research findings.

Private Economic Development policy (PED), a sub-indicator of PCI, has been included in the model of digitalization determinants with the expectation to capture the institutional role, given the major shares of the private sector in the economy (Pham, 2020). However, no significant impact has been found in the empirical model. This is in contrast to the theory and many previous studies (Aghimien et al., 2022; Alpidovskaya & Stompeleva, 2020; Rogers, 2003). In this study, PED is one component of Provincial Competitiveness Index (PCI), which has been calculated based on 24 items, reflecting the proportion of firms that have accessed advisory services and support from the government, especially the employment of technology-related services for private sector economic development. In the survey data, PED only implies the quantity of service support but fails to reflect the consulting quality. The fact that businesses are engaging with multiple services also implies that the quality of information is not satisfactory, indicating the need for support. This finding may reveal the insufficient measurement of institutional factors via the proxy of PED in this model.

5. Conclusion

The research has finally reached its objectives. In fact, the digitalization determinants for the Southeast region of Vietnam have been theoretically and empirically modeled. FMOLS has been employed with the data of 2005 - 2021 to capture the long-run relationship of the variables in the digitalization model. The positive relationship between income (GRDP), FDI, and education (WQ) with digitalization has been confirmed. The research findings also imply the shortage of absorptive capacity in the Southeast region when including the squared terms of GRDP and FDI in the model. The findings are important for policymakers in emphasizing the development of human capital to fully take advantage of regional economic growth and FDI. However, the doubtful question about the institutional impact of digitalization in the region remains unsolved due to the variable measurement limitation. Future research should be executed to test this relationship.

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