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The impact of human capital and ICT index on local economic growth in Vietnam

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Abstract: This study aims to examine the factors of human capital and technology (ICT) that impact the economic growth of localities in Vietnam in the period 2016-2021. The study also evaluates the interactive impact between information technology factors and human capital factors on economic growth. The data used is based on secondary data of 63 Vietnamese provinces and cities in the period 2016-2021, extracted directly from the General Statistics Office and Vietnamese business white papers. Data on indicators representing ICT are collected through the Vietnam ICT Readiness Index for Development and Application Report released by the Ministry of Information and Communication. Using SGMM will allow to overcome model defects such as multicollinearity, autocorrelation, heteroscedasticity and endogenous variables. The results show that the variables of the rate of labor over 15 years old, or the rate of workers with vocational training, have a positive impact on economic growth, while the factors of the number of people attending secondary school or spending on Education has a negative impact on local economic growth. The technology index (ICT) has a positive impact while the information technology human resource index has a negative impact on growth. Under the interactive impact of ICT, it can increase growth but can also reduce economic growth at a higher level. These results help provide some policy implications to help improve economic growth for localities in the next period by increasing the use of technology and continuously improving the quality of human capital.

Keywords: *Human capital, ICT, Local economic growth.*
JEL Classification*: A11; C33; E65; I25.*

1. Introduction

Vietnam's economy, after strong reforms towards a market economy in the period 1986 - 1990, created momentum for development. Since 1990 until now, Vietnam's economy has achieved a relatively fast growth rate, in the period 1996-2000, the GDP growth rate reached 7%, in the period 2016-2019, the average GDP growth rate reached 6.8%, in the period 2020-2023, despite the impact of the pandemic and economic recession, the overall growth still reached 3.83%. Despite achieving high overall growth, the area stretching from north to south has very different topographical distribution and geographical location, so opportunities and resources for economic development among localities are not the same. Recent economic growth theories show that, if an economy wants to grow quickly and at a high level, in addition to relying on human resources, capital, and natural resources, the technological factor is increasingly important plays an increasingly important role (Hodrob et al, 2016; Toader et al, 2018; Myovella et al, 2020). However, human capital is still a core factor for stable and sustainable growth (Barro, 1991; Azariadis and Drazen, 1990). It can be seen that one of the requirements for a sustainable economic growth to integrate into the regional as well as the world economy is to have qualified human resources, apply technology to be able to meet the requirements of regional and world development levels. In 2023, Vietnam will also rely on the common characteristics of the provinces to divide into 6 socio-economic regions, this is the basis for promoting the strengths and advantages of

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each region, contributing to promoting innovation, increase productivity, helping local economic growth optimally. However, recent studies only consider the role of human capital in Vietnam's economic growth (Tran Tho Dat, 2011; Ha Thi Thieu Dao et al, 2014; Phan Thi Bich Nguyet et al, 2018) or only consider the role of technological factors in Vietnam's overall growth (Ha Thanh Cong, 2021; Huynh Thi Tuyet Ngan et al, 2021). These studies have not considered the simultaneous impact of human capital and technology on growth, as well as the interaction between these two factors on the economic growth of provinces, considering the differences when comparing them. Compare 6 economic regions according to division in 2023. The author's research not only examines the impact of both groups of factors on human capital and technology, but also considers the interaction between these two groups of factors on economic growth divided into 6 economic regions from there. There are more reasonable recommendations for different economic regions, this is a new contribution of the study.

2. Literature Reviews

Research the impact of human capital on local economic growth: Human capital is understood as the totality of knowledge, abilities, attitudes and behaviors in an individual (Bontis, 1998; Rastogi, 2002). Human capital is one of the key factors for economic growth (Barro, 1991; Azariadis and Drazen, 1990). Based on this approach, there have been many studies examining the contribution of each factor of human capital to economic growth. Most of the research on human capital is based on a workforce with high school to university education, and good vocational education will contribute positively to economic growth (Zhang & Zhuang, 2011; Benos and Karagiannis, 2016; Su and Liu, 2016). Other studies approaching the contribution of education spending also play a positive role in economic growth (Ada and Acaroglu, 2014; Noorziah Mohd Salleh et al, 2022). In Vietnam, there are also studies approaching the impact of human capital including education at all levels and vocational training on economic growth (Tran Tho Dat, 2011; Ha Thi Thieu Dao et al, 2014; Phan Thi Bich Nguyet et al, 2018) or the impact of investment spending on education on economic growth (Ha Thi Thieu Dao et al, 2014; Phan Thi Bich Nguyet et al, 2018). The results of the studies all show the positive role in economic growth of the group of

Research on the impact of technological development on local economic growth: Studies on the impact of spending on science, technology or information and communication technology (ICT) development of the country or localities all have positive contributions to economic growth (Pradhan et al, 2018; Bahrini and Qaffas, 2019). In Vietnam, international integration and economic growth in recent times have promoted technology research activities through the ICT index (Ha Thanh Cong, 2021; Huynh Thi Tuyet Ngan et al, 2021) Studies were conducted to evaluate the impact of digital transformation on economic growth of provinces in the Southern key economic region. Research shows that if the readiness index for information technology application and development increases by 1%, it is likely to increase the gross domestic product of localities in the southern key economic region by 0.84%. The cause of this increase stems from the increase in information technology infrastructure indexes and information technology application indexes in localities in the Southern key economic region.

Research on the interactive impact between human capital and technology on economic growth: According to Jones and Manuelli (1990), Mankiw et al (1992), human capital is considered an input factor in the production process and separate from technology, it can affect: Wage growth of an individual, the production capacity of businesses and the economic growth of a country. In contrast to the above view is the endogenous growth model studied by Nelson and Phelps (1991); Aghion and Howitt (1998), they view human capital as a catalyst that promotes technological progress, it is a condition for technological change, there exists a close cause-and-effect relationship between human capital, technology and economic growth. Human capital can promote the technological activities of enterprises through innovation, imitation or application of new technologies (Romer, 1990; Teixeira & Fortuna, 2004), thereby creating motivation for growth of businesses and the economy. Besides, the diffusion of ICT has greatly improved the efficiency of resource allocation, significantly reduced production costs and promoted much greater demand and investment in all economic sectors (Arthur Grimes, Cleo Ren, Philip Stevens, 2012). ICT plays an important role in creating new jobs, new sources

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of income, new business models and reducing the cost of accessing public services...Technologically qualified human capital will lower future costs and increase labor productivity (Remeikiene et al, 2021).

Studies relating trade openness to economic growth: Regarding the impact of trade openness on economic growth, Andersen and Babula (2008) concluded that there may be a positive relationship between international trade and economic growth. The role of trade openness in the relationship with economic growth was also studied by Kakar and Khilji (2011) in Pakistan and Malaysia in the period 1980-2010. Research results show that trade openness has a positive impact on long-term economic growth. Sakyi et al.'s (2015) study on the impact of trade openness on growth in a sample of 115 developing countries in the period 1970-2009 shows a positive two-way relationship between trade openness and economic growth in the long and short term. Khobai et al (2018) concluded that trade openness has a positive effect on economic growth in Ghana but a negative effect on the Nigerian economy. Su and colleagues (2019) concluded that economic institutions and trade openness significantly affect economic growth in Vietnam in the period 2005-2015 by using system GMM regression. Raghutla (2020) studies the impact of trade openness on economic growth in the period 1993-2016 in emerging market economies, shows that trade openness also has a positive impact on economic growth.

Studies on labor productivity to economic growth: Several studies demonstrate the positive impact of labor productivity on economic growth and development. Labor productivity figures prominently in growth models following Solow (1956). Recent studies such as Fosse et al. (2014) apply more flexible forms of growth functions to measure the impact of labor productivity on economic growth. As labor force growth slows and unemployment rates remain relatively low, countries must increasingly consider improving productivity to maintain growth rates. Dang Van Luong (2019) in evaluating the relationship between labor productivity and Vietnam's economic growth in the period 2005-2017, also showed a close and positive relationship between labor productivity and economic growth. Or Nguyen Thi Hue (2019), in analyzing the impact of labor productivity on economic growth in Vietnam in the period from 2009-2018, shows a positive relationship between labor productivity and growth, and productivity plays a big role in economic development.

Research on urban and rural population and economic growth: Tran Manh Hung and colleagues (2021) believe that the economic development process has led to rapid urbanization in provinces and cities in the southern key economic region. However, widespread urbanization can create instability and lead to unsustainable economic growth trends. This study analyzes the current situation of urbanization in the context of implementing the orientation to promote stronger economic growth in provinces and cities in the southern key economic region. Nguyen Le Hoang Thuy To Quyen and Ngo Thi Cam Huong (2022), research results provide evidence about the role of exports, urban population ratio, education, and the ability to develop information technology for economic growth of the region. This finding is the basis for provinces and cities in key economic regions to focus on improving policies related to international trade and attracting foreign direct investment; accelerate the development of information technology; improve labor quality and promote the urbanization process. Similarly, Nguyen Thanh Tu (2022) also believes that the urbanization rate (UR) has a positive influence on economic growth in the Southeast provinces.

3. Methodology, Data and Models Research

Research method: The author uses a quantitative method, using the S.GMM balanced pooled panel data processing method because the Pooled-OLS method does not consider the dynamic impact of factors, in addition, it does not consider the dynamic impact of factors. Solve the endogeneity problem that may occur in the model. Therefore, the author also uses the GMM method. GMM generalized moment estimation method was proposed by Hansen in 1982. Using GMM will allow to overcome model defects such as multicollinearity, autocorrelation, heteroscedasticity and endogenous variables, due to Therefore, the estimated results will not be biased, stable and effective (Nguyen Quang Hiep, 2021). The GMM method has two alternative estimators, differential GMM (D-GMM) and system GMM (S-GMM). In this study, the author chose to use S-GMM because it has been improved upon the D-GMM version to provide better estimates.

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Research models: Based on the endogenous growth model presented in theory along with related empirical studies, the authors propose 03 research models as follows:

Model 1: Measuring the impact of human capital on local economic growth

$$g_{GRDPit} = a_0 + a_1 * g_{GRDPit-1} + a_2 * L\text{-over}15_{it} + a_3 * L\text{-Training}_{it} + a_4 * H\text{-School}_{it} + a_5 * E\text{-Spending}_{it} + a_6 * Open_{it} + a_7 * LP_{it} + a_8 * Popcity_{it} + a_j * \sum_{j=1}^{5} d_j + e_{it} \quad (1)$$

Model 2: Measuring the impact of technological factors on local economic growth

$$gGRDP_{it} = b_0 + b_1 * gGRDP_{it-1} + b_2 * ICT_{it} + b_3 * H\text{-}ICT_{it} + b_4 * Open_{it} + b_5 * LP_{it} + b_6 * Popcity_{it} + b_j * \sum_{j=1}^{5} d_j + e_{it} \quad (2)$$

Model 3: Measuring the interaction between human capital and technology index on local economic growth

$$gGRDP_{it} = c_0 + c_1 * gGRDP_{it-1} + c_2 * (ICT * L\text{-over}15)_{it} + c_3 * (ICT * L\text{-Training})_{it} + c_4 * (ICT * H\text{-School})_{it} + c_5 * (ICT * E\text{-Spending})_{it} + c_6 * Open_{it} + c_7 * LP_{it} + c_8 * Popcity_{it} + c_j * \sum_{j=1}^{5} d_j + e_{it} \quad (3)$$

The variables, measurement of variables and basis for constructing variables are summarized in Table 1 below:

Table 1.
Details of variables in research models.

Variable	Denoted	Measure	Referenced from research
Dependent variable			
Local economic growth in province or city i in year t	$gGRDP_{it}$	Gross regional product (GRDP) at comparative prices is calculated indirectly	Su and Liu, 2016; Kyophilavong et al , 2018; Maneejuk and Yamaka, 2021
Independent variables			
Local economic growth in province or city i in year t-1	$gGRDP_{it-1}$	Gross regional product (GRDP) at comparative prices is calculated indirectly from the previous year	Su and Liu, 2016; Kyophilavong et al , 2018; Maneejuk and Yamaka, 2021
Labors 15 years old or older in province or city i in year t	$L\text{-over}15_{it}$	This is the working age prescribed in Vietnam, According to Clause 1, Article 3 of the 2019 Labor Code	Benos and Karagiannis, 2016; Su and Liu, 2016; Tran Tho Dat, 2011; Ha Thi Thieu Dao et al, 2014; Phan Thi Bich Nguyet et al, 2018
Percentage of 15-year-old labors trained in province or city i in year t	$L\text{-Training}_{it}$	Ratio of trained 15-year-old workers to the total population in the province or city. Trained workers with vocational	Benos and Karagiannis, 2016; Su and Liu, 2016; Tran Tho Dat, 2011; Ha Thi Thieu Dao et al, 2014; Phan Thi Bich Nguyet et

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		degrees/certificates	al, 2018
Number of high school students in province or city i in year t	H-School$_{it}$	Number of people attending high school out of the total population of high school age in the province or city	Benos and Karagiannis, 2016; Su and Liu, 2016; Tran Tho Dat, 2011; Ha Thi Thieu Dao et al, 2014; Phan Thi Bich Nguyet et al, 2018
Expenditure on education and vocational training in province or city i in year t	E-Spending$_{it}$	Public expenditure on education (billion VND) in total provincial or city budget expenditure	Ada and Acaroglu, 2014; Noorziah Mohd Salleh et al, 2021; Ha Thi Thieu Dao et al, 2014; Phan Thi Bich Nguyet et al, 2018
ICT index in province or city i in year t	ICT$_{it}$	The ICT index is a measure of the level of development of information and communications technology (ICT) in the province.	Elena et al, 2018; Bahrini and Qaffas, 2019; Ha Thanh Cong, 2021; Huynh Thi Tuyet Ngan et al, 2021
Technology human resource infrastructure index in province or city i in year t	H-ICT$_{it}$	The "Human Infrastructure" index includes the sub-indexes "Human infrastructure of society" and "Human infrastructure of state agencies of the province"	Ha Thanh Cong, 2021; Huynh Thi Tuyet Ngan et al, 2021
Control variables			
Trade openness in province or city i in year t	Open$_{it}$	Trade openness refers to the relative size of the local trade sector, measured by provincial consumption of goods and services/provincial GRDP	Khobai et al, 2018; Su et al, 2019; Raghutla, 2020
Total investment in province or city i in year t	Invest$_{it}$	Measured by the province's total investment capital/province's GRDP	Agrawal et al, 2011; Le Thi Mai Huong, 2016; Pham Thi Bich Ngan, 2023
Labor productivity in province or city i in year t	LP$_{it}$	Total revenue divided by total number of employees	Jack Jones Zulu et al, 2015; Dang Van Luong, 2019; Nguyen Thi Hue, 2019
Proportion of urban population of province or city i in year t	Popcity$_{it}$	Ratio of urban population divided by total population of the province	Tran Manh Hung et al, 2021; Nguyen Le Hoang Thuy To Quyen and Ngo Thi Cam Huong, 2022
Dummy variable classified by 6 economic regions	d_j	The dummy variable has 6 regions, so the dummy matrix has 5 regions, of which 1	Author's partition. Take the Mekong Delta as the basis for comparison.

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		region is the base for comparison.	

Research data: Regarding zoning, the author relies on Resolution 81/2023/QH15 dated January 9, 2023 on the National Master Plan for the period 2021-2030, vision to 2050 issued by the National Assembly. Organize the country's development space into 06 socio-economic regions; Build an organizational model and regional coordination mechanism to implement intra-regional linkages and promote inter-regional linkages, improving the efficiency of resource use. According to Point a, Clause 1, Article 3 of Resolution 81/2023/QH15, the orientation of socio-economic zoning according to the national master plan into 06 regions is as follows: (1) Northern midland and mountainous region, including 14 provinces: Ha Giang, Cao Bang, Lang Son, Bac Giang, Phu Tho, Thai Nguyen, Bac Kan, Tuyen Quang, Lao Cai, Yen Bai, Lai Chau, Son La, Dien Bien and Hoa Binh, denoted as MNPB; (2) Red River Delta region, including 11 provinces and centrally run cities: Hanoi, Hai Phong, Hai Duong, Hung Yen, Vinh Phuc, Bac Ninh, Thai Binh, Nam Dinh, Ha Nam, Ninh Binh and Quang Ninh, denoted as DBSH; (3) North Central and Central Coast region, including 14 provinces and centrally run cities: Thanh Hoa, Nghe An, Ha Tinh, Quang Binh, Quang Tri, Thua Thien Hue, Da Nang, Quang Nam, Quang Ngai, Binh Dinh, Phu Yen, Khanh Hoa, Ninh Thuan and Binh Thuan, denoted as BTBDH; (4) Central Highlands region, including 5 provinces: Kon Tum, Gia Lai, Dak Lak, Dak Nong and Lam Dong, denoted as TN; (5) Southeast region, including 6 provinces and centrally run cities: Ho Chi Minh City, Dong Nai, Ba Ria - Vung Tau, Binh Duong, Binh Phuoc and Tay Ninh, denoted as DNB; (6) Mekong Delta region, including 13 provinces and centrally run cities: Can Tho, Long An, Tien Giang, Ben Tre, Tra Vinh, Vinh Long, An Giang, Dong Thap, Kien Giang, Hau Giang , Soc Trang, Bac Lieu and Ca Mau, comparison standard area.

The data used is based on secondary data of 63 Vietnamese provinces and cities in the period 2016-2021, extracted directly from the General Statistics Office and Vietnamese business white papers. Data on indicators representing ICT are collected through the Vietnam ICT Readiness Index for Development and Application Report released by the Ministry of Information and Communication

Table 2.
Descriptive statistics of variables.

Variable	Observations	Medium	Standard deviation	Min.	Max.
g-GRDP	378	0.0875	0.0468	-0.1183	0.3042
g-GRDP_1	378	0.0885	0.0494	-0.3014	0.3042
lnLover15	378	6.5634	0.5723	4.9739	8.4817
LTraining	378	20.5555	12.5329	8.2	50.30
LnHSchools	378	10.4301	0.5967	8.9235	12.9508
LnEspending	378	7.9693	0.4595	6.9663	9.7510
Lnopen	378	10.6151	0.9275	8.2044	13.8711
ICT	378	0.3861	0.1552	0.0626	0.9407
lnLP	378	7.1257	0.4830	4.5933	8.5176
ICTLover15	378	2.5683	1.1183	0.3208	6.0197
ICTTraining	378	8.3610	7.3799	1.0045	89.1261
ICTHSchools	378	4.0606	1.7143	0.5869	9.7131
ICTEspending	378	3.0909	1.2882	0.4852	7.2709
Popcity	378	0.2935	0.1737	0.0980	0.8817

4. Results and Discussion

Table 2 shows the statistical results describing the variables in the usage model. For the research period from 2016-2021 (n=6 years), there are 63 provinces and cities, so a total of 6x63 = 378 observations. Regarding the GRDP economic growth of the provinces, the average value during the

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research period is 0.0875 (8.75%) with the lowest growth value of -11.83% (in Ba Ria Vung Tau province in 2020 is a year of general economic recession due to the Covid19 epidemic. The highest growth reached 30.42% (in Lai Chau province in 2016). The variable working age over 15 is taken as a natural logarithm with the original unit being millions of people. This variable has an average value of 6.56 (the smallest value is 4.97 and the highest value is 8.48). The rate of trained workers has an overall average value of 20.55%, of which the smallest value is 8.2% (belongs to Bac Lieu province in 2018) and the highest value is 50.3% (belongs to Hanoi in 2021). Variables on the number of high school students, education spending, and trade openness are measured by the natural logarithm value of the original value in millions of people or million VND. The variables also show high deviations between the mean, maximum and minimum values and the value of the standard deviation, showing that the variables in the model have the phenomenon of variable error variance. The information and communications technology (ICT) index of the provinces has an average value of 0.38. Calculated on a scale of 1, this average value is generally quite low, the lowest being 0.06 (belongs to Lai Chau province in 2021), the province with the highest ICT index of 0.94 belongs to Da Nang in 2017. Regarding labor productivity, the province with the lowest labor productivity is Nghe An in 2016, the province with the highest labor productivity is Thai Nguyen in 2021. Regarding the urban population ratio, the overall average value is 29 .35%, of which the lowest value is 9.8% (belongs to Ben Tre province in 2021), the highest value is 88.17% belongs to Da Nang province in 2018. In summary, the analysis table described above shows the characteristics of the variables in the model, the characteristics of provinces and regions with average, high/low values. And in addition, it also shows that the data characteristic has the phenomenon of heteroskedasticity, requiring the use of adjusted GMM technique in the econometric regression model.

Table 3.
Quantitative results of the impact of human capital and technology on local economic growth.

Variables	Model 1		Model 2		Model 3	
	Be-ta	P-value	Be-ta	P-value	Be-ta	P-value
g-GRDP_1	0.5410	0.052***	0.7158	0.049**	0.4144	0.256
lnLover15	0.0577	0.00*				
LTraining	0.0007	0.011**				
LnHSchools	-0.0288	0.094***				
LnEspending	-0.0342	0.00*				
Lnopen	-0.0053	0.703	-0.0043	0.485	-0.0139	0.021**
ICT			0.0181	0.650		
H-ICT			-0.0316	0.216		
ICT* Lover15					0.1099	0.001*
ICT*Training					0.0009	0.300
ICT*HSchools					-0.0332	0.139
ICT*Espending					-0.0490	0.024**
lnLP	0.0011	0.864	-0.0019	0.769	0.0025	0.676
popcity	-0.0319	0.260	-0.0044	0.862	-0.0192	0.322
MNPB	0.0195	0.360	-0.0006	0.964	0.0060	0.695
DBSH	0.0180	0.245	0.0170	0.097***	0.0152	0.186
BTBDH	0.0174	0.268	0.0062	0.544	0.0112	0.306
TN	0,0186	0.131	.0,0030	0.715	0.0057	0.464
DNB	0,0104	0.337	0.0121	0.348	0.0050	0.682
Intercept	0.2633	0.000*	0.0907	0.130	0.1755	0.004*

Note: (*) (**) (***) corresponds to the statistical significance levels of 1%, 5% and 10%; The endogenous variable in the model is the economic growth variable in the previous period (g-GRDP_1), the author uses the instrumental variable as total investment capital compared to the GRDP of the provinces.

Table 3 shows the quantitative results of the impact of capital factors on the economic growth of localities divided into 6 different economic regions. In these quantitative models, the author uses The

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Mekong Delta is the economic region to compare with the remaining 5 economic regions of the country. With coding of regions as follows: MNPB (Northern Midlands and Mountains); DBSH (Red River Delta); BTBDH (North Central and Central Coast Region); TN (Central Highlands Region); DNB (Southeastern Region). For the model using the SGMM method, the author chose the lag variable to be endogenous because many previous studies also showed that the lag variable is endogenous (Miller et al, 2020; Nguyen Trong Nghia, 2022). In addition, because investment capital plays a very important role in economic growth, that's why the author chose the variable of total social investment capital as an instrumental variable (IV variable).

The estimation results in all models show that the previous period's economic growth contributed to this year's economic growth with a high and statistically significant marginal impact. The results show that the economic growth in the period 1% increase in the previous period contributes to 0.54% economic growth in the next period (for model 1). This result is similar to the research results of (Hanif & Arshed, 2016; Kyophilavong et al, 2018; Maneejuk and Yamaka, 2021; Ha Thanh Cong, 2021). Age over 15 years old or the existing labor force over 15 years old also has a positive impact on economic growth, an increase in the labor force of 1% has an impact on economic growth of 0.06%, even in The static model and the dynamic model are statistically significant, consistent with research by (Samans et al, 2017; Nguyen Ngoc Hung, 2016; Nguyen Van Thang, 2019). The proportion of people in the working age who have received training also has a positive impact on economic growth, but at a relatively low marginal impact level, this result agrees with the research results of (Liu, 2016; Samans et al, 2017; Tran Tho Dat, 2011; Phan Thi Bich Nguyet et al, 2018). The number of high school students has a negative impact on local economic growth at -0.03%, this result is contrary to the research results of (Kyophilavong et al, 2018; Maneejuk and Yamaka, 2021; Noorziah Mohd Salleh, 2021). This result implies that the number of high school graduates who have not received vocational training and lack vocational skills can create a burden for their families and society. In addition, this result also implies that general education teaching and learning does not meet the labor requirements of today's society, so after high school, students must increase their vocational training, or continue their studies. can equip themselves with job opportunities, helping to improve income for themselves and their families. This result is quite similar to the results of local education spending which also has a negative impact on economic growth. The majority of localities spend financial resources to spend on high school education levels, lacking resources to invest in vocational schools and skills development, so spending on education is not as effective as expected. Control variables in the model such as trade openness (open), labor productivity (LP), urban population ratio (Popcity) are not statistically significant, this result is contrary to the research results. by (Tran Manh Hung et al., 2021; Nguyen Le Hoang Thuy To Quyen and Ngo Thi Cam Huong, 2022; Nguyen Thanh Tu, 2022). This result shows that urbanization and increased urbanization while people and thinking are not compatible with urban civilization will create barriers to development. Only when urbanization is consistent with the nature of the urban population and meets all resources and cultural institutions can it help good economic growth.

Regarding the difference in economic growth of different economic regions, in comparison with the Mekong Delta, the remaining regions all have average growth values that are generally higher than the Mekong Delta and this difference statistically significant (except for the Southeast region), for example, the Northern mountainous and midland economic regions have a higher growth rate than the Mekong Delta region by 0.03%/year, or the Red River Delta region has a higher growth rate than the Mekong Delta region. Overall growth is higher than the Mekong Delta region at 0.026%. These results reflect the general characteristics of the six economic regions, in which the Mekong Delta region has slow growth, or even the Southeast region has a general growth decline compared to the average level of the remaining regions.

Regarding consideration and assessment of the impact of information and communication technology factors ICT, as well as human infrastructure on local economic growth, according to the results from table 3, showing the results of the impact mark. Other variables are also consistent with the results according to analysis table 3. Information and communications technology (ICT) factors have a positive and statistically significant impact on economic growth in static regression models, specifically, if the ICT index increases by 1% point, it will increase the GRDP of localities by 0.06%, this result is

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quite similar to previous studies such as (P. Pradhan et al, 2018; Madden and Savage, 1994; Lee et al, 2007; Ha Thanh Cong, 2021). Indeed, in the current period, information and communications technology is a core factor helping localities transform digitally, apply electronic government infrastructure systems, make information transparent, and reduce transaction costs, connecting the infrastructure of all parties, greatly helping in administrative reform and business system development for enterprises. Unfortunately, the factor of human resource infrastructure in the private industry has a negative impact on local economic growth. This result shows that the quality of human resources in technology currently does not meet innovation requirements in all three aspects of access, understanding and operations. Because IT is changing rapidly, while training, coaching, and digital transformation still have many shortcomings, it is difficult to meet social needs in the short term.

In order to consider how the interaction between human capital and technological factors affects the economic growth of localities, the author uses model 3, which uses interaction variables between the two factors. First of all, the interaction effect between the ICT index and the labor force over 15 years old (ICT*Over15) shows that the interaction effect magnifies local economic growth, specifically, if the effect is alone, then Workers over 15 years old have a marginal impact of 0.05%, the single impact of ICT on economic growth is 0.06%, while the interaction effect has boosted growth to nearly 0.11%. This shows that if the workforce over 15 years old is well trained and equipped with information and communication technology, growth will be much higher than current reality. This result supports previous research results of (Liu and Armer, 1993; Teixeira & Fortuna, 2004; Cammeraat et al, 2021; Balog & Demidova, 2021). The interaction variables between the rate of trained workers and ICT, or the interaction between ICT and the number of people attending high school, also have the same impact as the individual effects, do not magnify growth and are not statistically significant. The interaction effect between the information technology index and the level of spending on education also shows a good effect when reducing the reduction in growth (ie has a growth stimulating effect), specifically the separate marginal effect. The individual factor of education spending on economic growth is -0.04%, the individual impact of ICT on growth is +0.06%. However, when incorporating the interaction effect, it reduces growth to only -0.04%. Proving that spending on education, if spent correctly for the purpose of improving students' ability to use IT, will help future growth, in addition to increasing the quality of human resources who know how to use IT well and are capable of using it. Good IT skills will create momentum for better economic growth for localities.

5. Conclusion and Recommendation

Because previous year's economic growth has a positive impact on next year's economic growth, there needs to be a solution to stabilize economic growth. To do this, the government in general and local authorities need to coordinate closely to control inflation, stabilize the macroeconomy, and promote economic growth. A workforce over 15 years old and with vocational training will help improve growth, so there should be policies to develop vocational education and early career education for young people. Spending on education and the number of high school students has a negative impact on economic growth, because current local education spending is largely spent on general education, lacking career guidance and teaching occupations as well as being equipped with information technology skills or competencies. The information and communications technology (ICT) index has a positive impact on growth, so it is necessary to invest more heavily in development solutions for IT infrastructure, IT human resources and IT application capabilities. Economic regions have unstable growth and there are quite high disparities between regions. It is necessary to have good education policies and increase educational investment in a liberal and career-oriented direction.

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