THE IMPACT OF INFORMATION AND COMMUNICATION TECHNOLOGY ON FOREIGN DIRECT INVESTMENT INFLOWS ATTRACTION AMONG LOCALITIES OF VIETNAM: A GMM STYLE COMPARATIVE ANALYSIS BETWEEN MANUFACTURING AND SERVICES SECTOR

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ABSTRACT

Using the two-step system Generalized Method of Moments (GMM), the researcher critically analyzes the role of Information and Communication Technology (ICT) as a determinant of the Foreign Direct Investment (FDI) inflows to 57 out of 63 provinces of Vietnam during 2012-2019. The findings of this study indicates that: First, the development of Information and Communication Technology (ICT) of the host destination is significant and has a positive impact on the FDI inflows; Second, the FDI in Services sector is more ICT-intensive than the FDI in Manufacturing sector; Third, the FDI in Services sector is likely to locate in the metropolitan cities than in the non-urban provinces; Fourth, the FDI in Manufacturing sector is likely to establish to a greater degree in the non-urban localities than in the metropolitan cities. Finally, the FDI enterprises in Vietnam during 2012-2019 were more likely to locate in the non-urban localities.

Keywords: *ICT, FDI, determinants, GMM, Vietnam*

1. Introduction

In the past few decades, Information and Communication Technology (ICT) has become an important factor that enables businesspeople to effectively remove geographical barriers in transaction, instantly transmit important information to the business partners worldwide, and expeditiously access necessary information. Because ICT has brought about significant benefits that remarkably help reduce transaction costs for the international enterprises, it has been considered a new determinant of FDI.

2. Literature review

To examine the determinants of FDI inflows to Vietnam, many studies have been conducted since 2000s. One of the early studies by Nguyen (2002) investigates provincial location factors in attracting FDI across Vietnam from 1990 to 2000. This study finds that provincial market sizes have significant positive effects on FDI inflows across provinces in Vietnam. Later, (Pham, 2002) examines the regional determinants of FDI in Vietnam during 1988-1998 shows that infrastructure development, labor quality, and local market size attract multinationals; tax incentives have an insignificant effect on attracting FDI flows to provinces with socio-economic difficulties. A study by (Meyer & Nguyen, 2005) analyzes the pattern of FDI inflows in Vietnam and reports that industrial zones and the

friendly policies of local governments positively affect foreign investors' choice of location. Provinces with good educational systems, large populations, well-developed infrastructure, and high GDP growth attract relatively more FDI inflows. Using provincial-level data, the Nguyen (2006) study indicates that domestic investment, market growth, the exchange rate, market size, infrastructure conditions, human capital, and labor cost strongly affect foreign investment enterprises' choice of location in Vietnam. (Nguyen & Nguyen, 2007) used the Vietnamese provincial competitiveness index (VPCI) 2006 in their econometric models to analyze the determinants of FDI spatial distribution across provinces. As studies by Cheng and Kwan (2000) on China, and Nguyen (2002) and Nguyen (2006) on Vietnam, Nguyen and Nguyen (2007) find that market size, labor quality, and infrastructure development are important factors in attracting FDI at the provincial level. Using data covering 14 provinces of the North Central and South Central Coast regions in Vietnam in the period 2000 to 2010, (Chien & Zhang, 2012) investigates the relationship between FDI and Market growth, competition among provinces, and the effects of laws in attracting FDI. The findings indicate that the ability to access province-level information and infrastructure have significant effects on FDI attraction, and after the promulgation of the Law on Investment in 2005 and Vietnam joining the WTO in 2007, the volume of FDI inflows increased rapidly in provinces in these regions. Likewise, to investigate FDI location factors at the provincial level in Vietnam, (Esiyok & Ugur, 2011) conduct an empirical study across 62 Vietnamese provinces in the period 2006 to 2009. Their study shows that GDP per capita, domestic investment, and trade openness are positively associated with FDI inflows in provinces; labor cost is negatively associated with FDI. They find that a 10% increase in FDI in neighboring provinces tends to contribute to an increase of from 1.2% to 1.8% in the FDI of a given province. In addition, (Doan & Lin, 2016) conduct a study named "Provincial governance and Foreign Direct Investment in Vietnam. An Empirical study at sub-national level" tried to explore the role of provincial governance in attracting Foreign Direct Investment in Vietnam across provinces. The researcher used panel data for the period of 2006-2014 for a regression analysis. Nine independent variables were Entry Costs, Land Access and Security of Tenure, Transparency and access to information, Times costs of Regulatory Compliance, Informal charges, Proactivity, Business Support Services, Labor & Training, Legal Institutions for the study. In general, the studies in FDI determinants in Vietnam indicate that the key variables for determining FDI location at the provincial level includen Vietnam includeincludee eight factors: (1) market size, (2) labor cost, (3) labor quality, (4) infrastructure development, (5) special economic zones, (6) government support, (7) transparency, and (8) Time costs of regulatory compliance as below:

Table 1: *Determinants of FDI inflows across Vietnam (2002-2020)*

Variable	Effect on FDI inflows	Studies in the period 2002-2020
Market size	+	Le (2015) ; Esiyok & Ugur (2011) ; Nguyen (2002) ; Nguyen (2006) ; Nguyen & Nguyen (2007) ; Pham (2002); (NGO, CAO, NGUYEN, & NGUYEN, 2020)
Labor cost	-	Le (2015); Meyer & Nguyen (2005); Nguyen (2002)
Human quality	+	Meyer & Nguyen (2005) ; Nguyen (2002) ; Nguyen (2006) ; Nguyen & Nguyen (2007) ; Pham (2002)
Infrastructure development	+	Le (2015) ; Meyer & Nguyen (2005) ; Nguyen (2006) ; Nguyen & Nguyen (2007) ; Nguyen & Zhang (2012) ; Pham (2002)
Special Economic Zones	+	Le (2015); Meyer & Nguyen (2005); Nguyen (2002)
Government support	+	Meyer & Nguyen (2005) ; Nguyen and Zhang (2012) ; Le (2015) ; Doan & Lin (2016)
Transparency	+	Doan & Lin (2016)
Time costs of regulatory compliance	+	Doan & Lin (2016)
Relationship between host and home countries	+	(Vo, 2018)
Trade openness	-	(NGO et al., 2020)

(Source: Researcher's compilation)

Despite the favorable business conditions created by the ICT, there have not been any studies examining the relationship between ICT development and FDI attraction in Vietnam in general and in the sub-national level in particular. This study is undertaken to fill the gap of knowledge.

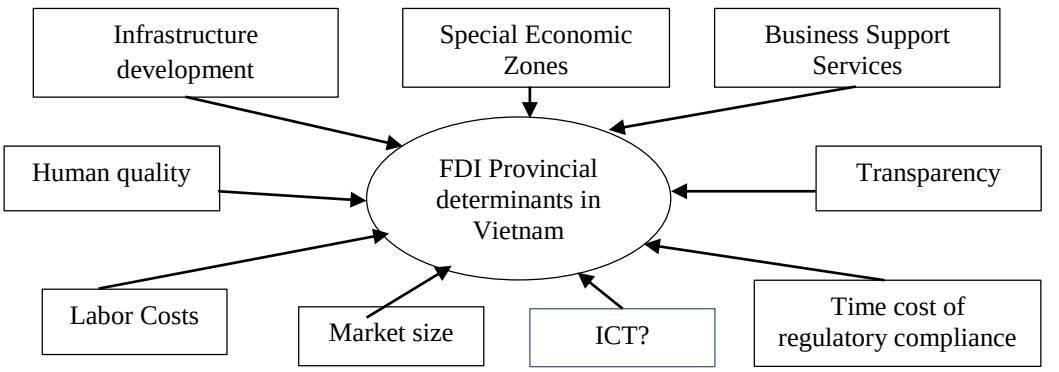

Figure 1: *Review on Determinants of FDI inflows to provinces of Vietnam*

This paper aims to provide a robust evidence-based analysis about the Information and Communication Technology (ICT) as a determinant of Foreign Direct Investment (FDI) inflows to provinces of Vietnam during 2012-2019 and find the answers for the following questions:

a. How does ICT affect the FDI inflows in localities of Vietnam?

b. What sector of FDI is more ICT-intensive, Services or Manufacturing?

c. Which location is the FDI in Manufacturing sector more likely to establish? Metropolitan cities or non-urban provinces?

d. Which location is the FDI in Services sector more likely to establish? Metropolitan cities or non-urban provinces?

e. Which location is the FDI more likely to establish? Metropolitan cities or non-urban provinces?

3. Variable selection, data collection and hypothesis formation

3.1. Variable selection

FDI inflows (FDI) is the inflows capital of Foreign Direct Investment (FDI), Foreign Direct Investment in Manufacturing sector (FDIM), and Foreign Direct Investment in Services sector (FDIS). The dependent variables in the econometric models of the study describe the flows of FDI, FDIM, and FDIS invested in 57/63 provinces of Vietnam during 2012-2019. These inflows of capital are measured in Vietnamese Dong (VND) converted from the U.S. dollars (US$) at the exchange rate of US$1 = 21,380VND imposed on January 1, 2015 by The Joint Stock Commercial Bank for Foreign Trade of Vietnam (Vietcombank).

Market growth (GROWTH) is the independent variable which is proxied by the annual percentage of the Gross Regional Domestic Product (GRDP) growth rate of 57 provinces of Vietnam in the study.

Labor Cost (LABCOST) is an independent variable that is proxied by the minimum wage measured in Vietnamese Dong (VND) that a company has to pay annually to an employee. The wages are different in provinces and imposed by the government.

Human quality (HUMAN) is the independent variable which is proxied by the number of students enrolled annually in high schools of each province in the period study.

The five metropolitan cities (BIGC) refer to Hochiminh City, Hanoi, Danang, Cantho, and Haiphong are also identified in the Statistical Yearbook of Vietnam.

Trade openness (TRADE) is an independent variable in the econometric model of the study. TRADE refers to the sum of imports and exports turnovers of each province in every year. The trade value is measure by Vietnamese Dong (VND) converted from the U.S. dollars (US$) at the exchange rate of US$1= 21,380VND on January 1, 2015 imposed by The Joint Stock Commercial Bank for Foreign Trade of Vietnam (Vietcombank).

Information and Communication Technology (ICT) is the independent variable which is proxied by the ICT index

3.2. Data collection

This study utilizes the data of 57 out of 63 provinces and cities of Vietnam during the period of 2012-2019. The sources of data are The Statistical Yearbook of Vietnam; The Annual Reports of the General Department of Vietnam Customs under the Ministry of Finance of Vietnam; The website of the Industrial Zones Authorities; The Reports of Information and Communications Index (ICT index) Ministry of Information and Communications of Vietnam.

3.3. Hypothesis formation

3.3.1. Information and Communication Technology and FDI inflows

The rapid development of the worldwide internet has affected the international transaction of business. This provides for businesspeople the possibilities to access the commercial and political information that was impossible in the past. Because Information and Communications Technology can help the investor reduce time and cost in business, it has drawn the attention of many researchers. There have been a variety of empirical studies confirming the positive impact of ICT on FDI in both developed and developing countries (Addison & Heshmati, 2003; Gani & Sharma, 2003; Gholami, Tom Lee, & Heshmati, 2006; Leitao & Baptista, 2011). The main reason is that ITC helps lower the transaction and production costs of foreign investors. In addition, ICT enables immediate response by transnational corporations to customer orders; it also gives possibility for foreign companies to be closer to the customers with the removal of barriers in transport and customs. This study uses the ICT index as an indicator to examine its relationship with the FDI inflows across provinces in Vietnam. The index made by the Ministry of Information and Communications of Vietnam is an overall score calculating from two sub-indices: (1) ICT infrastructure, and (2) ICT application. The studies reviewed above point out that Information and Communication Technology (ICT) could help attract FDI flows to the host location. Thus, the hypothesis could be formulated like this:

Hypothesis 1: ICT performance of a province has a positive impact on its FDI inflows attraction.

3.3.2. Information and communication technology and FDI inflows in sectors

While most of the FDI in the Manufacturing sector belong to the labour-intensive industries, FDI in the Services sector is hypothesized to be ICT-intensive. FDI in services such as the producer services refer to the activities supporting the production of the companies. Manufacturing companies always have close connections with the support services enterprises such as accounting firms, consultants, computer design, and so on. The high-quality services require not only the well-trained working forces but also the qualified computers and network to timely respond to the business demand of the manufacturing companies. On the contrary, the manufacturing enterprises usually require an abundant of unskilled manpower who are qualified enough for simple activities in the factories with the support from machines. Based on this logical argument, a hypothesis is made as follows:

Hypothesis 2: FDI in Services sector is more ICT-intensive than that of Manufacturing sector.

3.3.3. Preferred location of FDI in Manufacturing sector

Although most of the international corporations require certain location for operations, their demand on the scale of space is different. Manufacturing enterprises usually need large floor space with a low rental price to build the factories and production facilities. This objective could be achieved if the corporations base their production area in non-urban locations. In a populous country such as Vietnam, foreign manufacturing companies can easily

recruit abundant unskilled laborers in the under-developed provinces.

Hypothesis 3: FDI in Manufacturing sector is likely to locate in the non-urban localities.

3.3.4. Preferred location of FDI in Services sector

The services companies which usually require well-educated employees often establish firms in the urban areas. In Vietnam or developing countries in general, people living in the developed cities have better access to the technological innovation and advanced knowledge. In addition, the information and communication infrastructure in the metropolitan cities enable the services companies to provide customers with instant and reliable support for their activities. For the above reasons the relationship between well-developed location and FDI in Services sector could be hypothesized as follows:

Hypothesis 4: FDI in Services sector is likely to locate in the metropolitan cities.

3.3.5. Preferred location of FDI in general

Because Vietnam is a developing country, it has attracted the FDI inflows by specific competitive advantages. One of the key advantages of Vietnam has been huge working forces paying a low salary, usually available in the non-urban provinces. Because most of the FDI manufacturing companies doing business in labour-intensive industries such as footwear, garments, electronics, and so on, they tend to locate their production facilities in the non-urban areas to reduce the production cost. Compared to other sectors, the Manufacturing sector of FDI has accounted for the biggest share of the FDI structure. For this reason, it would be suitable for the researcher to come up with the hypothesis as follows:

Hypothesis 5: FDI in Vietnam is likely to locate in the non-urban localities

3.4. Descriptive statistics

Table 2 shows the descriptive statistics of the dependent and independent variables in the study, including the number of observations, mean, standard deviation of each variable, and the minimum and maximum values of the variables.

Table 2: *Summary of Descriptive Statistics of the Study*

Variable	Obs.	Mean	Std. Dev.	Min	Max
FDI	456	4.00	9.30	-20.72	11.59
FDIM	456	0.87	11.61	-20.72	11.24
FDIS	456	-4.13	13.14	-20.72	13.16
GROWTH	456	7.72	4.68	-31.81	43.22
LABCOST	456	-3.57	0.33	-4.33	-2.94
HUMAN	456	3.54	0.58	1.92	5.46
TRADE	456	10.25	1.92	3.23	14.51
ZONES	456	7.51	1.36	4.92	10.75
ICT	456	3.70	0.35	2.15	4.54

(Source: Researcher's computation)

Table 3 shows the correlations of every pair of coefficients of the independent variables in the study. As shown in Table 3, only HUMAN has the strongest correlation with TRADE (0.6420) which is smaller than 0.8, so the multicollinear is not serious (Farrar & Glauber, 1967). Therefore, these explanatory variables can be included in the model.

Table 3: *Correlation Matrix of the Independent Variables of the Study*

Variables	GROWTH	LABCOST	HUMAN	TRADE	ZONES	ICT
GROWTH	1.0000					
LABCOST	0.1007*	1.0000				
HUMAN	0.0413	0.0985*	1.0000			
TRADE	0.1482*	0.3199*	0.6420*	1.0000		
ZONES	0.0756	0.1086*	0.4229*	0.5617*	1.0000	
ICT	0.0752	0.1114*	0.5347*	0.6141*	0.3886*	1.0000

(Source: Researcher's computation)

4. Model specification and methodology

The model of main seven variables with logarithm values is designed. While FDI is the dependent variable, ICT, GROWTH, LABCOST, HUMAN, TRADE, ZONES, and lag value of FDI are explanatory variables. ICT is the target variable, and the rest are the control variables. The two-step system GMM estimation method is used in the study because it is suitable for the study case of "small T, large N" (Roodman, 2009).

The panel data model used in this study has been commonly used by many researchers when studying location determinants of foreign direct investment (Cole, Elliott, & Zhang, 2009; Chien & Zhang, 2012; Esiyok & Ugur, 2011). Panel data analysis is a method of studying a particular subject at different places, periodically observed during a defined timeframe.

The research methodology used in this study is quantitative. This is selected based on the research questions to be investigated; purpose of the study; theoretical framework; and the nature of the available data.

Stationarity test. Regarding the methods of estimation for time-series data, the Unit root test is firstly implemented to examine the stationarity condition of the variables (Ebiringa & Emeh, 2013).

Table 4: *Results of Levin-Lin-Chu unit-root test for target variables*

Variables	Adjusted t*	Hypothesis	P-value	Result
FDI	-8.5131	Ho: Panels contain unit roots Ha: Panels are stationary	0.00	Reject Ho
FDIM	-14.6661	Ho: Panels contain unit roots Ha: Panels are stationary	0.00	Reject Ho
FDIS	-7.0540	Ho: Panels contain unit roots Ha: Panels are stationary	0.00	Reject Ho
GROWTH	-5.6221	Ho: Panels contain unit roots Ha: Panels are stationary	0.00	Reject Ho

Variables	Adjusted t*	Hypothesis	P-value	Result
LABCOST	-42.2575	Ho: Panels contain unit roots Ha: Panels are stationary	0.00	Reject Ho
HUMAN	-8.9929	Ho: Panels contain unit roots Ha: Panels are stationary	0.00	Reject Ho
TRADE	-19.1876	Ho: Panels contain unit roots Ha: Panels are stationary	0.00	Reject Ho
ICT	-18.2758	Ho: Panels contain unit roots Ha: Panels are stationary	0.00	Reject Ho

(Source: Researcher's computation)

The Levin-Lin-Chu test results in Table 4 indicate that all the target variables are stationary at I(0). Note: "I" refers to "integration". I(0) means original difference integration. The variable ZONES is not necessary to conduct the Unit root test because the total area of Industrial Zones, in each province or city, are considered unchanged during the study period of 8 years (2012-2019).

Fourth, Model specification. Three equations (1), (2), and (3) are formulated in the form of dynamic panel data and the study uses the two-step system GMM for the estimation of dynamic balanced panel data. The key advantages of utilizing the model in the study are explained as follows:

* *Dynamic system GMM panel model is more appropriate than the OLS and static panel estimates:*

The system generalized methods of moments (GMM) estimators are suggested to be applied when the estimations for panel data cope with the problems of endogeneity (Nickell, 1981). In the study situation, dependent variables have possible effect on the independent variables and that might cause the endogenous problem. A solution to solve the issue was first suggested by (Anderson & Hsiao, 1982) and (Arellano & Bond, 1991) who proposed the GMM method which later improved by (Arellano & Bover, 1995) based on (Arellano & Bond, 1991), and extended by (Blundell & Bond, 1998) to reduce the bias related to the fixed effects in short panels and to solve the problem of endogeneity in dynamic panel data. In addition, many researchers have stated that the dynamic panel model is specifically created for the context of "small T, and large N" panels in order to control for dynamic panel bias (Baltagi, 2008; Baum & Christopher, 2006; Bond, 2002; Roodman, 2009; Sarafidis, Yamagata, & Robertson, 2009). Because this study has the samples taken from 57 provinces (N) over a period of 8 years (T), it utilizes the two-step system GMM for analysis.

* *Although both difference-GMM (DGMM) developed by Arrelano and Bond (1991) and system-GMM(SGMM) created by Arrelano and Bover (1998) are the appropriate dynamic estimation models for the study, the SGMM is chosen because of its advantages over the DGMM as described below:*

- Because the variables included in the model are macroeconomics variables, they seem to have the existence of random-walk values. According to (Baum & Christopher, 2006; Bond, 2002; Roodman, 2007, 2009), the SGMM estimate has the advantageous better than the DGMM in solving the random-walk phenomenon.

- Since the variable ZONES for total area of the Industrial Zones is the time-invariant variable, it might be lost by using the DGMM approach (Roodman, 2009). Therefore, the SGMM is more suitable for the analysis.

- The SGMM approach usually creates a more efficient and precise outcome compared to DGMM through enhancing the validity and decreasing the finite sample bias (Baltagi, 2008).

d. The distribution of FDI inflows to provinces and cities of Vietnam is different. In reality, many remote and mountainous provinces have not yet experienced FDI in some years. This creates an unbalanced panel that is temporarily solved by plus 1 which makes the case of FDI absence before transforming the variables into the Logarithm (Wooldridge, 2012). For the unbalanced panel, SGMM is more effective than DGMM in estimation (Roodman, 2009).

Due to the big divergence nature of the FDI inflows data between the metropolitan cities and the remote and mountainous localities, all the variables appearing in forms of absolute values, except for the ratio of GROWTH, are transformed into the natural logarithm to minimize the curvature of the data:

(1) $$lnFDI_{i,t} = \beta_0 + \beta_1 GROWTH_{i,t} + \beta_2 lnLABCOST_{i,t} + \beta_3 lnHUMAN_{i,t} + \beta_4 lnTRADE_{i,t} + \beta_5 lnZONES_{i,t} + \beta_6 BIGC_i + \beta_7 lnICT_{i,t} + \beta_8 lnFDI_{i,t-1} + \eta_i + \varepsilon_{i,t}$$

Where,

FDIi,t	Annual FDI inflows in VND to province i at time t;
GROWTHi,t	Gross Regional Domestic Product growth rate of province i at time t;
LABCOSTi,t	Annual salary in VND of employee in province i at time t;
HUMANi,t	Total enrollments in high schools of province i at time t;
TRADEi,t	Sum of Imports and Exports in VND of province i at time t;
ZONESi,t	Total area of Industrial Zones in hectares in province i at time t;
BIGCi,	Dummy variable: BIGC equals to 1 for metropolitan city, and 0 for other;
ICTi,t	Information and Communication Technology index of province i at time t;
η_i	Fixed effect over the time t
$e_{i,t}$	The random disturbance over the time t;
β_0	an intercept, which is assumed to be constant of FDI over time t regardless other factors.

i = 1, 2,…57 and t = 1, 2,…, 8.

(2) $$lnFDIM_{i,t} = \beta_0 + \beta_1 GROWTH_{i,t} + \beta_2 lnLABCOST_{i,t} + \beta_3 lnHUMAN_{i,t} + \beta_4 lnTRADE_{i,t} + \beta_5 lnZONES_{i,t} + \beta_6 lnICT_{i,t} + \beta_7 lnFDIM_{i,t-1} + \eta_i + \varepsilon_{i,t}$$

(3) $$lnFDIS_{i,t} = \beta_0 + \beta_1 GROWTH_{i,t} + \beta_2 lnLABCOST_{i,t} + \beta_3 lnHUMAN_{i,t} + \beta_4 lnTRADE_{i,t} + \beta_5 lnZONES_{i,t} + \beta_6 lnICT_{i,t} + \beta_7 lnFDIS_{i,t-1} + \eta_i + \varepsilon_{i,t}$$

Where,

FDIMi,t	Annual FDI inflows of Manufacturing sector in VND to province i at time t;
FDISi,t	Annual FDI inflows of Services sector in VND to province i at time t;
GROWTHi,t	Gross Regional Domestic Product growth rate of province i at time t;
LABCOSTi,t	Annual salary in VND of employee in province i at time t;
HUMANi,t	Total enrolments in high schools of province i at time t;
TRADEi,t	Sum of Imports and Exports in VND of province i at time t;
ZONESi,t	Total area of Industrial Zones in hectares in province i at time t;
ICTi,t	Information and Communication Technology index of province i at time t;
η_i	Fixed effect over the time t
$e_{i,t}$	The random disturbance over the time t;
β_0	an intercept, which is assumed to be constant of FDI over time t regardless other factors.

t = 1, 2,…, 57 and t = 1, 2,…, 8.

(4) $$lnFDIM1_{i,t} = \beta_0 + \beta_1 GROWTH_{i,t} + \beta_2 lnLABCOST_{i,t} + \beta_3 lnHUMAN_{i,t} + \beta_4 lnTRADE_{i,t} + \beta_5 lnZONES_{i,t} + \beta_6 BIGC_i + \beta_7 lnICT_{i,t} + \beta_8 lnFDIM_{i,t-1} + \eta_i + \varepsilon_{i,t}$$

(5) $$lnFDIS1_{i,t} = \beta_0 + \beta_1 GROWTH_{i,t} + \beta_2 lnLABCOST_{i,t} + \beta_3 lnHUMAN_{i,t} + \beta_4 lnTRADE_{i,t} + \beta_5 BIGC_i + \beta_6 lnICT_{i,t} + \beta_7 lnFDIS_{i,t-1} + \eta_i + \varepsilon_{i,t}$$

Where,

FDIM1i,t	Annual FDI inflows of Manufacturing sector in VND to province i at time t;
FDIS1i,t	Annual FDI inflows of Services sector in VND to province i at time t;
GROWTHi,t	Gross Regional Domestic Product growth rate of province i at time t;
LABCOSTi,t	Annual salary in VND of employee in province i at time t;
HUMANi,t	Total enrolments in high schools of province i at time t;

TRADEi,t	Sum of Imports and Exports in VND of province i at time t;
ZONESi,t	Total area of Industrial Zones in hectares in province i at time t;
BIGCi	Dummy variable: BIGC equals to 1 for metropolitan city, and 0 for other;
ICTi,t	Information and Communication Technology index of province i at time t;
η_i	Fixed effect over the time t
$e_{i,t}$	The random disturbance over the time t;
β_0	an intercept, which is assumed to be constant of FDI over time t regardless other factors.

i = 1,2,…57 and t = 1, 2,…, 8.

5. Empirical results

Table 5: *Synthesized Empirical results*

Variable	**Model (1) FDI**	**Model (2) FDIM**	**Model (3) FDIS**	**Model (4) FDIM1**	**Model (5) FDIS1**
ICT	**4.495*** **	**1.778*** **	**6.568*** **	**1.981*** **	**6.626*** **
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
GROWTH	**.01247*** **	**.01245*** **	**.1453*** **	**.005** **	**.1558*** **
	[0.003]	[0.000]	[0.000]	[0.024]	[0.000]
LABCOST	**-.8662*** **	**-2.986*** **	**4.501*** **	**-3.029*** **	**3.887*** **
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
HUMAN	**2.064*** **	**1.411*** **	**1.27** **	**1.050*** **	**2.235*** **
	[0.000]	[0.000]	[0.013]	[0.000]	[0.000]
TRADE	**.6027*** **	**1.688*** **	**1.544*** **	**1.882*** **	**.9675*** **
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
ZONES	**.8151*** **	**1.12*** **	**.1315**	**1.055*** **	
	[0.000]	[0.000]	[0.343]	[0.000]	
BIGC	**-1.956*** **			**-2.312*** **	**3.223*** **
	[0.002]			[0.000]	[0.005]
FDI L1.	**.2919*** **				
	[0.000]				
FDIM L1.		**.2534*** **			
		[0.000]			
FDIS L1.			**.2351*** **		
			[0.000]		
FDIM1 L1.				**.2543*** **	
				[0.000]	
FDIS1 L1.					**.2263*** **
					[0.000]
N	399	399	399	399	399
F	455710.13	33063.77	2809.59	17124.15	4898.93
F-p	0.00	0.00	0.00	0.00	0.00
Ar1p	0.01	0.00	0.00	0.00	0.00

Ar2p	0.28	0.68	0.58	0.67	0.60
Hansen	52.42	52.51	53.29	50.93	52.31
Hansenp	0.38	0.38	0.35	0.43	0.31
j	59.00	58.00	58.00	59.00	56.00

Note: P-values are in [ ]. *, **, *** are significant levels at 10%, 5%, 1%, respectively.

Results in Table 5 indicate that all the models in the Study contain strong explanatory power because of the four following reasons:

First, F-test of joint significance. The F-test examines the significance of the coefficients of independent variables stating that we may reject the null hypothesis that all coefficients of independent variables are jointly equal to zero (p = 0.000). On the contrary, the alternative hypothesis states that model is suitable if there is at least one coefficient of the independent variable which is not equal to zero.

- Ho: All of the coefficients of independent variables are equal to zero

- H1: At least one coefficient of independent variable is not equal to zero.

At the significance of 0.05, all FDI, FDIM, FDIS, FDIM1, FDIS1) have the Prob > Chi2 = 0.000 which is < 0.05, Ho is rejected and H1 is accepted, as a result the model is suitable significantly.

Second, there is no second-order autocorrelation in residuals. The SGMM assumes that there is no second-order autocorrelation in residuals. (Basu, 2008)

- Ho: Absent of second-order autocorrelation in residuals

- H1: Presence of second-order autocorrelation in residuals

All of FDI, FDIM, FDIS, FDIM1, FDIS1 have the P-values of AR(2) of 0.28, 0.68, 0.58, 0.67, 0.60 respectively which are greater than 0.05, so Ho is accepted.

Third, Hansen J-statistic tests the null hypothesis of correct model specification and valid overidentifying restriction. (Baum & Christopher, 2006)

- Ho: Model specification is correct and all overidentifying restrictions (all overidentified instruments) are correct (exogeneous)

- H1: the instrument variables (IV) in the model are not suitable

The Hansen J-tests of FDI, FDIM, FDIS, FDIM1, FDIS1 have the Prob > Chi2 = 0.38, 0.38, 0.35, 0.43, 0.31 which are greater than 0.05 indicating that the results are robust.

Fourth, Number of Instruments versus number of Observations. The number of instrument j (59, 58, 58, 59, 56) are smaller than number of observation (399) indicating that the results are robust.

5.1. Information and communications technology and FDI inflows

The result of regression on the Information and Communication Technology (ICT) strongly supports the *Hypothesis 1: "ICT performance of a province has a positive impact on its FDI inflows attraction."*. The result indicates that the ICT performance of a province has a decisive effect on the inward FDI volume. This finding is consistent with the study by (Addison & Heshmati, 2003).

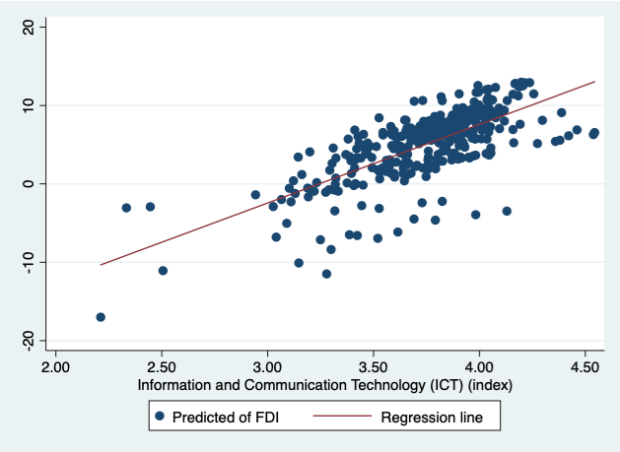

Figure 2: *Regression of ICT and FDI (Source: Drawn by researcher based on the study data)*

5.2. Different Impact of ICT on Manufacturing FDI and Services FDI

The Empirical results in the Table 8 show the difference between the impact of ICT on FDI in Manufacturing sector and FDI in Services sector. While the ICT coefficient of Manufacturing FDI equals to 1.778*** that one of Services FDI is 6.568***. Accordingly, the comparative charts below indicate the impact of ICT on Manufacturing FDI and Services FDI.

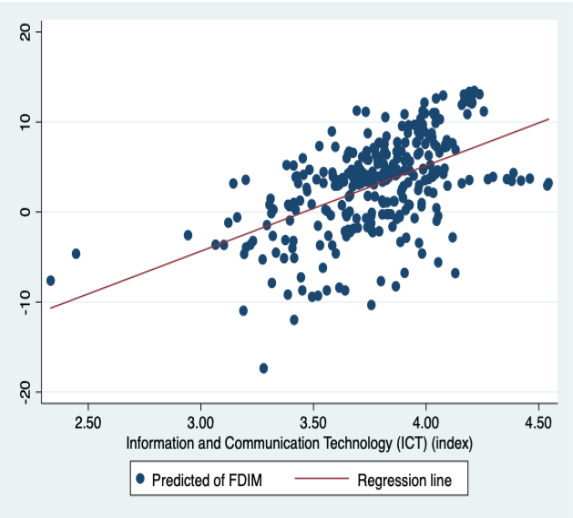

Figure 3: *Regression of ICT and FDIM* ((Source: By researcher)

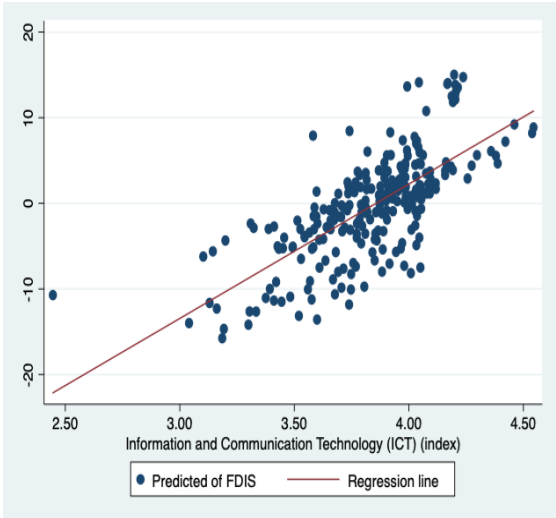

Figure 4: *Regression of ICT and FDIS* *(*(Source: By researcher)

Because the result indicates that ICT has a stronger significant effect on the inflows of FDI in Services sector than FDI in Manufacturing sector, it supports the *"Hypothesis 2: FDI in Services sector is more ICT-intensive than that of Manufacturing sector"*. This could be explained that the FDI in Services sector require a province to have the qualified ICT infrastructure. The producer

services such as banking, design, Research and Development are absolutely need the support and simulation of computers, internet, and well-trained staff.

5.3. The FDI in Services sector is likely to locate in the metropolitan cities

The Empirical results in the Table 12 are consistent to the *Hypothesis 4: "FDI in Services sector is likely to locate in the metropolitan cities"*. Most of the enterprises of the FDI in the Services sector requires a sound ICT infrastructure to support their activities. This is reasonable because the enterprisers of producer services such as finance, banking, marketing, consultancy, design, accounting, and so on expect to take advantage of ICT technology to transfer their services to the firms of manufacturing industry in the minimum amount of time. The coefficient 3.223*** for the Services sector confirmed this conclusion.

5.4. FDI in Manufacturing sector is likely to establish in the non-urban localities

The BIGC coefficients of -2.312*** for Manufacturing FDI indicates that the inflows of FDI in the Manufacturing sector is NOT likely to locate in the metropolitan cities, this is consistent with the *Hypothesis 3: "FDI in Manufacturing sector is likely to locate in the non-urban localities"*. The minus (-) shows that FDI in Manufacturing has the opposite tendency to the FDI in services sector. The BIGC coefficient of FDI is negative indicating that the FDI inflows is more likely to locate in the non-urban provinces.

5.5. FDI enterprises in Vietnam during 2012-2019 prefer to locate in the non-urban localities

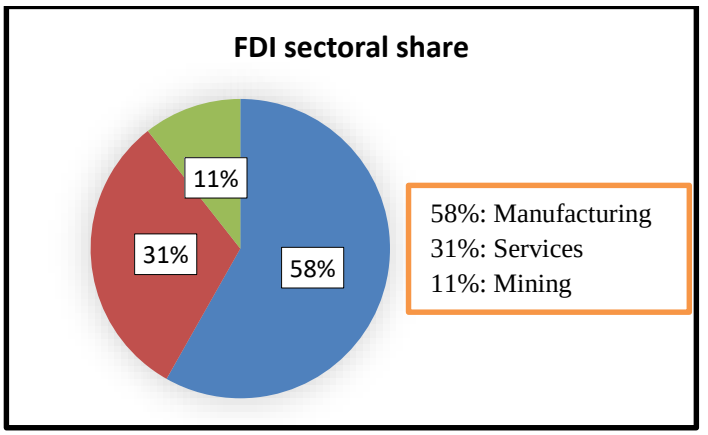

Figure 5: *FDI sector share in Vietnam (2012-2019)*
(Source: Researcher's calculation)

Since the share of FDIM accounts for a major part of the FDI structure, the coefficient of BIGC in FDI regression is the same as the one of FDIM, significantly negative. On the contrary, because the FDIS is mainly located in the metropolitan cities, the coefficient of BIGC of FDIS regression is significantly positive. The empirical result is consistent with the *Hypothesis 5: "FDI*

in Vietnam is likely to locate in the non-urban localities".

6. Discussion

Although examining the similar topic of FDI as the previous studies, this paper contributes some findings both in theory and practice. In theoretical aspect, apart from reviewing the traditional determinants of FDI, the study confirms that ICT is a new location factor while the international corporations selecting the destination for their investments abroad. In practical viewpoint, the host governments could give more priority in ICT improvement policy. This would help enhance the FDI inflows attraction to localities not only in quantity but also in quality. In recent years, the developing countries have selectively attracted more high-tech FDI projects than the labor-intensive ones for the reasons of value-added increasing and air pollution decreasing.

7. Conclusion and policy implication

Despite of many benefits brought about by ICT in business world, the correlation between ICT and FDI inflows has not yet been examined in Vietnam so far. In an effort to explore the impact of ICT on FDI inflows in Vietnam, the study has been conducted by analysing the sample of 57 localities out of 63 provinces of Vietnam during 2012-2019. The empirical results produced by the estimation method of two-step system Generalized Method of Moments (SGMM) and reveals five important findings: 1. ICT is an important determinant of FDI inflows in provinces of Vietnam and in the developing economies in general. 2. FDI in the Services sector is more ICT-intensive than FDI in the Manufacturing sector. 3. FDI in the Manufacturing sector is more likely to establish in the non-urban provinces. 4. FDI in the Services sector is more likely to locate in the metropolitan cities. 5. FDI with majority structure of Manufacturing sector tend to locate in the non-urban provinces.

By examining the impact of ICT determinant on the FDI inflows in Vietnam, this study provides the provincial governments in Vietnam, and the government in developing countries with additional evidence of the effect of ICT to the FDI attraction in the context of the fast growth of information and communication technology in the world. The governments of the host localities could take the following recommendation to attract the FDI into their territories:

First, improve the ICT performance for attracting FDI inflows. Because ICT positively effects FDI inflows, the government should be more invested in this development. More state budget should be allocated to the expenditure of Research and Development. In addition to the human resource investment, the government should develop the infrastructure for the ICT development. More internet transmission facilities should be built to meet the demand in the period of Revolutionary 4.0.

Second, more investment in ICT to attract the new-generation FDI. The value generated from the Services sector will account for an increasing proportion in the GDP structure. Especially when the country becomes more developed the percentage of services value in its

economic structure is higher (Jorgenson & Timmer, 2011). For this reason, the developing countries should selectively attract the FDI of new generation than the labor-intensive FDI.

Third, the ICT performance should be enhanced to attract more high-value FDI into the non-urban localities. In order to decrease the crowded status of FDI in the metropolitan cities, there must be methods to attract the FDI enterprises to move to the non-urban areas. Hence the governments of those non-urban areas should have the policies to develop the ICT performance in the localities.

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TÁC ĐỘNG CỦA CÔNG NGHỆ TRUYỀN THÔNG THÔNG TIN ĐẾN THU HÚT DÒNG VỐN FDI GIỮA CÁC ĐỊA PHƯƠNG CỦA VIỆT NAM: PHÂN TÍCH SO SÁNH BẰNG MÔ HÌNH GMM GIỮA KHU VỰC SẢN XUẤT VÀ DỊCH VỤ

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TÓM TẮT

Sử dụng phương pháp GMM hệ thống hai bước (two-step system Generalized Method of Moments), bài viết phân tích vai trò của Công nghệ thông tin và Truyền thông (ICT) như một yếu tố quyết định dòng vốn đầu tư trực tiếp nước ngoài (FDI) vào 57 trên 63 tỉnh thành của Việt Nam giai đoạn 2012 -2019. Kết quả nghiên cứu cho thấy: Thứ nhất, sự phát triển của Công nghệ thông tin và Truyền thông (ICT) của địa phương tiếp nhận đầu tư FDI là rất quan trọng và có tương quan dương đến dòng vốn FDI. Thứ hai, FDI trong lĩnh vực Dịch vụ có mức thâm dụng Công nghệ thông tin và Truyền thông hơn so với FDI trong lĩnh vực Sản xuất. Thứ ba, FDI trong lĩnh vực Dịch vụ có xu hướng tập trung ở các thành phố lớn. Thứ tư, FDI trong lĩnh vực Sản xuất có xu hướng tập trung ở các tỉnh. Cuối cùng, phần lớn các doanh nghiệp FDI tại Việt Nam trong giai đoạn 2012-2019 tập trung cơ sở sản xuất ở các tỉnh hơn là tại các đô thị.

Từ khóa: *Công nghệ thông tin và Truyền thông, FDI, các yếu tố quyết định, GMM, Việt Nam*