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Factors Affecting The Development Of The Supporting Industry For The Electronics Industry In Vietnam

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ABSTRACT
This article uses the enterprise census data set and GMM method to estimate the impacts of factors affecting the development of the supporting industry for the electronics industry in Vietnam. The estimated results show that the market size, the advancement of science and technology and organization, the quality of human resources, and the factors of the policy and information environment are all factors that affect the development of the supporting industry for the domestic electronics industry. The results of the research are also the basis for proposing some suitable solutions to promote the development of the industry in the next period.

KEYWORDS: affecting factors, supporting industry, electronics industry, GMM

I. Overview
The electronics industry is the manufacturing industry that plays an important role in the economy and has a strong impact on other industries. Vietnam's computer and electronics industry accounts for 17.8% of the whole industry (Ministry of Industry and Trade, 2021). Vietnam has started to participate strongly in the 3C value chain in the electronics industry since 2010 (including components, accessories, assembly of components, and finished products) and has become the electronic component assembly center of the word. In terms of global value chain, Vietnam has mainly integrated in the midstream with lower added value, including small assemblies such as screens and special parts, and finished products such as consumer electronics, communications and computers. In the group of electronic components, Vietnam's role in the global electronic value chain is limited to the role of an integrator of components. The underdevelopment of domestic supporting industries has made Vietnam's electronics industry difficult to create a breakthrough in recent years. Since 2005, the State has started to pay attention and issued policies to promote the domestic supporting industry. However, over the past 15 years, the supporting industry has been still in infancy, the number of supporting industry enterprises is small, and the scale and production capacity is still narrow, which greatly affects the general development of the domestic electronics industry. Especially, in the context of many fluctuations of the world economy, there are impacts on the development of the entire electronics industry. This requires research to survey and evaluate the factors affecting the development of the supporting industry; thereby, appropriate solutions will be proposed to promote the development of the supporting industry of the electronics industry in the coming years.

II. Theoretical and empirical basis on factors affecting the development of the supporting industry

2.1. Theoretical basis
The development process of the supporting industry in general and the supporting industry

for the electronics industry in particular is affected by many different factors.

Objective factors:

Firstly, the institutional and policy environment: The system of strategies and policies will promote link, attract and direct the FDI flow, as well as affect the competitiveness enhancement of main industries, increase the efficiency for the economy, etc. (Vietnam Development Forum, 2007; Nguyen Xuan Thuy, 2007; Mori J., 2007). Supportive and preferential policies for the development of the supporting industry for the electronics industry are also extremely necessary, especially for countries that are in the phase of starting the establishment and development of the supporting industry. Accordingly, the policies will help orient the supporting industry to develop in the right and quick manner, provide necessary incentives and support for benterprises, promote FDI attraction and improve competitiveness for the economy. (Luu Tien Dung & Nguyen Minh Quan, 2014). Supportive views are also shown in the research of Inoue (1998); Intarakumnerd, Sunami, & Ueki (2012); Phan Thi Minh Ly (2011); Le Ngoc Nuong (2018); Do Van Thang (2018); Tran Dinh Thien et al. (2012); the Central Institute for Economic Management (CIEM) (2009).

Secondly, market size. Large market size plays a very important role in the supporting industry for the electronics industry and this factor can be expanded through the search for export markets (Vietnam Development Forum et al., 2007). The supporting industry always requires a relatively large order quantity to participate in the market. Supporting industry products such as molds, metal processing, laminating, etc. need to invest in expensive machinery and equipment a lot. Once the installation of machinery and equipment is invested, the capital cost for the factory will always be at a fixed level, the unit cost of capital will be inversely proportional to the amount of output products. (Luu Tien Dung & Nguyen Thi Kim Hiep, 2016; Luu Tien Dung & Nguyen Minh Quan, 2014). The large market size is a necessary element to reduce production costs and attract foreign direct investors to the supporting industry (Intarakumnerd et al., 2012; Morisawa, 2000). Similar views are also confirmed in the research of Tran Dinh Thien et al (2012); Central Institute for Economic Management (2009).

Thirdly, the information system: according to Vietnam Development Forum (2007); Tran Dinh Thien (2012), to be able to develop the supporting industry for the electronics industry, it is necessary to have a timely, complete and effective information supply system for enterprises, both downstream enterprises and supporting enterprises in terms of environment, policies, the demands of the component, accessory market, opportunities for production and business cooperation, etc. In addition, a smooth information system is also a factor contributing to promoting the increase in connectivity and productivity, and efficiency of the whole economy, thereby, the economic growth will be promoted. (Do Van Thang, 2018); Morisawa, 2000).

Subjective factors:

Firstly, the size of the enterprises and the size of the supporting industry enterprises can influence the productivity and efficiency of the enterprises (Phan Thi Kim Ly, 2011; Intarakumnerd et al., 2012). Enterprises with small-scale and lack of capital will be less likely to innovate technology, production organization to meet the requirements of assemblers, have less opportunities to join the production chains, global supply chains. However, if the size of the enterprises is large, but they operate inefficiently, are slow to innovate, the cost burdens for the operation process of the enterprises will occur.

Secondly, technological innovation, organizational innovation at enterprises. The process of technological innovation and production organization innovation will contribute to increasing the total factor productivity (TFP) of the supporting industry enterprises, and help enterprises to meet the requirements of assemblers, multinational and transnational corporations to join their supply

and value chains. (Truong Thi Chi Binh, 2010; Inoue, 1998; Intarakumnerd et al., 2012; Morisawa, 2000; Nham et al., 2016; CIEM, 2009)

Thirdly, quality of human resources. The number of industrial human resources will directly affects the output scale of the supporting industry. The quality of human resources is one of the factors forming the TFP. Thus, the factor of industrial human resources enhances productivity and economic efficiency of the supporting industry. (Truong Chi Binh & Nguyen Manh Linh, 2017; Vietnam Development Forum et al., 2007; Luu Tien Dung & Nguyen Minh Quan, 2014; Inoue, 1998; Tran Dinh Thien et al., 2012)

2.2. Empirical research evaluates the impacts of factors affecting the development of the supporting industry for the electronics industry

In the research of Gonçalves & Martins (2016) on the determinants of growth in the Portuguese manufacturing and processing industry, the authors based on the approach of the Cobb-Douglas production function with the function form as $Y_{it} = A_{it} K_{it}^{\beta k} L_{it}^{\beta l} M_{it}^{\beta m}$, in which, Yit represents the physical output of company i the period t; Kit, Lit, Mit correspond to inputs from capital, labor and intermediate inputs. Ait is the Hicksian neutral efficiency of company i in period t. To solve the problem, the production function changes to a linear form by logarithm of both sides. The same method is also applied in the research of Chu (2008) on the impact of internal research and development efforts, from imported technology to economic value added with the case of Taiwan electronics industry.

In Vietnam, the research of Le Thi Kim Chung (2015), based on the Cobb-Douglas production function and quantitative research methods using fixed effect and random effect models, with data taken from the annual enterprise survey of the General Statistics Office, the research also analyzed and evaluated the impacts of FDI on the output of the chemical industry in Vietnam in the period of 2000-2012. At the enterprise level, the research of Pham The Anh & Nguyen Duc Hung (2013) based on the approach of production function and array data regression method with fixed effects, with analyses and evaluations of the impacts of the business environment institutions on the operation results of enterprises in Vietnam.

The research of Nguyen Tien Dung & Nguyen Minh Quan (2014) used structural equation modeling (SEM) to analyze the factors affecting the development of the supporting industry, the case of the mechanical industry in Dong Nai Province. Similarly, Luu Tien Dung and Nguyen Thi Kim Hiep (2016) used exploratory factor analysis, confirmatory factor analysis, and SEM model to study the factors affecting the development of the supporting industry in Vietnam in the case of the textile industry

In the research of Nham Tuan et al. (2016), the authors surveyed the figures of 118 enterprises in the mechanical, electronic, motorcycle and automobile supporting industries in Vietnam to find out the relationship of innovation (including product innovation, process innovation, marketing and organizational innovation) on the performance of the supporting industry enterprises. The authors used the quantitative analysis method including reliability analysis based on Cronbach's alpha coefficient (for 4 components of innovation process and 3 components of business performance), KMO exploratory factor analysis and regression analysis with 4 models.

Thus, via the process of reviewing some theories and empirical research on the development of the supporting industry for the electronics industry, it can be seen that the research has shown some factors affecting the development of the supporting industry for the electricity industry including factors such as market size, quality of industrial human resources, information system, infrastructure, policy system. However, some reasons from the internal weakness of the supporting industry enterprises in the electronics industry will greatly affect the development of the industry, but there are very little research, analysis and systematic evaluation.

Regarding the research model and methods of evaluating the status and impact level of the factors and activities promoting the enterprises to develop the supporting industry for the electronics industry: there is not a lot of quantitative research evaluating the impact level of activities promoting enterprises to develop the supporting industry for the electronics industry. Some research has analyzed the impact of factors affecting the development of the supporting industry for some industries based on SEM model and Liker scale, based on primary survey data of some enterprises at provincial and local levels; the advantage of the model is that it can consider a variety of factors affecting the development of the supporting industry of the industry/locality. However, the disadvantage of this method is that the number of observed samples is not large, it is more suitable for the small survey scope at the local level; the application is difficult if the analysis covers the whole economy due to expensive survey costs and insufficient human resources for the surveys. If this model and method are applied, the conclusions will be difficult to be representative of the whole industry and economy.

III. Research model, hypothesis and research method

3.1. Research model

From the affecting factors summarized in the overview, in order to clarify the current situation of factors affecting the development of the supporting industry for the electronics industry in Vietnam, the author intends to build a research model under the following form:

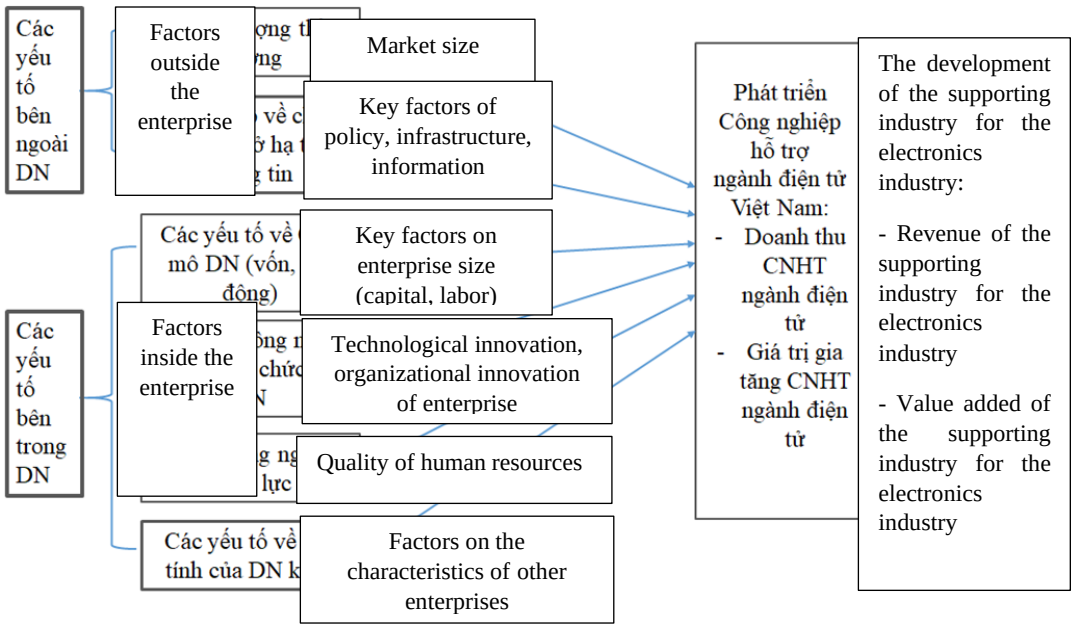

Figure1. Research model of factors affecting the supporting industry for the electronics industry

From this model, the author builds a general function under the following form:

$$\log(Y_{CNHTDT}) = \log(A) + \alpha \log(K) + \beta(\log L) + \lambda Xi$$

In which:

$Y_{CNLKĐT}$: output value of the industry of electronic component manufacturing, measured through the net revenue from sales and service provision of the supporting industry for the electronics industry.

K: Total capital

L: number of laborers

Xi: Variables are added to the model such as:

- Market size/scope (can be shown through the revenue target of the provincial electronics industry);
- Factors about the system of infrastructure, institutions, and policies (through the provincial competitiveness index);

- Variables of enterprise characteristics: Enterprise size (large, medium, small); labor quality; the process of technological innovation, organizational innovation of the enterprises; etc.

Endogeneity in the model:

Model estimation can lead to the change and bias in the variance of error due to endogeneity in the model. In which, endogeneity occurs in two specific directions:

The endogeneity of dependent variable with independent variable: In this case, the dependent variable can have the opposite effect of the independent variable. For example, in case the increase in the revenue of electronic components can lead to the increase the revenue of the electronics industry because this is one of the production inputs of the entire electronics industry.

The endogeneity among independent variables: This case occurs when the independent variables can have the linear relationship. For example, an increase in the quality of human resources, an improvement in technology, etc. also means an increase in production resources, which can be correlated with an increase in the revenue of the electronics industry.

3.2. Research hypothesis

Based on the research model, the author gives the following research hypotheses:

- ✓ H1: Market size positively affects the development of the supporting industry for the electronics industry.
- ✓ H2: The infrastructure system, supporting industry development policies, information systems, etc. affect the development of the supporting industry for the electronics industry.
- ✓ H3: Enterprise size affects the development of the supporting industry for the electronics industry.
- ✓ H4: Technological innovation and organizational innovation in supporting industry enterprises in the electronics industry positively affect the development of the supporting industry for the electronics industry.
- ✓ H5: The quality of human resources affects the development of the supporting industry for the electronics industry.

3.3. Research methods and data sources

Research methods:

Qualitative method: Descriptive statistics, comparisons, graphs, tables, etc. are used to analyze the current development status of the supporting industry for the electronics industry, and make evaluations about the shortcomings and limitations in the industry development process; the impacts of the process of technological innovation, innovation in production organization, issues related to the development of the supporting industry for the electronics industry.

Quantitative method: Based on the enterprise census data set of the General Statistics Office for the period 2010 - 2016, the research is expected to use the Cobb-Douglas production function and regression method to calculate the affecting coefficients of the factors affecting the development of the supporting industry in Vietnam's electronics industry (shown by the revenue of the electronic component manufacturing industry, product code 26100).

Because the final product industry revenue and the intermediate product revenue certainly have a strong bidirectional relationship, thus, to avoid the problem of endogenous variables, the research will use enterprise-level data for the dependent variable (the revenue of electronic components industry). The independent variable includes: market size (it is shown through the revenue of the provincial supporting industry and the opening level of the economy); institutional and policy environmental factors (through the provincial competitiveness index (PCI)); labor quality and technological innovation (through the TFP index); enterprise characteristics (labor, capital, enterprise size, etc.). Besides, to increase the relevance of the model, the author

also adds some control variables such as: proportion of FDI capital, level of industrial concentration (HHI index), dummy variable by region (Red River Delta, Southeast and the remaining areas).

The impact assessment equation has the following form:

$$\log(reEComponent_{it}) = \log(A) + \beta_1 \log(capital\_EComponent_{it}) + \beta_2 \log(capital\_labor\_EComponent_{it})$$
$$+ \beta_3 TFP + \beta_4 \log(reven\_EI\_prov_{t}) + \beta_5 \log(reotherSI\_prov_{t}) + \beta_6 PCI_{it}$$
$$\beta_7 FDIshare + \beta_8 HHI + \beta_9 \log(OPEN) + \beta_{10} busgroup_i + \beta_{11} region_{ii} + e_{it}$$

In which: $e_{it} = c_i + v_{it}$, c_i is the residual that varies only with i (varies by province/enterprise), v_{it} is the residual that varies with both i and t (province/enterprise and time).

Data sources

To estimate the impacts of factors affecting the development of supporting industries for Vietnam's electronics industry, the authors use the enterprise census data set implemented by the General Statistics Office of Vietnam in he period of 2010 – 2018. This is a survey implemented by the General Statistics Office annually with the subjects of the survey as enterprises, cooperatives and establishments under the enterprise across the country operate in all sectors prescribed in Vietnam Standard Industrial Classification (VSIC). However, in each period, the purpose of the survey may change, leading to the adjustment of information and data from year to year. In the scope of this article, the authors only focus on the period 2010 - 2018, to ensure the consistency in product sub-sectors and to ensure that the control variables in the model have complete statistics over the years.

The variables used in the model are calculated as follows:

Table 1. Variables used in the model

Variables	Variable explanation	Data source
log(revenue_Ecomponent)	Log (The revenue of the supporting industry for the electronics industry)	Enterprise census, GSO
log (capital_Ecomponent)	Log (The capital of the supporting industry for the electronics industry)	Enterprise census, GSO
log (K/L)	Log (Capital per unit of labor)	Enterprise census, GSO
TFP	Total factor productivity	Enterprise census, GSO
FDIshare	The proportion of FDI in total capital	Tổng điều tra doanh nghiệp, GSO
HHI_revenue	The level of industrial concentration	Enterprise census, GSO
log (revenueEI_provin)	Log (the revenue of the electronics industry by province): reflect domestic market size	Enterprise census, GSO
log (reotherSI_prov)	Log (revenue of other related supporting industries): reflect the linkage	Enterprise census, GSO
PCI	PCI: reflects the development of infrastructure system, policies, information system.	VCCI
log (OPEN)	Log [(Export + Import)/GDP]: reflect the integration and opening level of the economy	Enterprise census, GSO

Some descriptions of the variables used in the analysis in the sample are shown in Table 4, including some observations, mean, standard deviation, the minimum value, the maximum value.

Table 2. Descriptive statistics of variables used in the model

Variable	Obs	Mean	Std. Dev.	Min	Max
lnrevenueEComponent	1,534	9.624338	2.0693	2.692261	14.96287
lncapital_Ecomponent	1,533	8.093571	2.627272	0.355299	14.3739
Lkl	1,533	4.138392	1.801368	-3.24131	10.55385
Tfp	1,533	3.482764	0.858472	-1.74131	7.346103
FDIshare	2,131	0.0318087	0.111482	9.37E-08	1
hhi_revenue	4,360	0.0782336	0.120676	0.000114	1
lnrevenueEI_provin	4,360	17.03687	1.42787	6.72356	18.06214
lnreotherSI_prov	4,360	18.06429	1.519645	11.2036	19.72312
Pci	4,360	61.15615	3.254227	49.76844	70.19

Source: Calculation from the enterprise census data set, General Statistics Office

Next, the author calculates the correlation coefficient (shown in Table 5). The calculation results of correlation coefficients show that there is a close relationship between the revenue of electronic components industry with labor, capital, the revenue of the whole electronics industry, and revenue of other supporting products. The steps of running the econometric model are described in Appendix.

Table 3. Calculation of model correlation coefficients

	lnrevenueEComponent	lncapital_Ecomponent	Lkl	Tfp	FDIshare	hhi_revenue	lnrevenueEI_provin	lnreotherSI_prov	pci
lnrevenueEComponent	1								
lncapital_Ecomponent	0.6628	1							
Lkl	0.1034	0.6895	1						
Tfp	0.1689	-0.0094	0.1189	1					
FDIshare	0.4745	0.5958	0.3601	-0.0785	1				
hhi_revenue	-0.0129	0.0825	0.0268	-0.1854	0.199	1			
lnrevenueEI_provin	0.1024	-0.0246	0.0064	0.2173	0.0353	0.0456	1		
lnreotherSI_prov	-0.0147	-0.0961	0.0047	0.1279	-0.0218	0.1129	0.4927	1	
Pci	-0.0393	-0.0688	0.0278	0.0904	-0.0982	-0.1804	0.1935	0.147	1

Source: Calculation from the enterprise census data set, General Statistics Office

To estimate the above model, the author estimates via the random and fixed effect methods. Then, the author uses Hausman test to select the appropriate model from the results obtained from the random effects model and the fixed effect model.

However, the above model may occur the endogeneity towards the independent and dependent variables or between the independent variables and this can lead to incorrect estimates. Therefore, to solve the problems for this defect, Lars Peter Hansen (1982)developed

and added an instrumental variable (which has a close relationship with the independent and dependent variables without the relationship with the residual. The model that adds this instrumental variable is called generalized method of moments - GMM.

GMM was proposed by Arellano and Bond in 1991. In 1995, Rellano and Bond reintroduced the GMM estimation method, and in 1998, Blundell and Bond developed more fully.

Arellano and Bond (1991) developed the GMM where the equations are considered under the system of equations at different periods. Arellano and Bover (1995) described the method, if the original degree equations moved to the state of being added to the system, additional timing conditions can be introduced to increase the efficiency. In these equations, the predefined and endogenous variables at the levels are linked with an appropriate lag of their initial difference. Blundell and Bond (1998) made the necessary assumptions for this incremental estimator more accurately and tested it with a Monte Carlo simulation. The initial estimator is sometimes called "differential GMM" and "systemic GMM". Bond (2002) is a good introduction to these estimators and use of them. xtabond2 implements both estimators. As a GMM estimator, the Arellano-Bond estimator has variations as one-step or two-step estimators. But despite being more effective in terms of symptoms, two-step estimates of standard errors tend to be severely biased (Arellano and Bond 1991; Blundell and Bond 1998). To compensate, xtabond2, unlike xtabond, provides a finite sample correction for the two-step covariance matrix originated from Windmeijer (2000). This can make robust two-step estimator more efficient than one-step estimator.

Thus, the topic will use the estimation method as GMM to assess the impact of factors on the development of the supporting industry for the electronics industry.

IV. Research results and discussion

4.1. Overview of the development situation of the supporting industry for Vietnam's electronics industry

Regarding the number of enterprises: According to the data of (Ministry of Industry and Trade, 2018), the number of supporting industry enterprises in Vietnam is still small, there are only about 2000 domestic supporting industry enterprises, of which, about 300 enterprises join multinational corporations but it is still difficult to find supply sources for the production chain. According to the statistics of (Supporting Industry Enterprise Development Centre (SIDEC), Institute of Industrial Policy Strategy Research, 2017), there are 610 enterprises manufacturing electrical - electronic components, the average growth in the number of enterprises in the period 2011 – 2016, reaching 13.66%, rapid development, the rate of component manufacturing enterprises/total number of enterprises in the electronics industry accounts for about 53.28%. Theoretically, to achieve the development of a manufacturing industry, the number of enterprises supplying components and spare parts must be many times greater than the number of assembling enterprises, therefore, with the number of enterprises manufacturing electronic components accounting for just over half of the total number of enterprises in the whole industry, it can be seen that the supporting industry for Vietnam's electronics industry has not really developed.

About the size of enterprises of the supporting industry for the electronics industry: supporting industry enterprises are mainly small and medium enterprises, they lack capital, technology, and high-quality human resources; in addition, the participation of pure Vietnamese supporting industry enterprises is still limited, they mainly supply simple materials and spare parts such as packaging, some plastic and metal molds; complex and sophisticated components such as electronic components are usually undertaken by FDI enterprises or imported from outside. (Ministry of Industry and Trade, 2018)

Regarding import and export:

Export turnover of products, components and spare parts of Vietnam has continuously increased over the years. According to SIDEC (2017), in 2015, the export turnover of components and spare parts was 21.1 billion USD, up 43% compared to 2014, the average growth in the period 2012-2015 was 32.9%/year. Some products of electronic components with high export turnover include telephone components and spare parts (code 851770), integrated electronic circuits (8542), camera components (900691, etc. However, to serve the demands of domestic manufacturing, Vietnam's electronics industry still has a trade deficit of components and spare parts at a relatively large value. Each year, Vietnam has a trade deficit of more than 10 billion USD in electronic components to serve domestic assembly needs, with two main components products as integrated circuits and telephone components. China and Korea are the main markets of supplying components to Vietnam. Imports from these two countries accounts for over 90% of Vietnam's total import turnover of electronic components (Ministry of Industry and Trade, 2018). This makes the trade balance of Vietnam's electronics industry often faces a situation of trade deficit and the added value of the industry is low.

According to the investigation of (SIDEC - Institute of Industrial Policy Strategy Research, 2015), The electronics industry must import about 77% of the product value. The domestic manufacturing part focuses on some mechanical , plastic - rubber components, the supply rate of electronic components is very low. The tier 1 suppliers to the electronics industry are also mostly FDI companies. However, there have been some Vietnamese enterprises supplying components and materials for these tier 1suppliers.

Some products of electronic components reach the high import turnover including integrated circuits, components and spare parts for phones of all kinds, printed circuits (8534), components for radio and television machines (8529), transistor diodes (8541), etc. Import sources are mainly from China, Korea, Japan and ASEAN countries. The largest import value is the integrated circuits (HS code:8542). In 2017, the import value of code 8542 was 21.05 billion USD, a growth of up to 57.78%/year in the period 2011 - 2015 (UN Comtrade, 2019).

Regarding the responsiveness of domestic supporting industry enterprises

Table 4. Supply capacity of the field of manufacturing components and spare parts for Vietnam's electronics industry

Downstream fields	**Domestic supply capacity (%)**		
	Mechanical components	Electrical and electronic components	Plastic - rubber components
Household electronics	50%	30 – 35%	40%
Electronics in informatics and telecommunications	30%	15%	15%
High-tech industry	10%	5%	5%

Source: Ministry of Industry and Trade, 2018

The rate of domestic supply to assemblers is low, usually undertaken by foreign-invested enterprises. Supporting industry products are mainly manufactured by FDI enterprises or imported. Products manufactured by domestic enterprises have low quality and high cost (outdated technology, slow innovation (due to limited resources, poor production process, etc.)

so they can only be sold within within domestic enterprises. Domestic enterprises only supply simple spare parts, their technological content and added value is very low. Supporting industry enterprises at the wish of development must meet 3 factors including stable quality, on-time delivery and reasonable price. Currently, very few Vietnamese enterprises meet all three factors mentioned above. In the immediate period, it is extremely difficult for Vietnamese supporting industry enterprises to play the role of tier 1 suppliers for multinational assembly groups, especially for components and materials with a fairly high technological content. These factors show the weak linkage between the system of domestic supporting industry enterprise and FDI enterprises, enterprises in the main electronics manufacturing industry, which makes the supporting industry difficult to develop strongly in recent years.

4.2. Impacts of factors affecting the development of the supporting industry for the electronics industry

Using the GMM model, we can see that the factors affecting the supporting industry for Vietnam's electronics industry clearly show their impacts on the development of the industry. Specifically: positive factors include: TFP, contribution of FDI, market size, development of other related supporting industries and opening level of the market. According to the regression results, the total productivity of factors (representing the quality of human resources, technological innovation and production process innovation, etc.); the participation of FDI enterprises have positive impacts on the increase in revenue of the electronic component manufacturing industry, these factors are statistically significant. Besides, the market size (shown by the increase in total revenue of Vietnam's supporting industry) also has a positive meaning in promoting the development of the supporting industry for the domestic electronics industry. The linking factor in the manufacturing of the electronics industry which is expressed through a variable reflecting the development of other related supporting industries and the development of international trade (expressed through the opening level of the market) also shows a positive meaning to the development of supporting industry for Vietnam's electronics industry.

In contrast, the level of industrial concentration (expressed by the HHI coefficient) has a negative impact on the development of the supporting industry for the domestic electronics industry. This shows that the greater the monopoly level of FDI enterprises, the more it inhibits the development of the supporting industry for the domestic electronics industry. Meanwhile, the business environment and policy coefficients are not statistically significant in the GMM model.

Table 5. The GMM model analyzes the impact of factors on the development of the supporting industry for Vietnam's electronics industry in general across the country and by region

	(1)	(2)	(3)	(4)
VARIABLES	Country	Red River Delta	Southeast region	Other
lncapital_Ecomponent	0.9783***	1.0275***	0.9721***	0.8187***
	(0.0094)	(0.0158)	(0.0143)	(0.0260)
ln(K/L)	-0.7469***	-0.7608***	-0.8297***	-0.5441***
	(0.0095)	(0.0169)	(0.0126)	(0.0261)
TFP	0.3619***	0.3554***	0.3520***	0.4238***
	(0.0140)	(0.0239)	(0.0192)	(0.0349)
FDIshare	9.5051***	7.2063***	10.9166***	12.9610***
	(0.7745)	(1.3453)	(1.4511)	(1.2708)
HHI_revenue	-3.9017***	-6.6179***	-0.6110	-5.2517***

	(0.6001)	(1.1276)	(0.7448)	(1.5605)
lnrevenueEI_provin	0.0917***	0.1483***	0.2500***	0.0892***
	(0.0103)	(0.0265)	(0.0421)	(0.0180)
lnreotherSI_prov	0.0588***	0.1171***	-0.2715***	-0.0234
	(0.0080)	(0.0224)	(0.0423)	(0.0198)
PCI	-0.0031	-0.0010	-0.0106*	0.0381***
	(0.0042)	(0.0102)	(0.0057)	(0.0105)
lnOPEN	1.4514***	0.9845**	2.2695***	-0.8653
	(0.2113)	(0.4204)	(0.2712)	(0.6038)
Constant	14.9386***	8.1517*	27.0572***	-7.6820
	(2.0932)	(4.3229)	(2.6829)	(6.0372)
Observations	834	399	324	111
Number of id	342	197	96	49

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Source: Calculation from the enterprise census data set, General Statistics Office

By region, the total productivity of the synthetic factors, the proportion of FDI capital continues positively affecting the development of the supporting industry for the electronics industry in all three regions: the Red River Delta, the Southeast region and remaining regions. The market size is a factor that positively affects the development of the supporting industry for the electronics industry in all regions of the country. Factors related to policy and business environment create positive impacts in other regions, negative impacts in the Southeast region, but are not significant in the Red River Delta.

In the comparison between the Red River Delta and the Southeast region, the difference is in the impact of the HHI coefficient, which has no impact on the development of the supporting industry for the electronics industry in the Southeast region. On the other hand, related supporting industry has a positive impact on the development of the supporting industry for the electronics industry in the Red River Delta but has a negative impact on the Southeast region.

By scope, the total productivity of factors positively affects all enterprises at all scopes. Besides, the role of FDI positively affects medium and large enterprises, but it is not significant for micro and small enterprises, this may be because this group of enterprises has not been able to attract FDI inflows to develop the supporting industry for the electronics industry. Industrial concentration (reflecting the level of monopoly) has a negative effect on the development of the supporting industry for the electronics industry in all groups of enterprises. The proportion of FDI capital has a positive impact on the group of medium and large enterprises, but it is not significant for micro and small enterprises. The market size (including domestic and international markets - expressed through the opening variable of the market) has a positive impact on the development of two groups of enterprises. Besides, the development of other related supporting industries also has a positive impact on promoting the development of two groups of enterprises. Factors related to policies and business environment do not play a role for two groups of enterprises in the supporting industry for the electronics industry.

Table 6. The GMM model analyzes the impact of factors on the development of the supporting industry for Vietnam's electronics industry by scope

	(1)	(2)	(3)
VARIABLES	General	Micro and small enterprises	Medium and large enterprises
lncapital_Ecomponent	0.9783***	0.9504***	0.8818***
	(0.0094)	(0.0184)	(0.0263)
ln(K/L)	-0.7469***	-0.7512***	-0.5134***
	(0.0095)	(0.0176)	(0.0240)
TFP	0.3619***	0.4384***	0.2569***
	(0.0140)	(0.0197)	(0.0209)
FDIshare	9.5051***	-1.3644	6.7044***
	(0.7745)	(2.5458)	(0.7766)
HHI_revenue	-3.9017***	-1.7069*	-5.2947***
	(0.6001)	(0.8971)	(0.7594)
lnrevenueEI_provin	0.0917***	0.0475***	0.1297***
	(0.0103)	(0.0149)	(0.0144)
lnreotherSI_prov	0.0588***	0.1138***	0.0278***
	(0.0080)	(0.0135)	(0.0097)
PCI	-0.0031	-0.0035	0.0033
	(0.0042)	(0.0059)	(0.0056)
lnOPEN	1.4514***	1.4038***	0.6679**
	(0.2113)	(0.3062)	(0.2887)
Constant	14.9386***	14.2035***	7.5183***
	(2.0932)	(3.0367)	(2.8723)
Observations	834	499	335
Number of id	342	241	135

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Source: Calculation from the enterprise census data set, General Statistics Office

V. Conclusion and policy implications

Herefore, it can be seen that market size, quality of human resources, process of technological innovation and organizational innovation are factors positively affecting the development of the supporting industry for Vietnam's electronics industry, the regression coefficients of these factors are statistically significant. In which, the market size includes both domestic and foreign markets (highly affected by the integration process). Next, the proportion of foreign investment capital also positively affects the development of the supporting industry for the electronics industry, however, the level of industrial concentration will negatively affect the development of the supporting industry for Vietnam's electronics industry. In addition, according to the RE model, the provincial competitiveness (expressed through the development of infrastructure, policy systems, information systems, etc.) related activities also have positive impacts on the development of supporting industry for Vietnam's electronics industry. In the context of economic integration taking place more and more deeply, along with adverse impacts from the context such as participation in new generation FTAs, the impact of the COVID-19 pandemic, etc.; the supporting industry for Vietnam's electronics

industry will face many great challenges and have new opportunities. To promote the development of the supporting industry for Vietnam's electronics industry in the current new context, it is necessary to focus on the following solutions:

Firstly, developing domestic and foreign market sizes through the promotion of linkages between supporting industry enterprises, between supporting industry enterprises and FDI enterprises, multinational corporations, etc. It needs to rapidly build a database system of information on the situation of the supporting industry in the country in general, and he electronics industry in particular to meet the information research demands of FDI enterprises, MNCs, TNCs, as well as domestic manufacturing and assembling enterprises in the process of finding partners, learning from the successes and failures of domestic supporting industry manufacturing enterprises. On the other hand, programs of trade promotion and market development of the supporting industry need to be implemented more frequently and diversify forms of organization, timely inform relevant enterprises to attract the participation of more enterprises, thereby new investment and cooperation opportunities will be created.

Secondly, continuing to improve the infrastructure, information system and enhance the efficiency of implementation of supporting and preferential policies for the development of the supporting industry for the electronics industry. Specifically, it is necessary to concretize in guiding circulars; clearly assign responsibilities to each State management agency in receiving and processing applications for support and incentives from supporting industry production enterprises, and publicly and widely announcing the focal points for receiving and handling profiles at the Ministry of Industry and Trade and the provincial Departments of Industry and Trade. On the other hand, it is necessary to supply information on steps taken to receive support and preferential policies for supporting industry enterprises on the official websites of the Ministry of Industry and Trade and local management agencies; provide forms and templates to facilitate enterprises to access and follow; strengthen the enforcement capacity of organizations implementing the policy's issues through capacity enhancementof human resources directly related to policy implementation.

Thirdly, improve the quality of industrial human resources; promoting the process of technological innovation and organizational innovation in supporting industry enterprises for the electronics industry. To gradually improve the quality of human resources for industrial manufacturing in general, and the supporting industry in particular, it is necessary to have policies to attract experts from developed industrial countries, such as Japan, Korea, etc. supporting Vietnam in building the supporting industry, training human resources and guiding access to modern technology. On the other hand, the country also needs to issue mechanisms and policies to improve efficiency in the training and development of domestic industrial human resources to create a core force for the development of the supporting industry, meet the requirements of the supply demands for domestic assemblers and join the global production chain. It is urgent to develop and issue Circulars guiding the details on the order and procedures for receiving technological support, especially enhancing access to funding sources from the National Technology Development Fund, National Technology Innovation Fund, National Technology Innovation Fund, as well as some other supporting capital sources for SMEs to invest in innovation and technology development, quickly apply new and modern technologies for product manufacturing.

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