The Determinants of Vietnam's Information and Communication Technologies Exports to the European Union

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Abstract

Vietnam is one of the top information and communication technologies (ICT) exporters globally, and the ICT products constitute nearly one-fifth of Vietnam's total exports to the European Union (EU). This study empirically investigates the determinants of Vietnam's ICT exports to the EU by applying the gravity model for trade with panel data from 2000 to 2019. Besides the traditional variables of the gravity model, we added gross capital formation, patent application and exchange rates as explanatory variables. The results show that among factors affecting Vietnam's ICT export to the EU, market size, patent applications, and exchange rate are the most significant determinants. The article also suggests some policy implications for the development of ICT exports between the two parties.

JEL Codes: F14, C2

Keywords

ICT exports, export determinants, panel data, Vietnam, the EU

Introduction

Over the past decades, information and communications technology (ICT) has been among the most rapidly growing sectors in world trade. In 2019, the trade

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of ICT products accounted for 11.5% and 12.9% of global merchandise exports and imports, respectively (World Bank, 2021). In Vietnam, the ICT sector has been one of the most important economic and technical industries. In 2019, the industry revenues reached $112.35 billion, and 81.5% of these came from exports. Vietnam's ICT export, which accounted for about 30% of the total national exports and 4% of global ICT exports, was ranked second globally in the production of phones and components and ranked tenth in manufacturing electronics and components in 2019 (Ministry of Information and Communication of Vietnam, 2020). Thus, the literature of international trade studies shows the great attention of many researchers on the ICT trade. Over time, there have been many economists who contributed to this area, for example, Srholec (2007), Feghali et al. (2007), Braunerhjelm and Thulin (2008), Tebaldi (2011), Chadha (1998), Sandu and Ciocanel (2014) and Nguyen and Pham (2020).

With the EU–Vietnam free trade agreement (EVFTA) coming into effect, bilateral trade has increased continuously. The EU–Vietnam's trade has nearly quadrupled in the past ten years. The EU was Vietnam's second-largest export market in 2019, after the US, with a value of $41.48 billion. Vietnam was the EU's second-largest trading partner in the Association of Southeast Asian Nations (ASEAN) after Singapore, with trade in goods worth €45.5 billion in 2019. The EU was one of the largest foreign investors in Vietnam, with a total foreign direct investment (FDI) stock of €7.4 billion in 2018. (European Commission Press, 2020).

There has also been a dramatic increase in manufacturing trade between Vietnam and the EU since the 2000s. Vietnam mainly exports telecommunications equipment, clothing and food products to the EU. The EU exports machinery and transport equipment, chemicals and agricultural products to Vietnam. The ICT constitutes nearly 20% of Vietnam's total exports to the EU among manufacturing exported products.

Although Vietnam is one of the top ICT exporters globally, there have been limited studies in its ICT sector, especially ICT trade. Typical studies in this area, such as Wang et al. (2019), Duc and Linh (2018), Sturgeon and Zylberberg (2017), Vu (2017) and so on, provide an overall assessment of the ICT industry in terms of the efficiency, development policy and contribution the Vietnamese economy. As far as we know, there is no study on ICT export determinants. Therefore, to complement these limitations, this study analyses the development and determinants of Vietnam's ICT exports to the EU for the 2000–2019 periods.

The article is structured as follows. The second section reviews the literature on ICT's export and its determinants. The third section provides an analysis of Vietnam's ICT exports to the EU. The fourth section concludes the article.

Literature Review and Research Methods

Literature Review

The standard theory for analysing and explaining international trade specialisation models are the Heckscher–Ohlin and Ricardian trade models, which

constitute comparative advantage trade theory. In ICT, R&D (knowledge capital) and human capital (skilled labour) are the key determinants of comparative advantage (Vogiatzoglou, 2009). The R&D activities arise from capital accumulation, invention, innovation, efficient use of resources and so on, thus, raises demand in domestic markets and increases exports. Moreover, R&D expenditures positively affect patent applications which leads to the increase in high-tech exports (Türedi, 2016).

Factor conditions, human, physical information, capital resources, quality and usability of the infrastructure allow the competition to be realised. The creation of advanced technology factors (highly skilled human resources, research centres and communication infrastructure) is critical in creating and developing a competitive advantage in technology-intensive sectors. Therefore, the higher the number of scientists and engineers involved in a country's R&D, the higher the high technology exports (Seyoum, 2004).

FDI is the key driver of host countries' exports, with direct and indirect effects. The direct effects refer to exports by foreign affiliates themselves, while the indirect effect includes the spillover effect of Multinational corporations (MNCs) on local firms' export activities (Chandra, 2002). The spillover effect creates technology transfers that host countries cannot achieve on their own. By using this transferred technology, these countries can increase the high technology exports (Zhang, 2005). In the case of Vietnam, it is found that FDI is a significant variable that increases exports with a one-year time gap (Bhatt, 2013). Based on an econometric specification, Li and Shi (2013) investigate the determinants of China's exports of ICT goods in terms of export quantity and quality. They find that China's ICT export growth is mainly due to manufacturing a high quantity of low quality. They further find that FDI, processing trade and government supporting policies drive China's ICT exports volume and pattern.

Regarding electronics, a component of ICT goods, Vogiatzoglou (2012) investigates the importance and effect of vertical specialisation on electronics exports of a country. His study is based on panel-econometric cross-country analysis covering 28 developed and developing countries between 2000 and 2008. His main finding is that a country's degree of vertical specialisation has a significant and positive impact on its electronics exports. Therefore, he suggests that fragmentation should be accounted for in any research on determinants of electronics exports. Kabaklarli et al. (2017) examine the determinants of high-technology exports, including ICT products, in selected OECD economies for the 1989–2015 period, using a panel data approach. Their main findings are that FDI and patent applications have a strong positive effect on high-tech exports, while there is no evidence of GDP growth affecting high-tech export growth. Vogiatzoglou (2009) employs a panel-econometric analysis to examine the drivers of ICT export specialisation. He finds that research-development expenditure and human capital serve as significant determinants. However, international market access and agglomeration economies have been found to be more important drivers. Research-development expenditure and human resources have also been the main causal drives for high tech export in EU countries by Sandu and Ciocanel (2014).

In the context of the EVFTA, the impact of this agreement on Vietnam's trade is shown in several studies. For example, Maliszewska et al. (2020) use

a global dynamic computable general equilibrium model to estimate the impact. They indicate that the full implementation of this agreement would expand Vietnam's exports by 12%. Baker and Vanzetti (2019) examine the effect of EVFTA on the United Kingdom economy. Regarding the bilateral trade with Vietnam, their results indicate that UK's exports to Vietnam and its imports from Vietnam would rise by 60% and 33%, respectively, by 2030. At sectoral levels, Kikuchi et al. (2018) employ a static global CGE model to evaluate the economic impacts of different mega-regional trade agreements on Vietnam. The sectoral impact shows that Vietnam's exports of light manufactures, especially leather products, motor vehicles, transport equipment and electronics, expand following this agreement. Le et al. (2020) apply single market partial equilibrium simulation tool (SMART) to assess the potential impact of EVFTA on the imports of the automobile in Vietnam. They find that as a result of this agreement, export turnovers of the automobile from European nations to Vietnam would increase, with Germany having the largest export turnovers, followed by Sweden, Italy and Slovakia. They also find that countries outside the European Union would experience a negative growth of automobile exports to Vietnam following the agreement. Hoang et al. (2019) quantify the determinants of Vietnam's potential exports of agricultural commodities to the EU employing a stochastic frontier analysis and a system GMM. They find that financial market development, trade freedom, technological readiness and labour freedom positively affects Vietnam's potential exports of agricultural products to the EU.

Research focusing on Vietnam's ICT exports to the EU has not been available yet. In addition, there has not been much research on Vietnam's ICT trade in general. The previous studies provide an overall assessment of the ICT industry regarding the efficiency, development policy and contribution to the Vietnamese economy. Therefore, this study will fill in the gap in the existing literature, thereby suggesting policies to promote Vietnam's ICT exports in the future.

Research Methods

The determinants of Vietnam's ICT exports are examined by applying the augmented version of the traditional gravity model. The model is modified by using Vietnam's ICT export volume as the dependent variable. Along with the classical variables traditionally used in the gravity model (GDP, distance), other variables such as exchange rate, FDI, gross capital formation and patent applications are served as the determinants of ICT's exports in our model. The proposed model has the following form:

$$
\begin{aligned}
\log(\mathrm{ICT}_{ijt}) = {} & \beta_0 + \beta_1 \log(\mathrm{GDP}_{ijt}) + \beta_2 \log(\mathrm{TAR}_{ijt}) \\
& + \beta_3 \log(\mathrm{FDI}_{it}) + \beta_4 \log(\mathrm{EXR}_{ijt}) \\
& + \beta_5 \log(\mathrm{GCF}_{it}) + \beta_6 \log(\mathrm{PAT}_{ijt}) + \varepsilon_{ijt}
\end{aligned}
$$

Where ICT is the volume of ICT exports between country i (Vietnam) and its trading partners j (the members of EU) at time t (2000, …,2019); and all independent variables can be described as follows:

- Average GDP (GDP) is the average GDP of Vietnam and the EU members. GDP is used as a measure of economic size in terms of both production and market. Larger economies are more likely to achieve economies of scale, increase their exports based on their comparative advantage and absorb more imports. Therefore, Vietnam's ICT export is expected to be positively correlated with the average GDP.
- Bilateral ICT tariffs (TAR) are the EU's effectively applied rates on Vietnam's ICT exports. Obviously, lower EU tariff barriers will boost Vietnam's ICT exports, (for tariff effects, see more on Khanderia, 2018).
- Gross capital formation (GCF) is a proxy for investment in Vietnam. Capital formations can have a relationship with exports. Theoretically, capital formation can enhance economic growth by increasing capital stock levels and promoting domestic technology. This would result in the expansion of exports and higher economic growth (Albiman & Suleiman, 2016). Therefore, a positive association between GFC and export would be expected.
- FDI is the net inflow of Vietnam FDI in terms of percentage of GDP. FDI will promote exports of the host countries by increasing productivity and productive capacity, transferring technology, managerial skills and upgrading the local workforce's skills through training. The impact of FDI is evident, primarily in technology-intensive exports (Chandra, 2002). Thus, FDI's coefficient is expected to be positive.
- Exchange rate (EXR) is The Nominal Exchange Rate between respective countries. The rate of currency exchange, which acts as a proxy for price and a set of conditional variables, can either facilitate or restrict trade between pairs of countries. An increase in the exchange rate means that there is devaluation in Vietnam's currency devalued. Exports would be cheaper as a result. Therefore, the exchange rate variable is expected to affect trade between Vietnam and the EU positively.
- Patent applications (PAT) are the total patent applications of Vietnam, including residents and non-residents. Patent applications are the result of joint R&D activities between different MNCs subsidiaries or firms. Patent applicants contribute to the increase in high-tech exports (Brunel & Zylkin, 2019).

The EU is a single market in terms of trade (one customs clearance and customs duties point), and according to Eurostat (2020), most of the imports to the EU are handled in three main ports in EU (Rotterdam, 69%; Antwerp, 51%; and Hamburg, 61%). Other studies on the EU trade also used distance variables, measured between the original centre of the Eurozone and its partners (e.g., Marku, 2014). Therefore, we do not include the distance variable, as a proxy for transportation cost in international trade, in the model because it does not change over time.

The data set contains annual and bilateral flows between Vietnam and members of the EU. Description of explanatory variables and expected signs are summarised in table 1.

Table 1. Variable Descriptions, Expected Sign and Data Sources.

Variable Name	Variable Description	Expected Sign	Data Sources
GDP	Average GDP (in current USD) of Vietnam and the EU members.	+	World Bank data
EXR	The nominal exchange rate between Vietnam and the EU members	+	World Bank data
TAR	The EU's effective tariff rate on Vietnam's ICT export	−	TRAIN
FDI	Vietnam's FDI net inflows (% of GDP)	+	World Bank data
GFC	Gross capital formation (GCF, % of GDP) of Vietnam	+	World Bank data
PAT	Patent applications (residents and non-residents) of Vietnam	+	World Bank data

Source: The authors.

Development and Determinants of Vietnam's ICT Exports to the EU

Development of Vietnam's ICT Exports

Over the past 10 years, Vietnam has been one of the world's leading countries in ICT production. Vietnam's ICT exports account for about 30% of the total national export value and 4% of global ICT exports, and the ICT products constitute nearly 20% of Vietnam's total exports to the EU. As shown in Figure 1, the volume of Vietnam's ICT exports to the EU rose dramatically from $41,320 million in 2000 to $22,408 million in 2019. The annual average rate of about 35% during this period.

Figure 2 shows the volume and compound annual growth rate (CAGR) of Vietnam's ICT exports to the EU for the 2000–2019 periods. As can be seen from figure 1, the four largest importers were the Slovak Republic ($4.184 million), Germany ($3.502 million), the Netherlands ($3.393 million) and the United Kingdom ($2.466 million). Regarding CAGR, exports to Latvia exhibit the highest rate (84.3%), followed by Slovak Republic (66.1%), Malta (63.7%) and Romani (62.4%). This figure indicates that Vietnam's export to the Slovak Republic is significant in both the growth rate and the volume.

In general, about a third of the EU members have an ICT's import volume of more than $1 billion from Vietnam, and also about one-third of them have an import volume of between $100 million and less than 1 billion USD. It can be said
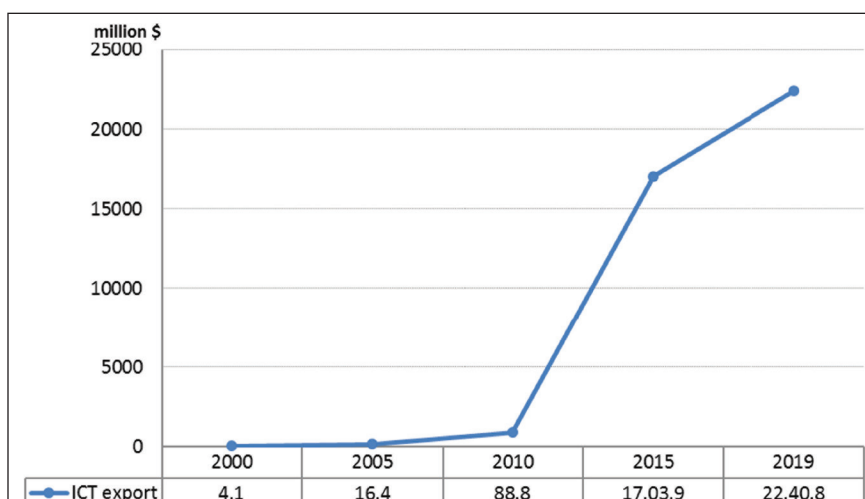
Figure 1. Vietnam's ICT exports to EU: 2000–2019.

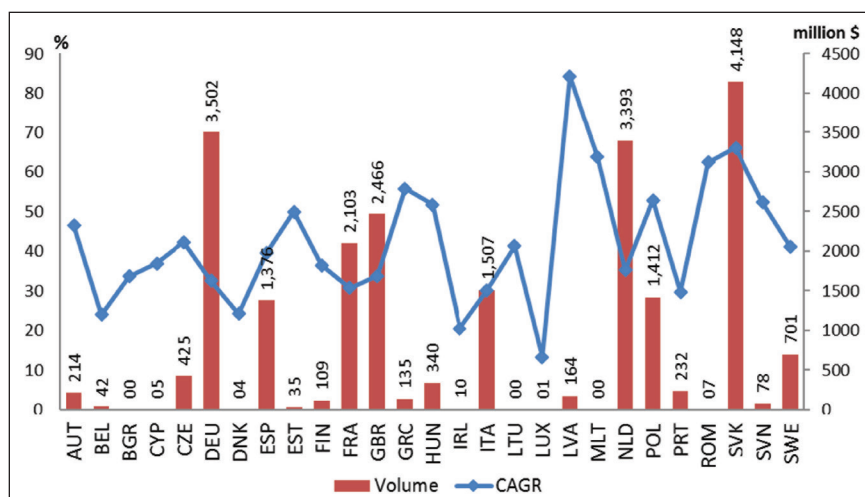**Source:** Calculated from UN Comtrade data.

Figure 2. Volume and Compound Annual Growth Rate (CAGR) of Vietnam's ICT Exports to the EU 2000–2019.

Source: Calculated from UN Comtrade data.

that the European Union is an important market for Vietnam's exports in general and ICT goods in particular.

Regarding the structure of Vietnamese ICT products exported to the EU, Figures 3a and 3b show that communication equipment products have the largest increase in proportion, from about 55% to 69% of the total exported ICT goods in the 2010–2019 period. The second-largest increase in share was electronic
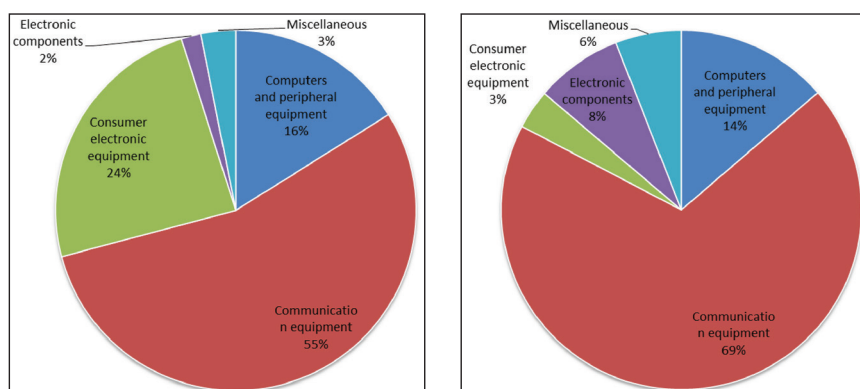
Figure 3a. Proportions of ICT Exports in 2010. **Figure 3b.** Proportions of ICT Exports in 2019.

Source: Calculated from UN Comtrade data.

components, from 2% to 8% of total ICT exports during this period. In contrast, consumer electronic equipment products fell sharply in percentage terms, from 24% to 3% of total ICT exports. Thus, Vietnam's ICT industry has undergone a significant change in the production structure, from final product assembly to manufacturing ICT intermediate products and consumer electronics to technology equipment. This result is thanks to many large MNCs having invested in production lines in Vietnam.

Determinants of Vietnam's ICT Exports

The influence of specific determinants on Vietnam's exports to the EU in 2000–2019 is estimated based on a panel framework. In panel data, pooled ordinary least squares (OLS), fixed-effects (FE) and random-effects (RE) are three main estimators which alternatively used in this type of study. In order to choose an appropriate model for our research, the redundant likelihood ratio and Hausman test are carried out. The results show that FE is the suitable model in both tests (Table 2). Therefore, the result interpretation focuses on the FE model.

The estimated results of the proposed model are presented in Table 3. In general, the models are significant in terms of explanatory power, with the adjusted *R*-squared above 0.65. Most of the explanatory variables used in the models are statistically significant at the 10% level or better, indicating that explanatory variables effectively explain Vietnam's ICT exports to the EU.

The estimation results in Table 3 show that the coefficient of the average size of the two economies has the expected sign and is statistically significant in both pooled and RE models but non-significant in the FE model. This could be explained that the average economic size of each EU member with Vietnam has no fixed impact on Vietnam's ICT exports. However, it is statistically significant in pooled and random effect estimates because these models consider all coefficients constant across countries and time.

Table 2. Redundant Fixed Effects and Hausman Test Results.

Redundant Fixed Effects Tests			
Effects Test	Statistic	*df*	Prob.
Cross-section *F*	18.134917	(26,507)	0.0000
Cross-section Chi-square	355.059604	26	0.0000
Random Effects-Hausman Test			
	Chi-Sq. Statistic	Chi-Sq. *df*	Prob.
Cross-section random	0.000000	6	1.0000
Period random	0.000000	2	1.0000
Cross-section and period random	33.089605	2	0.0000

Source: The authors.

Table 3. Regression Results.

Explanatory Variable	Pooled OLS	FEM	REM
AGDP	2.289***	0.586[ns]	1.604***
EXR	−0.318***	0.442***	0.258**
FDI	−0.664[ns]	−0.662[ns]	−0.696[ns]
GCF	−5.354***	−4.300***	−4.815***
PAT	2.708**	3.774***	3.063***
TAR	−0.207[ns]	−0.306**	−0.235[ns]
Adjusted *R*-squared	0.65	0.82	0.65
Observations	540	540	540

Source: The authors.
Notes: ns = Not significant.
*** and ** mean significant at 1% and 5% level, respectively.

Other explanatory variables such as exchange rate, PAT and TAR all carry the expected signs and significantly impact Vietnam's ICT exports to the EU. Especially, the patent application has a large magnitude of effect (3,774) and is significant at 1%. This means that the number of patents registered in Vietnam (residents and non-residents) contributes to increased high-tech exports. The result is consistent because the number of PAT in Vietnam increased more than five times in 2000–2019. For exchange rate and tariffs, the effects of these two variables are moderate (0.442 and 0.306) and consistent with the trade theory background. The impact of GCF on ICT exports is tremendous (4.3) but has a negative sign. is consistent with Vietnam's actual GCF data during the studied period and the literature on the relationship between GCF and other macroeconomic variables (Rani & Kumar, 2019).

An interesting point in this result is the effect of FDI. As explained above, increased FDI in a country will create effects such as technology transfer, an expansion in production exports and labour productivity improvement. Thus, it

will increase exports in general and exports of high-tech products in particular. However, FDI in all three models is not statistically significant. It would be due to the ICT manufacturing export being mainly based on components import; the sector neither could make any technological progress nor could manufacture products for import substitution (Duc & Linh, 2018). Although not as expected, this result is consistent with studies on FDI and ICT (Sinha & Sengupta, 2019).

Conclusion

This article has provided an empirical analysis of the factors affecting Vietnam's ICT exports to the EU using the panel data approach. The results show that Vietnam's ICT exports to the EU are affected by the exchange rate, gross capital formation, patent applications and bilateral tariffs. Among the factors, exchange rate and patent application have a significant positive impact, while the bilateral tariffs have a considerable negative impact on Vietnam's ICT exports to the EU. This finding implies that macroeconomic policies should focus on innovation such as patent applications and the attraction of R&D-intensive FDI to boost ICT exports. Regarding FDI policy, more incentives should be granted to foreign firms using domestic supply, investing in R&D activities and ensuring that domestic firms and foreign firms in the industry receive equal preferential treatment. Implementing the EVFTA will eliminate tariffs, thus benefit key export industries, including the ICT products, to the EU. The FTA also facilitates the expansion of the industry, both in terms of capital and increasing employment. The adjustment of exchange rates is a suitable measure to promote the ICT export to the EU in the future.

This study has the following limitations: (a) the article may not include all possible factors affecting Vietnam's ICT exports to the EU due to the limited data available and (b) estimation techniques cannot be considered all in this study. Therefore, it is worth considering all of the above in any future study.

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