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Yükselen Sanayi Ekonomilerinde Bilgi ve İletişim Teknolojileri Ürünleri İhracatının Belirleyici Faktörleri

Factors Driving the Export of Information and Communications Technology Products in Emerging Industrial Economies

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ÖZET

Bu çalışma, 30 yükselen sanayi ekonomisinin (YSE) 2000-2014 dönemini kapsayan 15-yıllık panel veri setlerini kullanarak, bilgi ve iletişim teknolojileri (BİT) sektörlerindeki ihracat performansının belirleyicilerine ilişkin yeni bulgular ortaya koymaktadır. İhracat performansı BİT ürünleri ihracatının toplam ihracat içindeki payı ile temsil edilirken, ihracat performansını etkilemesi beklenen faktörler ise BİT ürünleri ithalatı (öğrenme etkisi), ihracatta ürün yoğunlaşma endeksi (uzmanlaşma etkisi), yurtiçindeki doğrudan yabancı sermaye yatırımları stoku (dışsal teknoloji transferi ve yayılma etkisi), tüketici fiyat endeksi (istikrar etkisi), kişi başına reel gayrisafi yurtiçi hasıla (gelir etkisi), reel döviz kuru (ticaret hadleri etkisi) ve araştırma ve geliştirme harcamaları (içsel yenilik etkisi) olarak belirlenmiştir. Çalışmanın ampirik kısmında, dengesiz panel veri yapısı altında sırasıyla yatay-kesit sabit etkiler en küçük kareler yöntemi ve içsellik durumunu kontrol etmek için, sistem genelleştirilmiş momentler metodu tahmin prosedürleri izlenmiştir. Ulaşılan sonuçlar, genel olarak, teorik beklentiler ve önceki çalışmaların sonuçları ile uyumludur: BİT ürünleri ithalatı ve doğrudan yabancı sermaye stoku ile araştırma ve geliştirme harcamaları değişkenlerinin BİT sektörlerindeki ihracat performansı ile pozitif ilişkili, ancak ürün yoğunlaşmasının, fiyat düzeyinin ve reel efektif döviz kurunun negatif etkilerinin olduğunu ortaya koymaktadır. Ayrıca, gelir etkisinin istatistiki olarak anlamsız olması, bilgi ve yenilik yoğun BİT ürünlerinin yüksek gelirli ülkelerde üretileceği ve onlar tarafından ihraç edileceğini savunan statik karşılaştırmalı üstünlüklere dayalı yaklaşımları destekler gibi gürünse de geleneksel yakınsama ve yetişme hipotezlerine uymamaktadır. Genel bulgular, diğer taraftan, sürekli değişen ticaret yapılarını açıklamaya yönelik potansiyel yeni ticaret teorilerinin önemini ve gerekliliğini ortaya koymaktadır.

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ABSTRACT

This paper provides new evidence for the determinants of the export performance in the information and communications technology (ICT) sectors using a panel dataset of 30 emerging industrial economies (EIEs) for a 15-year period spanning from 2000 to 2014. The export performance is proxied by the export share of the ICT products in total export while its potential determinants are the imports of the ICT products (learning effect), index of product concentration in export (specialization effect), inward foreign direct investment stock (exogenous technology transfer and diffusion effects), consumer price index (stability effect), real gross domestic product per capita (income effect), real effective exchange rate (terms of trade effect) and research and development expenditures (indigenous innovation effect). In the empirical part, cross-section fixed effects least square and, in order to control for endogeneity concern, system generalized method of moments techniques are carried out respectively in an unbalanced panel data framework. In general, the results are consistent with the theoretical expectations and evidence of previous studies. Imports of the ICT products, inward foreign direct investment stock and research and development expenditures are positively associated with the export performance in ICT sectors while the product concentration, price level and real effective exchange rates have negative impacts. Furthermore, even the positive impact of GDP per capita is not statistically significant, it might be seen as supporting the predictions, suggesting that knowledge and innovation intensive ICT products are made in and exported by high-income countries, thereby opposing the conventional wisdom of convergence and catch-up hypotheses. On the other hand, the overall results underscore the importance and necessity of the potential of new trade theories for explaining the ever-changing trade pattern.

INTRODUCTION

Given the ample existing evidence emphasizing that what countries export matters for their overall productivity levels and consequently for their growth performances (Hausmann *et al*., 2007), examining the contents of countries' export baskets has become one of the main interests in the foreign trade literature. As a result, there has come to be an ongoing debate in the literature about the effects of quality components of countries' exports on their economic growth. Findings, in general, support the view that, as the skill and technology content of the exports increase, their contributions to gross domestic product (GDP) per capita increases, both in developing countries (Basu and Das, 2011) and in industrialized countries (Falk, 2009).

When the two tracks of this literature are surveyed, it is seen that one strand of related studies examines the contribution of export upgrading to various economic activities, while the other strand explores the determinants of export upgrading. The increasing share of high-technology (high-tech) exports in many countries has attracted a substantial attention of scholars to assess empirically the determinants of the high-tech content of export. One specific product group that scholars have been interested in is the information and communications technology (ICT) products produced in knowledge-based sectors of innovation-driven economies (WEF, 2015). This interest has stemmed from the stylized facts that the ICT goods production may contribute substantially to economic performance characterized by very high rates of output and productivity growth led by technological progress. This contribution can come directly through its value-added to output, employment, or productivity growth, or indirectly through technological progress impacting other parts of the overall economy (OECD, 2000: 23-35; OECD, 2011:60).

In the related literature, export upgrading is usually proxied by export sophistication and export diversification (*e.g*. Iwamoto *et al*., 2012; Zhu and Fu, 2013), high-tech export (Tebaldi, 2011), export specialization in ICT products (*e.g*. Vogiatzoglou, 2009) and product quality (*e.g*. Henn *et al*., 2013) together with several derivations of these indicators. This gradual progress made along this path towards higher technology can be termed the export ladder, as first proposed by Pearson (1994) who associated countries' export sophistication process from labor-intensive, capital-intensive, to technology-intensive products with climbing up from lower to middle, and upper rungs on the ladder, respectively. Today, no doubt, we can include new rungs as knowledge- and innovation-intensive rungs on the so-called export ladder.

Included among the main determinants of ICT export performance are often proxies for human and physical capital stocks, research and development (R&D) expenditures, foreign direct investment (FDI), trade of ICT goods, trade promotion, macroeconomic stability/volatility, institutional quality, capital formation, income, exchange rates, and savings rates (Hausmann *et al*., 2007; Tebaldi, 2011; Zhu and Fu, 2013; Amighini and Sanfilippo, 2014; Gnangnon and Roberts, 2015).

In this study, we measure the export upgrading of a country in terms of its ability to export ICT products and investigate the potential determinants of the export upgrading in a panel of 30 emerging industrial economies (EIEs) for the 15-year period from 2000 to 2014. The EIEs included in the sample are *Argentina, Belarus, Brazil, Brunei Darussalam, Bulgaria, Chile, China, Colombia, Costa Rica, Croatia, Cyprus, Greece, India, Indonesia, Kazakhstan, Latvia, Macedonia, Mauritius, Mexico, Oman, Poland, Romania, Saudi Arabia, South Africa, Thailand, Tunisia, Turkey, Ukraine, Uruguay,* and *Venezuela*. Even though Suriname and Serbia belong to the EIEs group in UNIDO's (2014: 44-45) classification we utilized, they were excluded from the study sample in the analysis section because of the lack of data for some relevant variables for these two countries.

The rest of the paper is organized as follows. Section 1 presents the conceptual framework and the sectoral/country sample characteristics of ICT products together with the global trends. Section 2 describes the determinants of export upgrading and provides some previous empirical evidence. Section 3 introduces the model and data. Section 4 presents the results followed by our conclusion.

1. Conceptual Framework and Global Trends

During the global economic crises pervaded in the late-2000s, many developing countries faced a steady decline in their export revenues due to the over-dependence on international trade in their GDP components. Nevertheless, some developing countries such as China, India, Brazil, and others could speed up the recovery process by diversifying their exports baskets and could stabilize the growths in export sectors and subsequently in overall output (Basu and Das, 2011). Most of those countries with faster recovery are emerging industrial economies/countries (EIEs) grouped by United Nations Industrial Development Organization (UNIDO, 2014: 41-59) for their considerable improvement in industrialization paths measured by the manufacturing value-added per capita. The adding value performances of the EIEs in manufacturing are relatively higher than those of other developing countries but lower than those of industrialized countries. The EIEs have characteristics similar to those of both developed and developing countries and thus, we investigate these countries since they have lessons from industrialized countries to followers/laggards, *i.e.* developing countries.

The ability of developing countries to shift from low-quality to high-quality products is seen insufficient but necessary condition for export success and, ultimately, economic development (Khandelwal, 2010). In addition, export upgrading and export diversification are seen the key pillars to decrease the fragility of the countries to the sector-specific shocks (Krishna and Levchenko, 2013). In fact, export diversification is more meaningful when the diversification occurs towards the knowledge and innovation that matter for international competitiveness in high-tech products (Grossman and Helpman, 2001). Consequently, rather than restricting the inference to just prices and quantities, as typically the case, the quality-based export upgrade is about a diversification of the export basket towards the uppoer rungs of the export quality ladder (Khandelwal, 2010).

Defining the ICT products is not that easy because their productions take place in many industries either as principal or secondary output. Therefore, it is not possible to use industry statistics directly to get a complete measure of ICT production (OECD, 2011: 58). Nevertheless, more surely ICT sectors make office machines, data processing machines, telecommunication, and advance electrical machinery. Following the OECD's (2000: 23-25, 250) definition, ICT sectors can be classified as in Table 1.

Table 1: ICT Product Sectors: Standard International Trade Classification (SITC) Revision 3 (3-digits)

75	Office machines and automatic data processing machines	
	751	*Office machines*
	752	*Automatic data processing machines*
	759	*Parts, accessories for machines of groups 751 and 752*
76	Telecommunication and sound recording apparatus	
	761	*Television receivers, whether or not combined*
	762	*Radio-broadcast receivers, whether or not combined*
	763	*Sound recorders or reproducers*
	764	*Telecommunication equipment and parts*
77	Electrical machinery, apparatus, and appliances	
	771	*Electric power machinery, and parts thereof*
	772	*Apparatus for electrical circuits; board, panels*
	773	*Equipment for distributing electricity.*
	774	*Electro-diagnostic apparatus for medical sciences, etc.*
	775	*Household type equipment, electrical or not.*
	776	*Cathode valves and tubes*
	778	*Electrical machinery and apparatus.*

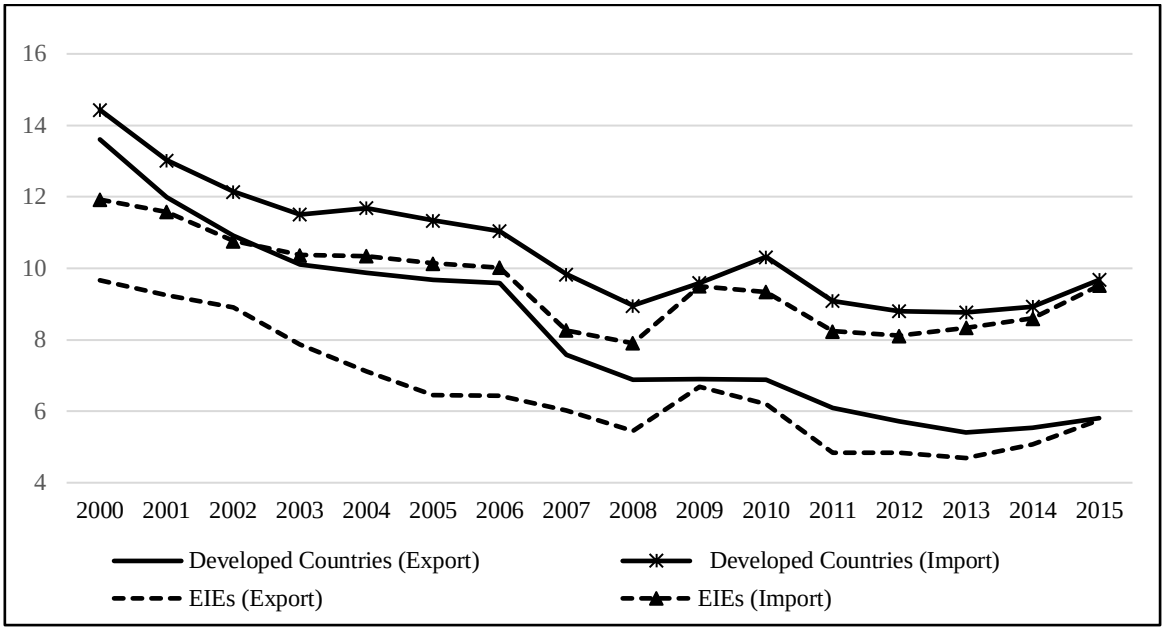
Source: OECD, 2000: 23-25, 250

Why ICT export is so important is because of its spillover effects on the other sectors. If an economy increases its capability to produce ICT, it can also increase net and real trade gains. This suggestion has been long argued that not only but one of the most important factors improving the trade balance in developing countries is to upgrade their export. The technology

in this sector also disperses over the whole economy that eventually increases the overall productivity and growth rate. This is seen very important for the especially EIEs that have seemingly increased their export but at the expense of using highly import contents.

Figure 1 depicts the global trade pattern of the ICT products for the 2000-2015 period. As seen in the figure, developed countries' ICT export share in their total merchandise exports has rapidly decreased over time with a sharp decline in 2007-2009 global crisis period, whereas the decline of their ICT import share in total merchandise imports stopped in the post-crises period. A similar pattern exists for EIEs. Moreover, the figure illustrates a convergence process between developed countries and EIEs. This can be stemming from the fact that the ICT products are made of the complex participation of many sectors either in domestic or international industries. Therefore, this study is also to provide dynamics of international interdependence in ICT sectors.

Figure 1: Shares of ICT Products Trade in Total Merchandise Trade, %



Source: UNCTAD, 2017

Looked closer at the current trade performances of leading EIEs in ICT products shown in Table 2, China's dramatic dominance in the world market seem to be supporting the suggestion that China's export rise has crowded out the other countries in the ICT markets. However, when the export values are corrected by the country size in terms of population, Poland's and Mexico's performances become better than those of China.

Table 2: Trade Performances of Selected EIEs in ICT Products (SITC, Rev.3), 2015

	Brazil	***Poland***	***India***	***China***	***South Africa***	***Mexico***	***Turkey***
Sectors Indicators	*75- Office Machines and Automatic Data Processing Machines 76- Telecommunication and Sound Recording Apparatus*						
Exports, million USD	648	14 223	1 871	478 695	903	58 986	2 066
Share in national exports	0.01	0.07	0.00	0.20	0.01	0.15	0.01
Share in national imports	0.06	0.07	0.07	0.03	0.08	0.11	0.05
Relative trade balance	-0.88	0.00	-0.87	0.76	-0.75	0.14	-0.67
Export per capita, USD	3.1 (88)	374.3 (42)	1.4 (104)	349.1 (44)	16.4 (65)	464.4 (34)	26.3 (63)

Share in world market, %	0.06 (46)	1.27 (15)	0.17 (31)	42.65 (1)	0.08 (39)	5.25 (4)	0.18 (34)
	77-Electrical Machinery, Apparatus, and Appliances						
Exports, million USD	2 128	15 173	5 978	293 551	1 196	42 801	8 515
Share in national exports	0.01	0.07	0.02	0.12	0.01	0.11	0.05
Share in national imports	0.06	0.07	0.03	0.17	0.04	0.13	0.04
Relative trade balance	-0.69	0.04	-0.39	0.00	-0.49	-0.09	0.00
Export per capita, USD	10.2 (96)	399.3 (36)	4.6 (123)	214.1 (57)	21.8 (92)	337.0 (35)	108.2 (68)
Share in world market, %	0.16 (23)	1.13 (19)	0.45 (21)	21.90 (1)	0.09 (41)	3.19 (8)	0.64 (31)

Note*:* USD refers to United States dollar. The numbers (in parentheses) show countries' ranks out of 126 and 138 exporting countries in 75-76 and 77 coded sectors, respectively. For SITC (Rev.3) sector codes see Table 1.
Source: Authors' computations from ITC (2017).

While examining the cross-country competitiveness in foreign trade, one of the traditional indicators is the index of comparative advantages. In this context, Balassa index (Balassa, 1965) is the commonly used in the literature to measure a country's Revealed Comparative Advantage (RCA) in a specific sector. In our case, Balassa's (1965) RCA index is calculated as country industry shares of country total exports of ICT products divided by world industry shares of world total exports of ICT sectors.

$$RCA_{ij} = \frac{x_{ij} / X_{it}}{x_{wj} / X_{wt}} \qquad (1)$$

Where x_{ij} and x_{wj} are the values of country *i*'s and world's exports of *j* ICT products respectively while X_{it} and X_{wt} respectively refer to the country *i*'s total exports and world total exports in all sectors. In table 3, RCA indices higher (lower) than 1 reveals a comparative advantage (disadvantage) and values around 1 refer to higher global competition in the relevant ICT sectors in the world market. Figures in the table reveal that China and Mexico seem to have comparative advantages and progress over time where other countries have disadvantage in the ICT sectors. Poland seem to have been dealing with a severe competition in its information- and innovation-led quality path of export.

Table 3: Revealed Comparative Advantage Indices of EIEs in ICT Sectors, 2000-2014, Selected Years

	2000	**2002**	**2004**	**2006**	**2008**	**2010**	**2012**	**2014**
Brazil	0.22	0.25	0.27	0.27	0.20	0.31	0.37	0.39
Poland	0.78	0.82	0.74	0.91	0.71	0.88	0.89	0.93
India	0.25	0.42	0.55	0.73	0.57	0.58	0.65	0.73
China	0.14	0.97	***1.77***	***2.50***	***2.16***	***2.74***	***2.45***	***2.81***
South Africa	0.04	0.07	0.10	0.10	0.12	0.10	0.09	0.13
Mexico	0.34	0.61	***1.08***	***1.92***	***1.24***	***1.22***	***1.27***	***1.41***
Turkey	0.32	0.58	0.60	0.66	0.64	0.68	0.67	0.60

Note: For CIT sectors (SITC, Rev.3 codes 75-76, 77) see Table 1.
Source: Authors' calculations from UN-COMTRADE (2017).

2. Determinants of Export in ICT Sectors: Previous Evidence

There are several characteristics of ICT sectors that embody specific factors affecting the quality ladder of export. Importing ICT products enables local producers to know how these products are produced that is related to the imitation and learn-by-doing effects. This prediction, in fact, dates back to Posner's (1961) technological gap theory that underlines a gradual decline of the technological superiority of the developed countries that first invent new products and/or improve their production technologies. These industrialized and innovative countries, later, tend to lose the comparative cost advantages as they start exporting the new products (ICT products in our case) to developing countries those gradually learn how to

produce these products cheaper by imitating over time. This diffusion of innovations formed by both learning and imitation effects, force inventor/innovative countries to upgrade their production and export structures to sustain their technological advantages.

Empirical studies have documented strong negative relationships between product overspecialization (product concentration), especially in natural resource-dependent countries, and export upgrading (Hausmann *et al.*, 2007; Papageorgiou and Spatafora, 2012; Callen *et al.*, 2014). Evidence in the related literature reveals that export upgrading entails export quality improvement and export diversification. Gnangnon and Roberts (2015) indicates that this export diversification can include overall export diversification as well as diversification at the intensive and at the extensive margins.

Numerous studies have focused on the influences of foreign direct investment (FDI). In the extant literature, there is a well-proven evidence that FDIs boost the technology level in host countries by means of technology spillover effects (Girma *et al.*, 2008). In this context, together with the imports of ICT goods, FDIs represent the sources of foreign knowledge that are available to recipient countries (Gnangnon and Roberts, 2015: 18). Besides the overall economy-wide contribution, Gnangnon and Roberts (2015) finds that FDI inflows encourage export upgrading proxied by the indices of overall export quality and overall export concentration in host countries. Their evidence also signifies that the impact of FDI on export diversification is higher in the least developed countries than others. Moreover, using 105 countries' data from 1984 to 2000, Harding and Javorcik (2012), finds a positive effect of FDI on the quality of exports in developing countries and they conclude that there is no indication that FDI increases the similarity of export structure of developing and developed economies.

ICT sectors need the long-term investment trajectories in exporting industries that are strongly related to the macroeconomic stability usually measured by inflation (Harding and Javorcik, 2012). Iwamoto *et al.* (2012) use GDP deflator for controlling economic stability and find that inflation is negatively associated with export diversification and export sophistication that are commonly used to define the export upgrading towards ICT sectors.

One other variable that is commonly used among the main determinants of export upgrading in and towards ICT sectors is income level. Income level is also used to group countries for controlling income effect and development stages in some cases (*e.g.* Zhu and Fu, 2013). Consistently with the fact that the process of technological diffusion is so complex and expensive, many studies find positive impacts of income level measured by GDP per capital as that of Iwamoto *et al.* (2012). More specifically, using a dataset covering 178 countries and hundreds of products over 1962-2010, Henn *et al.* (2013) show that export quality upgrading is particularly rapid during the early stages of development, until a country reaches a GDP per capita of about 10,000 United States dollar (USD). Convergence in export quality continues at a slower pace until GDP per capita reaches 20,000 USD and levels off thereafter. Again, their results also suggest that countries with faster growth in export quality have recorded faster GDP per capita growth as predicted by many studies as well.

In the related literature, a traditional determinant of trade performance is the exchange rate. Exchange rate changes have both direct and indirect impacts that they can alter the terms of trade and upgrade the export components. However, exchange rates volatility and instability-based fluctuations can hinder exporting sectors from investing in quality. Therefore, the exchange rate-export upgrading nexus is still unclear. On the relationship, Gnangnon and Roberts (2015) finds that real effective exchange rate appreciation is associated with lower improvement of export quality, *i.e.* it discourages exporting firms from upgrading their export products.

ICT sectors have complex production structures and need rapid knowledge upgrading that is led by research and development (R&D) investments. Therefore, R&D investment variable is traditionally added in the model of export upgrading and/or ICT export development. Vogiatzoglou's (2009) study investigates the determinants of export specialization in ICT products distinguished between three main groups: computers and office machinery, ii) integrated circuits and electronic components, and telecommunications equipment. Vogiatzoglou's (2009) findings from an analysis of 29 countries' 2000-2006 data suggest that

R&D investment together with human capital defined as comparative advantage factors are among the significant determinants of export specialization (opposite of export upgrading) in ICT products. Again, Zhu and Fu's (2013) study affirms that R&D investments enhance export sophistication, which is also widely used as a proxy for export upgrading and ICT export performance.

3. Model and Data

In this study, we empirically assess the effects of i) imports of ICT products (*ICTPIM*), ii) index of product concentration in export (*PCIEX*), iii) inward foreign direct investment stock (*INFDIS*), iv) consumer price index (*CPI*), v) real GDP per capita (*RGDPPC),* vi) real effective exchange rate (*REER*) and research and development expenditure (*RD*) on the export performance in ICT product sectors (*ICTPEX*). The relationships are modeled theoretically as in the following equation (2).

$$ICTPEX = f(ICTPIM, PCIEX, INFDIS, CPI, RGDPPC, REER, RD) \quad (2)$$

Variables and relevant details are presented in Table 4. Research and development expenditure (*RD)* data are those of the World Bank Group's World Development Indicators (WB WDI, 2017), and the others were obtained from the United Nations Conference on Trade and Development (UNCTAD, 2017). Because of some years with missing values, we have an unbalanced panel data set.

Table 4: Variables and Descriptions

Dependent variable	
log(ICTPEX)	Export performance in the information and communications technology (ICT) products. Exports of ICT products as a percentage of total merchandise exports.
Explanatory variables	
log(ICTPIM)	Imports of information and communications technology (ICT) products as a percentage of total merchandise import.
log(PCIEX)	Index of product concentration in export
log(INFDIS)	Inward foreign direct investment stock as a percentage of total world.
log(CPI)	Consumer price index. 2005=100. All items.
log(RGDPPC)	Real GDP per capita at constant (2005) prices
log(REER)	Real effective exchange rate. Based on consumer price index. At 2005 prices. Trade partner aggregated and period average. Index 2005=100.
log(RD)	Research and development expenditures/investment as a percentage of GDP.

Note: *log* refers to the natural logarithm of the variables.

The theoretical model in equation (2) can be specified in a panel framework as in equation (3):

$$\log(ICTPEX_{it}) = \beta_0 + \beta_1 \log(ICTPIM_{it}) + \beta_2 \log(PCIEX_{it}) + \beta_3 \log(INFDIS_{it}) + \beta_4 (\log CPI_{it}) + \beta_5 \log(RGDPPC_{it}) + \beta_6 \log(REER_{it}) + \beta_7 \log(RD_{it}) + \lambda_i + \mu_t + u_{it} \quad (3)$$

Where, *i* is the country index (*i=1,...,30*), *t* is time index (*2000,...,2014*), u_{it} is a composite error term, λ_i is a country-specific effect, μ_t is a time-specific effect, and β_i (*i=1,...,7*) are the parameters to be estimated. The regression model in equation (3) was estimated following the unbalanced panel data regression analysis procedure. In order to capture the dynamic structure of export upgrading, it is somewhat a necessity to add the lags of some variables since they affect current export upgrading. The variables with expected lagged effect are *ICTPEX* on its own, *ICTPIM, REER*, and *RD*. Consequently, the regression model in equation (3) is modified as in the following equation (4) in a dynamic panel data framework.

$$\log(ICTPEX_{it}) = \beta_0 + \beta_1 \log(ICTPEX_{it-1}) + \beta_2 \log(ICTPIM_{it}) + \beta_3 \log(ICTPIM_{it-1}) + \beta_4 \log(PCIEX_{it}) + \beta_5 \log(INFDIS_{it}) + \beta_6 (\log CPI_{it}) + \beta_7 \log(RGDPPC_{it}) + \beta_8 \log(REER_{it}) + \beta_9 \log(REER_{it-1}) + \beta_{10} \log(RD_{it}) + \beta_{11} \log(RD_{it-1}) + \lambda_i + \mu_t + u_{it} \quad (4)$$

There are possible problems of endogeneity and multicollinearity expected since both the variables and their lags exist in the same model seen in equation (4). Endogeneity means the correlation of the right-hand side regressors and the disturbances, and multicollinearity

problem occurs when two or more explanatory variables in a multiple regression model are highly correlated. These problems imply that least square estimations cannot separately identify the coefficients (Baltagi, 2005). Following Gnangnon and Roberts (2005) and Zhu and Fu (2013), in order to hinder misleading inferences, the model in the equation (4) is re-estimated using the System Generalized Method of Moments (GMM) technique developed and named by Hansen (1982) (see Baltagi, 2005: 135-160, for discussion of GMM with panel data).

ANALYSIS and RESULTS

Descriptive statistics and correlation matrix are presented in Table 5, where there are no strong correlations between variables except that of product concentration index in export (*PCIEX*) and ICT export performance (*ICTPEX*) which is negative, not surprisingly.

Table 5: Descriptive Statistics and Correlation Coefficients

	log(ICTPEX)	*log(ICTPIM)*	*log(PCIEX)*	*log(INFDIS)*	*log(CPI)*	*log(RGDPPC)*	*log(REER)*	*log(RD)*
Mean	0.265	1.918	-1.650	-1.557	4.737	8.624	4.684	-0.615
Median	0.461	1.849	-1.835	-1.391	4.692	8.616	4.643	-0.621
Maximum	3.425	3.261	-0.220	1.464	6.905	10.307	5.836	4.130
Minimum	-7.543	0.535	-2.755	-6.240	3.259	6.322	4.140	-4.140
Std. Dev.	1.912	0.562	0.677	1.481	0.365	0.799	0.189	1.063
N (individual)	439	441	450	448	449	450	418	364
log(ICTPEX)	1							
log(ICTPIM)	0.486	1						
log(PCIEX)	**-0.655**	-0.218	1					
log(INFDIS)	0.277	0.490	-0.300	1				
log(CPI)	-0.204	-0.215	0.094	0.018	1			
log(RGDPPC)	-0.027	-0.116	0.123	-0.065	0.088	1		
log(REER)	-0.214	0.016	0.152	-0.113	0.090	0.053	1	
log(RD)	-0.061	0.052	-0.086	0.203	0.172	-0.124	0.250	1
N (group)	333							

First, the model in equation (3) was estimated through the least squares technique within a panel framework where the appropriate regression model is determined from the pooled, fixed effect and random effect alternatives. We carried out the effects test (*the F-test*), Lagrange multiplier (*LM*) tests (Breusch-Pagan and Honda), and the Hausman test (Baltagi *at al*., 2003; Baltagi, 2005) in order to choose the best-fitting model. After evaluating the statistics of these tests, the cross-section fixed effects model is preferred to the alternatives and the results are reported in Table 6.

Results, in general, are consistent with the theoretical expectations and evidence of previous studies for different country and/or country samples. The positive impacts of imports of ICT products (*ICTPIM),* inward FDI stock (*INFDIS*), and R&D expenditure (*RD*) together underline the importance of learning effects and technology/knowledge diffusion. Given the negative influences of the price level (*CPI*) and real effective exchange rate (*REER*), it is seen that export performance in ICT products (*ICTPEX*) is sensitive to the macroeconomic stability in EIEs. More specifically, the negative impact of *REER* can be explained by the high-dependency of ICT products on the expensive content imported which is negatively affected by the real depreciation of local currencies. However, an undervalued local currency is expected to improve the export in final products. One of the most important factors hindering the export performance in ICT products is over concentration on several products in export. The negative effect of the product concentration index (*PCIEX*) stresses the necessity of product diversification in contrast with the neoclassical theories' specialization suggestions. The income, which ranges around lower and upper middle level for EIEs has no significant impact on ICT products export in our case.

Table 6: Determinants of Export Performance in ICT products: Panel Least Square Estimation

Variable	***Coefficient***	***Standard error***	***Probability (p)***
log(ICTPIM)	1.264	0.141	0.000***
log(PCIEX)	-0.710	0.148	0.000***
log(INFDIS)	0.225	0.070	0.002***
log(CPI)	-0.589	0.108	0.000***
log(RGDPPC)	0.340	0.232	0.144
log(REER)	-0.465	0.162	0.004***
log(RD)	0.443	0.150	0.003***
C	-0.800	1.940	0.680
R^2 0.955 Adjusted R^2: 0.949		F-statistic: 173.237 Prob. (F-statist): 0.000	
Period: 2000-2014; Cross-section: 30; Unbalanced observations: 333			
Tests to Determine the Estimation Model			
F-group (cross-section) fixed effects		76.379***	
F-time fixed effects		1.431	
LM (*Breusch-Pagan*) cross-section random effects		1326.396***	
LM (*Breusch-Pagan*) time random effects		1.101	
LM (*Honda*) cross-section random effects		36.420***	
Hausman's x^2*: Cross-section random effects*		19.398***	
Hausman's x^2*: Time random effects*		24.875***	

Note: ***, ** and * indicate statistical significance at 1%, 5% and 10% levels, respectively.

Finally, the model in equation (4) was estimated using System GMM technique in order to control the estimation for endogeneity and multicollinearity and the results are presented in Table 7. The results are strongly consistent with those of panel least square estimation reported in Table 6. However, the negative effect of *REER* shifted to one lagged time and it remained insignificant in current time.

Table 7: Determinants of Export Performance in ICT products: Panel System GMM Estimation

Variable	*Coefficient*	*Variable*	*Coefficient*
$log(ICTPEX_{t-1})$	2.053*	$log(ICTPIM)$	1.221***
$log(PCIEX)$	-0.753***	$log(ICTPIM_{t-1})$	0.953***
$log(INFDIS)$	0.222***	$log(REER)$	0.157
$log(CPI)$	-0.652***	$log(REER_{t-1})$	-0.102***
$log(RGDPPC)$	0.269	$log(RD)$	0.414***
		$log(RD_{t-1})$	0.307***
Hansen's J-statistic: 2.279		Probability (J-statistic): 0.516	

Notes: ***, ** and * indicate statistical significance at 1%, 5% and 10% levels, respectively. Constant is added to instrument list.

CONCLUSION

In the empirical literature, while one strand has quite intensively examined the contribution of export upgrading to economic activities, the other strand has focused on exploring the determinants of export upgrading with specific interest in the export performance in the information and communications technology (ICT) products. As a contribution to the second strand and improving understanding why export quality varies across countries and over time, this paper aimed to explore potential determinants of technological progress in the composition of export baskets in a sample of 30 emerging industrial economies (EIEs) for the period 2000-2014. In particular, the paper empirically identified the effects of index of product concentration in export, inward foreign direct investment (FDI) stock, consumer price index, real gross domestic product (GDP) per capita, real effective exchange rate and research and development expenditures on the export in the high-tech manufactures consisting of ICT products that are strongly linked to the information economy.

In the empirical part, both panel least squares estimates with fixed effects and, (to control for endogeneity and multicollinearity), system generalized method of moments (GMM) techniques were applied to our unbalanced panel data framework. In general, results are consistent with the theoretical expectations and evidence of previous studies for different country or countries sample. The positive impacts of imports of ICT products, inward FDI stocks and R&D expenditures collectively underscore the importance of learning effects and technology/knowledge diffusion. Given the negative influences of price level and real effective exchange rate, it is seen that ICT export performance is also sensitive to the extent of macroeconomic stability. More specifically, the negative impact of *REER* can be explained by the high-dependency of ICT products on the expensive content imported which is negatively affected by the real depreciation of local currencies. One of the most important factors hindering the export upgrading is overconcentration on several products in export. The negative effect of the product concentration index stresses the necessity of diversification, that is in contrast with the neoclassical theories. Finally, in our case, the income level has no significant impact on ICT export performance in the emerging industrial economies that have been recording significant progress in capital-intensive manufacturing. Moreover, results obtained from the System Generalized Method of Moments technique are strongly consistent with those of panel cross-section fixed effects estimation.

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