Journal of Business, Economics and Finance
Year: 2017 Volume: 6 Issue: 4

INFORMATION COMMUNICATION TECHNOLOGIES EXPORT and ECONOMIC GROWTH RELATIONSHIP: AN ANALYSIS on SELECTED COUNTRIES

DOI: 10.17261/Pressacademia.2017.765
JBEF- V.6-ISS.4-2017(4)-p.328-335

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To cite this document
Kilic, N.O., Acdoyuran, B., Calhan, H. S. (2017). Information communication technologies export and economic growth relationship: an analysis on selected countries. Journal of Business, Economics and Finance (JBEF), V.6, Iss.4, p.328-.335.
Permemant link to this document: http://doi.org/10.17261/Pressacademia.2017.765

ABSTRACT

Purpose- The purpose of this study is to analyze the effects on economic growth of export in the leading countries ICT exports. In this context, the relationship between information communication technology exports and economic growth of 7 selected countries using annual data between 2000-2015 was investigated with the help of panel data analysis.
Methodology- The relationship between information communication technology exports and economic growth of 7 selected countries using annual data between 2000-2015 was investigated with the help of panel data analysis.
Findings- The existence of cross section dependency and the slope coefficients are homogeneous. According to the analysis of causality, there is a bi-directional causality relation from export of information technologies to economic growth.
Conclusion- This result reveals the importance of information and communication technologies' export to support economic growth. As a result of policies to be implemented in this direction, the growing sector can make a significant contribution to growth by creating production and export increases.

Keywords: Information communication technology, export, economic growth, panel data analysis, bootstrap panel unit root test
JEL Codes: 040, 047, 033

1. INTRODUCTION

When prehistorical times are defined, the mines that are processed and used have been a key factor. Throughout the historical process, Humanity's knowledge let the different improvements of technological devices. Every social, economic, cultural, and technological change and transformation occurred on the ground of the previous period. In the meantime, different development levels were observed between different communities. While muscle power was the basis of economic activity in primitive societies, in industrial societies it became capital and labor. In today's society called as the knowledge society, the basis of economic activity is transforming to "information" and information based technologies.

After 1970s, developments on information and communication technologies have started to accelerate, and these developments have pushed the countries to change their political, economic and social structure at an unprecedented pace. Information based technologies caused an increase in the number of views about insufficiency of using only physical capital to develop production conditions by easing the access to information. Many developed countries started to strengthen their economic infrastructure by putting the information based technologies in the center of their economic policy. In the countries adapting quickly to this period of change, the changes in the means of production contributed to diminish the costs of goods and services, improvement in the international competition conditions and to increase welfare. Information and technological development related to this has become almost a precondition to increase countries' economic welfare. In sum, information and information technologies, which makes it easier to access information and enables to integrate information into production process, have become the key factor for not only social and cultural areas but also the economic progress. Lots of countries increased investments on the information and communication

technologies in order to increase their welfare level, and correspondingly such exports have gained importance in their economy. It is claimed that information and communication technologies are a driving force behind countries' economies. According to an OECD study in 2006, the information and communication technology sector is providing added value more than 9% in many OECD countries. At the same time, spreading information and communication technology trade is also contributing to growth in the non-OECD countries. In this context, information and communication technologies export's effects on economic growth are examined in seven selected countries in our study.

2. LITERATURE REVIEW

2.1. Information Society and Information Economy

Humanity has transformed from primitive social order to today's information society thanks to social, political, economic and technological progress. In the structure of today's society called as the knowledge society or information society, relations and organizations of production have changed by integrating the information and communication technologies (ICT) into production process (Bensghir, 1999; Tonta, 1999; Atik and Altıparmak, 2011).

As a notion, information economy constitutes the economic field of globalization. Information economy is named also as "network economy", "new economy" and "knowledge based economy", in other words, it can be defined as an economic structure including all knowledge based and information integrated economic activities (Kevük, 2006). Information economy consists data collecting, processing and converting periods associated with distribution period. Within this framework, the most important characteristic of goods and services is information as a main factor of production (Kevük, 2006, Artan et al., 2014).

Improvements in ICTs have changed the industry structure, given an advantage to firms in competition by decreasing production costs, and have crated different employment opportunities in the market (Bensghir, 1999, Gürdal, 2004; Işık and Kılınç, 2013). In 1960s and especially in 1970s, the information technologies were used for processing and organizing the datum by organizations; in 1980s and 1990s, they provided a competitive advantage for these organizations by decreasing costs and creating new employment opportunities (Ekinci, 2006; Hatipoğlu, 2015).

Existing computer usage from 1950s has accelerated especially in 1980s and 1990s, and its effects can be seen on national economies. 1970s' economic crisis occurred in western world eventuated by the neo liberal policies in the beginnings of 1980s, the expectation of positive effect on employment and growth from multiplier effect of industrial policies based on information technology and investments on information sector has become popular in a lot of countries. Information economy, on one hand, linking up with the USA experience in 1990s and information and communication technologies, on the other hand, with the global competition and rapid technological progresses, express that economies with their institutions and rules has gone into a period of change (Söylemez, 2001; Kevük, 2006).

2.2. The Role of Information and Communication Technologies in Economy

Information has become a strategic source, material and foundation of every activity (Castells, 2008). The emergence and convergence of the information and communication technologies constitute the focus of global socio-economic transformations. Proper use of these technologies can reduce the gap between rich and poor, between strong and outsider (Kabanda, 2011). Improvements in information and communication technologies in recent years have caused a series of structural changes such as; restructuring economy, globalization, increasing in capital flow and information usage (Castells, 2008). Information and communication technologies have played an important role in the process of developing the economic sectors especially in the liberalization period (Farhadi and Ismail, 2011). Increase in the number of information and communication technologies' usage areas has caused a decrease in costs, at the same time it has increased the productivity and efficiency. Moreover, increase of the information and communication technologies usage contributes the network effects such as lower transaction costs, improvement in the knowledge workers' productivity, and speed-up in innovations (Moradi and Kebryaee, 2009; Kevuk, 2006). There exists many research about economic growth's indicators in economic policies. Economists generally try to explain GDP per capita variations among countries. One of the key factor that explains these variations is the information and communication technologies. The changes that are created by global economy which relies on information, investment and usage of information and communication technology have become the explanatory element of countries' productivity, growth in international trade and economy. Information and communication technologies which let information be produced, distributed and used are seen as a tool for economic growth, wealth increase and employment (Castells, 2007; Moradi and Kebryaee, 2009; Santibanez and Castillo, 2011).

Information and Communication Technologies' Effects on Economy

- Reduce transaction costs and thereby improve productivity
- Substitute for other, more expensive means of communicating and transacting such as physical
- Increase choice in the marketplace and provide access otherwise unavailable goods and services

- Widen the geographic scope of potential markets
- Channel knowledge and information of all kinds (Kramer et al., 2007).

Increasing usage of information and communication technologies have created an evolution on the management structure of the global economy and the nature of competition. Rapidly rising world's information threshold is changing the course of relations between the individual and the countries. Recent developments have caused an efficiency increase in industries which are unrelated with this technology as a result of the spillover effect, and became the strategic planning center of organizations which are eager to join the occurring digital economy (Santibanez and Castillo, 2011; Wang, 1999).

In the beginning of the 1990s, common usage of computer networks made a contribution to globalization of economic activities. Information and communication technologies converging with telecommunication and being named as information infrastructure are being seen as essential and crucial bases for economic and social progress. Convergence of information, data processing technology and telecommunication technologies are happening for a long time in many countries. Information and communication technologies are accepted as poverty decreasing, skill improving, productivity increasing tools; in short, fundamental tools for progress. It's expected that information technology's contribution to an economy will be predominantly by adopting and using this technology (Wang, 1999). Technological progress has the effecting power on the production by increasing both production info (efficiency increase, change in manufacturing type and R&D) and production subject (new goods and services). Developments and transformations in the information and communication sector, which is directly influenced by technological progress, can increase both production and trade thanks to competition, advertising, more effective and extensive communication opportunities (Karagöz, 2007).

Technological progress has become a determining factor for international competition (Kaymakçı, 2006). In European Commission's 2010 report, information and communication technologies industry occupies only 5% of Europe's GDP but it constitutes 20% of overall productivity growth, so it makes an important contribution to economic growth in Europe. Also in the las 25 years, a significant increase in information and communication technology usage and investment has been observed in developing countries. In studies conducted on countless OECD countries, it's observed that investments on information and communication technologies have an effect upon economic growth between 0.2% and 0.5% (European Commissions, 2010; OECD, 2003). Similarly, many sectoral and national economic analyses show the increasing importance of information and communication technologies in developments such as employment and value creation in all economic sectors. Productivity growth constitutes a basis for improvements of living standards. In an economy, it's seen that the economic growth sustained with productivity growth is supported by investments on the information and communication technologies. This relationship is analyzed for many countries and it's generally observed that information and communication technologies' influence on productivity is favorable and meaningful in an economic sense (European Comissions, 2010; Niebel, 2014). With the transition from industrial society to information society, developments in the information and communication technologies have become an important factor for growth by transforming the economy (Uçkan, 2006). Cost reduction and productivity growth depending on ICT developments show that the investments on this field will be the driving force behind the countries' economic growth (Artan et al., 2014). In modern economy, information and communication technology is considered as an important production factor because of information-driven reasons. Many studies argue that information, innovation and technological changes are an important factor in economic growth. Modern growth theories emphasize that the information is an important tool for economic growth. For this reason, information and communication technologies' impact on economic growth attracts researcher's attention. Even if there is not a certain consensus about the development of information technologies' impact on economic growth, more and more researchers state that the impact is positive (İşcan, 2012; Kim, 2007). Investments on information and communication technologies supports the economic growth by contributing the capital deepening (e.g., Roller and Waverman (2001), Driouchi, et al. (2006), Kim (2007), Moradi and Kebryaee (2009), Farhadi and Ismail (2011), Iscan (2012), Mahyideen, et al. (2012), Göçer (2013), Türedi (2013), Vu (2013), Niebel and Mannheim (2014), Mefteh and Benhassen (2015), Yousefi (2015), Ishida (2015), Edquist and Henrekson (2017).

3. DATA AND METHODOLOGY

In this study, 2000-2015 period annual export of ICT goods, annual import of ICT goods and GDP data are used belonging to leading ICT exporter countries[1]. Dependent variable GDP representing the economic growth shows the annual percentage growth rate of GDP per capita. Data is collected from World Bank data base. For analysis Gauss 10 program and codes written for this program are used. The model to be estimated is as follows:

$$GDP_{it} = \alpha_{it} + \beta_1 ictexp_{it} + \beta_2 ictimp_{it} + e_{it} \quad (1)$$

[1] India, Japan, China, Hong Kong, Germany, United States, United Kingdom

First of all, cross-sectional dependence and homogeneity tests are performed. Not taking into consideration of cross-sectional dependence and homogeneity test while choosing the unit root tests will make the results analysis unbiased and consistent. When there are cross-sectional dependencies between series, making the analysis without taking this into consideration will affect the results considerably (Peseran, 2004).

3.1. Test for Cross-Sectional Dependence

Existence of cross-sectional dependency is tested by Pagan (1980) $CDLM_1$ when time dimension is greater than cross-section dimension, Peseran (2004) $CDLM_2$ when time dimension is equal to cross-section dimension, Peseran (2004) CDLM when time dimension is less than cross-section dimension.

These tests are biased when ensemble average is less than zero.

Initial LM test statistic is as follows:

$$LM = T\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\left(\hat{\rho}_{ij}^{2}\right) \sim \frac{\chi^{2}_{N(N-1)}}{2} \tag{2}$$

Pesaran et al. (2008) corrected this bias by adding variance and average to test statistics. For this reason, the name of the test is expressed as bias-adjusted LM test (LM_{adj}). LM_{adj} statistic is as follows:

$$LM_{adj} = \left(\frac{2}{N(N-1)}\right)^{1/2}\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}^{2}\left(\frac{(T-K-1)\hat{\rho}_{ij}-\hat{\mu}_{Tij}}{\upsilon_{Tij}}\right) \sim N(0,1) \tag{3}$$

Null and alternative hypotheses for cross-sectional dependence test which tests the existence of cross sectional dependence are given below:

H_0: Cross-sectional dependence doesn't exist.

H_1: Cross-sectional dependence exists.

When the obtained test result is less than 0.05, H_0 hypothesis is rejected with 5% significance level and it's determined there exists cross-sectional dependence between panel units (Pesaran et al., 2008).

Existence of cross-sectional dependence between variables is indicated on Table 1 below.

Table 1: Cross Section Dependence Test

Constant Model	GDP Statistic	p-value	ictexp Statistic	p-value	ictimp Statistic	p-value
CD_{lm} (BP,1980)	54.143	0.000***	36.195	0.021**	49.368	0.000***
CD_{lm}(Peseran,2004)	5.114	0.000***	2.345	0.010**	4.377	0.000***
CD (Peseran, 2004)	-2.532	0.006***	-1.227	0.110	-0.806	0.210
LM_{adj} (PUY, 2008)	15.004	0.000***	25.357	0.000	23.168	0.000***

Note: *, **, *** represent 10%, 5%, 1% significance levels.

With reference to Table 1, for all variables of Model (1) probability value of cross-sectional dependence test statistic CD_{BP} is less than 0.05 significance level. Then, null hypothesis which determines non-existence of cross-sectional dependence is rejected. Then there exists a cross-sectional dependence between countries in the panel. In the created panel, existence of cross-sectional dependence shows that any crisis occurring in one country can affect the other countries even if it originates from a local shock.

3.2. Homogeneity Test

The homogeneity of variables is analyzed by means of Pesaran and Yamagata's (2008) delta test. Under the null hypothesis of slope homogeneity as long as $\sqrt{N}/T \to \infty$ error terms follow normal distribution, therefore, Peseran and Yamagata's delta_tilde statistic follows standard normal distribution. For small samples, Peseran and Yamagata (2008) suggest adjusted

delta_tilde statistic. This statistic also follows standard normal distribution. Thereby, in case of probability value of test statistics being less than 0.05 significance level, null hypothesis defending that slope coefficients are homogeneous will be rejected. Null and alternative hypotheses for homogeneity test which tests whether the slope coefficients are homogeneity or heterogeneity for each country are given below:

H_0: Slope coefficients have homogeneous.

H_1: Slope coefficients are not homogeneous.

Table 2: Pesaran and Yamagata (2008) Homogeneity Test

	Test Statistic	Probability
delta_tilde	0.429	0.334
adjusted_delta_tilde	0.491	0.312

Null hypothesis which suggests slope coefficients are homogeneous is accepted because delta and adjusted delta test statistics' probability values are greater than 0.05 significance level according to Table 2. In short, slope coefficients are homogeneous. Therefore, when the unit root analysis of the series that are used in the study is tested by considering to cross-sectional dependence and homogeneity.

3.3. Unit Root Tests

Panel unit root tests are accepted as statistically more powerful than time series unit root tests which only consider information about time dimensions, because panel root tests take into account both time and cross-section dimensions (Güloğlu and İspir, 2008).

Pane unit root tests which are common in the literature belong to Levin et al. (2002) and Im, Pesaran and Shin (1997). These tests are defined as first generation unit root tests and do not consider cross-sectional dependence. Thus, despite commonly mentioning the mutual interaction between economic variables, first generation unit root tests assume cross-section members of the panel are independent.

However, for the case of cross-section members being influenced from same kind of shock, suggesting cross-sectional independence will be unrealistic. And this assumption, according to O'Connell (1998), cause excessive denial of null hypothesis.

Differently from the first-generation panel unit root tests, second generation panel unit root tests consider cross-sectional dependence. These tests inform about which member series of the panel are stationary or non-stationary one by one. Unit root hypotheses are given below:

H_0: β_i =0: Series is not stationary.

H_1: β_i <0: Series is stationary.

In the study, since it's detected a cross-sectional dependence among panel countries, one of the second-generation considering cross-sectional dependence unit root tests developed by Smith et al. (2004) is used to analyze the stationarity of the series. This test takes into account cross-sectional dependence when making a unit root test. When there is a cross-sectional dependence between series, making an analysis without considering this condition severely effects the obtained results (Breusch and Pagan, 1980; Pesaran, 2004). Not considering the cross-sectional dependence when choosing the unit root test to perform, it makes tests results unbiased and consistent (Peseran, 2004).

$\bar{t}$ test developed by Smith et al. is a boostrap version of Im et al.'s (2003) panel unit root test, and is calculated as follows: $\bar{t} = N^{-1}.\sum_{i=1}^{N} t_i$. Aforesaid tests are predicated on unit root null hypothesis (Özcan and Arı, 2013).

Whether series contain unit root or not is tested by Smith el al.'s (2004) test and results are given below.

Table 3: Smit et al. "bootstrap" Panel Unit Root Test

Levels Constant		
	Statistic	Bootstrap p-value
GDP	-3.081	0.011**
Ictexp	-2.461	0.014**
Ictimp	-2.424	0.024**

Note: ** represents 5% significance levels.

In Table 3, it is shown in which conditions variables are stationary according to Smit et al. bootstrap unit root test results. When the series are tested to determine stationarity in test statistics, it is observed all of the four variables used in a study for the 1987-2015 period was at stationary level. All of these variables were stationary at the 5% significance level.

3.4. Causality Test

Panel Fisher test developed by Emirmahmutoğlu and Köse (2011) relies on the time series' Toda-Yamamoto (1995) causality test logic. Superior characteristic of this test is I(0) and I(1) series can be analyzed together.

In the first step following model estimation is done:

$$Z_{i,t} = U_i + A_{i1}Z_{i,t-1} + \cdots + A_{ik}Z_{i,t-k_i} + \sum_{l=k_i+1}^{k_i+dmax_i} A_{il}Z_{i,t-1} + u_{i,t} \quad (4)$$

$$i = 1, 2, 3, \ldots\ldots\ldots\ldots N, \qquad t = 1, 2, 3, \ldots\ldots\ldots\ldots\ldots T \quad (5)$$

When null hypothesis shows there is not a causality relationship in the panel, alternative hypothesis shows at least one series has a causality relationship between variables.

Table 4: Emirmahmutoğlu and Köse's (2011) Panel Fisher Causality Test

	Statistic	**p-value**
ictexp =>GDP	68.058	0.000***
GDP=> ictexp	202.137	0.001***
ictimp=>GDP	7.220	0.926
GDP=>ictimp	18.753	0.931
ictexp=>ictimp	35.732	0.001***
ictimp=>ictexp	39.680	0.000***

Note: *** represents 1% significance levels.

According to Table 4, since bootstrap p-value values are less than 0.05, null hypothesis is rejected by 5% significance level. In this case, there is bidirectional causality relationship from ictexp to GDP. This result matches with theoretical expectations. Because with the export increase, it will contribute to economic growth. On the other hand, export will increase when the economic growth increases. Similarly, bidirectional causality relationship from ictexp to ictimp is also detected. Any causality relationship from ictimp to GDP cannot be founded.

4. CONCLUSION

In this study, the development of information and communication technologies' effect on economic growth is analyzed for the period between 2000-2015. Panel data analysis is utilized for the analyses. In the study, at first existence of cross-sectional dependence among the member countries of the panel is searched and detected. Then homogeneity of slope coefficients is searched for every country one by one, and detected. Unit root and causality tests are the other tests used in the study. According to study's findings, there is bidirectional causality relationship from the export of information and communication technologies to economic growth. This result reveals the importance of information and communication technologies' export to support economic growth. It can be stated that when the countries in which information and

communication technologies have high effect on economic growth are thought to be developed countries that produce and export such technologies, the sectors that produce goods and services related to these technologies should be supported by various credit and incentive applications. As a result of policies to be implemented in this direction, the growing sector can make a significant contribution to growth by creating production and export increases. Foreign trade practices that hinder the possession of sophisticated technologies should be relaxed or removed altogether.

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