New Trends and Issues Proceedings on Humanities and Social Sciences

Volume 5, Issue 2 (2018) 121-129

www.prosoc.eu
ISSN 2547-8818

Selected Paper of 7th World Conference on Business, Economics and Management (BEM-2018), 28-30 April 2018, Ephesus – Kusadasi, Turkey

Determination of the effect of information and communication technologies (ICTs) to unit labour cost: G7 countries examples

Serdar Ozturk, Department of Economics Policy, Faculty of Economic and Administrative Sciences, Nevsehir Haci Bektas Veli University, 50300, Nevsehir, Turkey

Lutfi Bicimveren∗, Ph.D. Student, Department of Economics, Institute of Social Science, Nevsehir Haci Bektas Veli University, 50300, Nevsehir, Turkey

Suggested Citation:

Ozturk, S. & Bicimveren, L. (2018). Determination of the effect of information and communication technologies (ICT) to unit labour cost: G7 countries examples. *New Trends and Issues Proceedings on Humanities and Social Sciences*. [Online]. *5*(2), pp 121–129. Available from: www.prosoc.eu

Selection and peer review under responsibility of Prof. Dr. Cetin Bektas, Gaziosmanpasa University, Turkey

Abstract

Following the realisation of the revolutions in various fields on Earth, the field of information and communication has also been incorporated into these developed fields. Where information and communication technologies (ICTs) are not enough for human power, they are confronted as a field that seizes work, or even accelerates them in practice. The main purpose of this study is to determine whether there is a relationship between investment of ICTs and unit labour costs (ULCs) in the G7 countries between 1990 and 2010. In the study panel, vector autoregressive and Granger Causality tests were applied. As a result of the analysis made, a negative and significant relationship has been determined between the investments made in the ICTs and the ULC.

Keywords: ICT, labour cost, causality, relationship.
Jel Classification Codes: O3, J2.

∗ ADDRESS FOR CORRESPONDENCE: **Lutfi Bicimveren**, Ph.D. Student, Department of Economics, Institute of Social Science, Nevsehir Haci Bektas Veli University, 50300, Nevsehir, Turkey.
E-mail address: lutfi_bicimveren@hotmail.com / Tel.: 0537 251 90 89

1. Introduction

Countries around the world have come a long way in global innovation and change, as they entered the race to complete their development, especially in the period after the Second World War. When considered in macro size, the goal of economic growth lies in the ideal of countries. On the way to this goal, innovations were created to provide various facilities for countries and domestic firms in terms of production. One of them is information and communication technology (ICT). Gradual development process is seen in the development of ICTs in the 1990s (Saglam, 2016, p. 1).

When we look at ICTs, information about the problems that people in the human life see as important has become almost a part of life in the whole, evaluating the information about them, offering solutions and many other areas (Leu, Kinzer, Coiro & Cammack, 2004, p. 1577). In addition, ICTs are spread by any means and can be expressed as an indication of the rapid adoption of this phenomenon by people. In addition, people are able to make the number of alternatives that are limited in their everyday lives to facilitate their routine work, meet their wishes, needs and expectations, and to do so quickly and easily, with less effort on huge dimensions. Perhaps, the most popular technology classification in recent years is ICTs. Through the Internet, people have turned to e-books, e-commerce, and now they have the opportunity to watch movies in electronic form without having to go to the cinema. It can also be seen that the institutional affairs are coming from above without any difficulty. For example, transactions such as making payments, receiving and transferring via the mobile applications of the banks are made easy via Internet.

WithICTs, we are in an age when transactions are now easier and faster. The automation systems that are revealed together with the newly developed devices are confronted all around the world. This technology, which is used in many fields, such as military, political, social, political, production, consumption, science, education, health and agriculture, is an important research area. It is considered as a subject that needs to be investigated in terms of its effects and results.

In terms of ICTs, that has been defined as the devices that have spread from the United States since the 1990s and are increasingly used in computer hardware, software equipment and communication technologies surrounding the World (Wangwe, 2007, p. 1). Turedi (2013, p. 299) defines ICTs as technological systems that provide communication for information access. ICTs have reached a wide use with the spread of mobile phones and Internet (Saglam, 2016, p. 1). Considering the literature on ICTs, there are many studies that are about ICT in the last decade (Feiguine & Solovjova, 2014; Lu, 2018; Saidi, Mbarek & Amamri, 2018; Salehan, Kim & Lee, 2018).

As to unit labour cost (ULC) concept, a unit is expressed as the labour cost used as input in production to produce output (Van Ark, Stuivenwold & Ypma, 2005, p. 2). There are many studies in the literature about this concept, which have a really big design for the nations that harbour manufacturing companies and give importance to economic growth (Van Ark & Monnikhof, 2000; Perez & Sanz, 2006; Menzler-Hokkanen, 1989).

Kumar, Stauvermann, Kumar and Shahzad (2018) have studied the ICTs and tourism and production per worker relations between 1960 and 2016. In the short run, they have been found a significant relationship between ICTs, tourism and production per worker. Also, only a significant relationship has been found for the long run between ICTs and production per worker. It has been stated that focusing on ICTs and increasing tourism will help to create the conditions for economic growth on the results of the study. Bongo (2005) examined the relationship between ICTs and economic growth and found a significant relationship. As a result of the analysis made, researchers defined the production process of enterprises as faster, more cost-effective and increase the production levels.

Stiroh (2002) studied about ICTs and total factor productivity and investigated a relationship between two variable. According to the results obtained from the analysis, no significant relationship between the two variables can be determined. With this result, attention is drawn to the following point. It is stated that the efficiency of computers in communication is likely to contribute. However, it

is mentioned that other variables, in which the information communication technologies alone do not have a production effect, are the production effect. Punamaki, Wallenius, Nygard, Saarni and Rimpela (2007) examined the effect of age and gender differences in the use of ICTs in their work. The work was tested on 7,292 Fin citizens aged 12, 14, 16 and 18 years. In this study, the mediating effect of personal health conditions in the use of ICTs was purposed to determine. According to the results of the analysis, it was found that men tend to use information communication technologies in order to play games, and women use mobile phones for surfing on the Internet intensively in comparison to men. According to the results of the analysis, personal health problems, insomnia and fatigue were found to affect the use of ICTs negatively.

Pradhan, Mallik and Bagchi (2018) examined the long-term relationship between ICTs, labour force participation rate, consumer price index, real GDP per capita and gross fixed capital formation. In the study, G20 countries data between 2001 and 2012 are considered. According to the results of the analysis, it is emphasised that long-term variables will not be separated from each other and that ICTs are an important factor in increasing the gross domestic product in the future policies. Unlike other studies in the literature, Niebel (2018) compared the effects of ICTs in developing and developed countries on economic growth. It has been found from the research with data from 59 countries between 1995 and 2010 that the investment in ICTs are more effective on the economic growth in the developed countries.

Njoh (2018) has done an investigation to find out whether there is a relationship between the use of basic communication technologies and development in Africa. He used multiple regression analysis method in the study. As a result of the analysis made, in Africa, a significant and positive relationship between the use of ICTs and development has been found. Hofman, Aravena and Aliaga (2016) have attempted to explain the contribution of ICT investments to economic growth and productivity in five Latin American countries, namely, Brazil, Chile, Colombia, Argentina and Mexico. As a conclusion, ICTs helped to reduce the gap in per capita GDP by the U.S. Shahiduzzaman and Alam (2014) examined the relationship between information technology investments, economic outcomes and productivity in Australia between 1975 and 2011. According to the results of the analysis carried out in the study, a strong technical progress has been made in the period when the study data on the Australian economy is based. According to this, in the 1990s, information technologies showed significant effects on labour productivity and output. However, it has been observed that this effect has decreased in recent years.

In this study, the main purpose is to examine the relationship between ULCs and investments made in information communication technologies in G7 countries, namely, Canada, Germany, France, Italy, Japan, UK and U.S. between 1990 and 2010. This study aims to contribute ICTs to the literature and is more different than other related studies. Because, in this study, all the variables were analysed and evaluated by the panel data analysis method. Another difference in the study is that the ULC variable is involved in working as a dependent variable.

In the first part of the work, the definitions, concepts and studies made in the relevant field in the literature are mentioned. In the second part, data, analysis method and information about analysis are given. In the third part of the study, the results of the analysis made in the study are tabulated and the values related to the analysis are explained. Finally, comments on the results of the study were made and policy recommendations for researchers and producers were presented.

2. Method

In this study, the main purpose is to determine whether there is a relationship between investment in ICT and ULC in G7 countries between 1990 and 2010. The ceteris paribus hypothesis was applied in the study. Accordingly, ICTs and ULC data have been obtained from the OECD database (OECD Data, 2018). The data are handled annually. Since some of the data in the study contain negative values, they are converted to positive and the logarithm is taken to make the analysis suitable. Stata 14.2

package program was used in the analysis. Panel data method was applied in the study. Accordingly, the order of analysis applied in this study is as follows.

1. Unit root analysis.
2. Determination of lag number.
3. Panel vector autoregressive analysis (VAR).
4. Granger causality test.
5. Eigenvalues related to variables.
6. Explained variance.

Analysis codes used in the study were obtained from the study of Abrigo and Love (2016). In order to determine whether the variables are stationary, first, the unit root analysis method developed by Levin, Lin and Chu (2002) was used. Panel VAR analysis is usually used to investigate whether there is a relationship between the two variables. The model was first proposed in Sims (1980, pp. 15). In Panel VAR analysis, the relationship coefficients between the two variables are included in the analysis results. Evaluations can also be made as to whether the relationship is positive or negative. Accordingly, the panel VAR method is equated as follows.

$$Y_{it} = Y_{it-1}A_1 + Y_{it-2}A_2 \ldots\ldots Y_{it-p+1} + Y_{it-p} + Y_{it-p}A_p + X_{it}B + u_i + e_{it} \quad (1)$$

The terms u_i ande_{it} in the panel VAR equation represent the stationary effects of the panel and the error vector X_{it}. is the vector of the exogenous eigenvalues, and Y_{it} is the vector of the independent variables. Later, this method was expanded and innovated by some researchers (Bernanke, Boivin & Eliasz, 2005). After the Panel VAR analysis, the Granger causality test was applied for this study. The Granger causality relation is equated to

$$y_{it} = \alpha_i + \sum_{k=1}^{k} \gamma_k y_{it-k} + \sum_{k=1}^{k} \beta_k x_{it-k} + \varepsilon_{it} \quad (2)$$

In this equation, $\alpha_i$is the original efficacy and ϵ_{it} is the error term. In the Granger causality test, the relationship between the variables is determined (Granger, 1969, p. 424). Accordingly, it provides convenience for assessing causality between variables. Hypotheses regarding the variables involved in the study are as follows.

H0: There is no significant relationship between investment in ICT and ULC.

H1a: There is a positive and significant relationship between investment in ICT and ULC.

H1b: There is a negative and significant relationship between investment in ICT and ULC.

3. Results

In this part of the work, there are tables on the results of the analysis carried out in the study and information on the analysis made. First, a unit root analysis was performed to determine the stability of the data. In Table 1, results, which are about the unit root analysis of the variables, have been given.

Table 1. Levin Lin Chu unit root test results of variables at levels

Varıables	Constant			Constant and trend		
	Statistic (Unadjusted t^*)	Statistic (Adjusted t^*)	*p*-value	Statistic (Unadjusted t^*)	Statistic (Adjusted t^*)	*p*-value
ICT	−5.224	−1.615	0.0532	−4.5603	−1.1032	0.1350
ULC	−8.5043	−3.668	0.0001***	−10.1875	−3.1804	0.0007***

***0.01 level significance; **0.05 level significance.

According to Table 1 part of the constant values, *p*-value of the ICT variable was determined as 0.0532. It is not significant compared to the probability value of 0.05 because it is greater than 0.05. In other words, ICT is not stable at the level of change. In other words, ICT contains unit roots at the level of change. The probability of the ULC variable is lower than 0.01, so it is stable at the level and does not contain the unit root. When the results of the unit root analysis including the fixed and trending values of the study in Table 1 are taken into consideration, it is seen that the ICT variable is not stationary, i.e., it contains unit root (p = 0.1350). In order to perform panel VAR analysis, the data must be stable at the same level. Accordingly, the unit root analysis was performed again by taking the difference of the variables in the study. The results of unit root analysis of the variables that are differenced are shown in Table 2.

Table 2. Levin Lin Chu unit root test results of variables at first difference

Variables	Constant			Constant and trend		
	Statistic (Unadjusted t^*)	Statistic (Adjusted t^*)	*p*-value	Statistic (Unadjusted t^*)	Statistic (Adjusted t^*)	*p*-value
DICT	−7.073	−3.6142	0.0002***	−8.7113	−3.5150	0.0002***
DULC	−11.101	−4.4162	0.0001***	−10.9653	−2.2938	0.0109**

Note: The letter 'D' at the beginning of the variable names represents the first difference.

According to Table 2, *p*-value of both ICT and ULC variables are significant at the level of 0.01 in the study. All variables became stable in the first difference. The data unit root of any variable does not contain the root. After providing the stationarity condition, the process of determining the number of lag (lag) for panel VAR analysis was performed. The test results used in determining the number of lag are shown in Table 3.

Table 3. Lag determination criteria

Lag	CD	J	J *p*-value	MBIC	MAIC	MQIC
1	0.65	88.11	0.14	−260.94	−61.89	−142.55
2	−0.53	52.71	0.37	−179.986	−47.29	−101.06
3	0.80	17.31	0.87	−99.04	−32.69	−59.58

According to Table 3, MBIC, MAIC, MQIC and Hansen J Test values are considered to be the minimum in lag 1. In the study of Abrigo and Love (2016), MBIC, MAIC and MQIC criteria should be the minimum when choosing a lag number. After this step, the panel VAR analysis was done. In panel VAR analysis, it is determined whether or not there is an association between the variables in the data set regulated by the panel data method, and if there is a relationship, it is determined that there is a positive or negative relationship (Love & Zicchino, 2006, p. 191). The results, which are about panel VAR analysis, are shown in Table 4.

Table 4. Panel VAR analysis results

Variables				
DULC (L1)^	**Coefficient**	**Standard error**	***z***	***p* > |*z*|**
DICT (L1)	−0.0369	0.0151	−2.43	0.015**

'^' represents dependent variables.

Table 4 shows the results of panel VAR analysis of ICT and ULC variables in the study. According to this, a relation between the investments in ICT and the ULC was found at a significance level of 0.05 (p = 0.015). However, the point to be noted here is shuddered. The coefficient on investments in ICTs in the VAR analysis is −0.0369. The relationship is negative. Here, each unit increase made to move ICTs will cause the ULC to decrease by 0.0369. Accordingly, the hypothesis H0, which indicates that there is no significant relationship between investments in ICTs and ULC and H1a, which is one of the research hypotheses, implies that there is a positive and meaningful relationship between investments in ICTs and ULCs rejected. The hypothesis H1b, which implies that there is a negative relationship between the investments made in ICTs and ULCs, is supported. After evaluating the results of the VAR analysis, the Granger causality test was included in the study. According to this test, it is possible to determine the relationship between variables (Granger, 1969, p. 424). Granger causality test results are shown in Table 5.

Table 5. Granger causality test results

Variables			
DULC^	chi^2	df	$p > chi^2$
DICT	5.929	1	0.015**
All	5.929	1	0.015**
DICT^	chi^2	df	$p > chi^2$
DULC	12.548	1	0.001***
All	12.548	1	0.001***

'^' represents dependent variables.

As shown in Table 5, there was a significant positive correlation between ULCs and investment in ICTs (p = 0.015). Second, it has been found that the ULC to investment in ICTs is significant at the 0.01 level. From these results, it can be said that there is a bi-directional relationship between the variables involved in the movement.

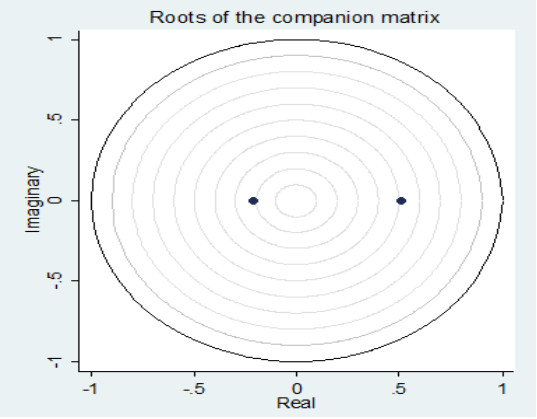

Figure 1. Eigenvalue graph

Table 6. Eigenvalues related to variables

Eigenvalue		Modulus
Real	Imaginary	
0.5123	0	0.5123
−0.2154	0	0.2154

Table 6 and Figure 1 show the eigenvalue values of the variables. If it appears as a vector in a complex numbered plane, the module is its length. The real number module is its absolute value. That is, the distance to the center is defined in this way (Physics Forum, 2018). Accordingly, all eigenvalues are in the unit cycle, so they meet the stable state (Abrigo & Love, 2016, p. 21). The variance values explained for the variables included in the study are shown in Table 7.

Table 7. Variance of variables

Response variable and forecast horizon	Impulse variable	
	DULC	DICT
DULC		
0	0	0
1	1	0
2	0.9575008	0.0424993
3	0.9543546	0.0456453
4	0.952808	0.047192
5	0.952488	0.0475121
6	0.9523948	0.0476052
7	0.9523714	0.0476286
8	0.9523652	0.0476349
9	0.9523635	0.0476365
10	0.9523631	0.0476369

In Table 7, the explained variances of ICT and ULC variables are shown. This table is based on the separation of error terms in the estimation. Accordingly, when we look at the last estimation range, ULC explain about 95% variance of the model. This ratio is the largest on the table in terms of variance explained. Second, investments in ICTs explain for about 5% of the model.

4. Discussion

This study examines whether there is a relationship between investment in ICTs and ULCs in the G7 countries between 1990 and 2010. As a result of these analyses, a negative and significant relationship was found between the investments made in ICTs and ULCs. Based on this obtained result, the following comment can be made. As the investments in ICTs increase, the ULC decreases. Given the variance ratios described, it appears that 95% of the model is explained by ULCs, and the remaining 5% is explained by investments in ICTs. Given that this work was done under ceteris paribus assumptions, further work by researchers in later studies may lead to more diverse results by incorporating more variables into the study analysis. In this study, the data of G7 countries between 1990 and 2010 were used. Different results can be obtained when the sample of the worker is changed and applied to different countries. In subsequent studies, researchers can contribute to the relevant literature on different methods of analysis.

When the results of the study are considered in terms of producers, it can be said that the investments made in the fields related to ICTs will increase the profit or profit rate by lowering the cost of labour of the firm. For example, companies can save both time and labour by investing in technical software tools and equipment in production. In this regard, it is possible for firms and producers' to be informed about this information by participating in fairs related to the ICTs in order

to increase about the investments of the producers in ICTs. A government that aims to nationally promote economic growth, such as incentives and tax reductions in investments in ICTs, will be an incentive to invest. It can be said that both manufacturer and consumer satisfaction will be provided. By investing in ICTs of producers, it can be said that they will lead to standardisation and serialisation in the production band, which reduces ULCs. Due to the investments made in ICTs, it can be said that due to the decrease in ULCs, the surplus that will arise in the area will cause investment, saving or employment in different fields.

References

Abrigo, M. & Love, I. (2016). *Estimation of panel vector autoregression in stata: a package of programs*. University of Hawaii at Manoa, Department of Economics Working Paper Series, pp. 1–28.

Bernanke, B., Boivin, J. & Eliasz, P. (2005). Measuring the effects of monetary policy: a factor-augmented vector autoregressive (Favar) approach. *The Quarterly Journal Of Economics, 120*, 387–422.

Bongo, P. (2005). *The impact of ICT on economic growth*. EconWPA Working Paper Series, pp. 1–4.

Feiguine, G. & Solovjova, J. (2014). Ict investment and internationalization of the Russian economy. *International Economics and Economic Policy, 11*, 231–250.

Granger, C. (1969). Investigating causal relations by econometric models and cross-spectral methods. *Econometrica*, 424–438.

Hofman, A., Aravena, C. & Aliaga, V. (2016). Information and communication technologies and their impact in the economic growth of Latin America, 1990–2013. *Telecommunications Policy, 40*, 485–501.

Kumar, R., Stauvermann, P., Kumar, N. & Shahzad, S. (2018). Exploring the effect of ict and tourism on economic growth: a study of Israel. *Economic Change and Restructuring*, 1–34.

Leu, D., Kinzer, C., Coiro, J. & Cammack, D. (2004). Toward a theory of new literacies emerging from the internet and other information and communication technologies. *Theoretical Models and Processes of Reading, 5*, 1570–1613.

Levin, A., Lin, C. & Chu, C. (2002). Unit root tests in panel data: asymptotic and finite-sample properties. *Journal of Econometrics, 108*, 1–24.

Love, I. & Zicchino, L. (2006). Financial development and dynamic investment behavior: evidence from panel var. *The Quarterly Review of Economics and Finance, 46*, 190–210.

Lu, W. (2018). The impacts of information and communication technology, energy consumption, financial development, and economic growth on carbon dioxide emissions in 12 Asian countries. *Mitigation and Adaptation Strategies for Global Change*, 1–15.

Menzler-Hokkanen, I. (1989). Can international competitiveness be measured by the relative unit labour cost approach? A comment on Professor Artto. *Management International Review*, 72–77.

Niebel, T. (2018). Ict and economic growth—comparing developing, emerging and developed countries. *World Development, 104*, 197–211.

Njoh, A. (2018). The relationship between modern information and communications technologies (Icts) and development in Africa. *Utilities Policy, 50*, 83–90.

OECD Data. (2018, February 25). Retrieved from https://data.oecd.org/

Perez, J. & Sanz, Y. (2006). The use of permanent and temporary jobs across Spanish regions: do unit labour cost differentials offer an explanation? *Suscripcion Anual*, 85.

Physics Forum. (2018, March 24). Retrieved from https://www.physicsforums.com/threads/what-is-themodulus-of-an-eigenvalue.121326/

Pradhan, R., Mallik, G. & Bagchi, T. (2018). Information communication technology (Ict) infrastructure and economic growth: a causality evinced by cross-country panel data. *IIMB Management Review, 30*, 1–13.

Punamaki, R., Wallenius, M., Nygard, C., Saarni, L. & Rimpela, A. (2007). Use of information and communication technology (Ict) and perceived health in adolescence: the role of sleeping habits and waking-time tiredness. *Journal of Adolescence, 30*, 569–585.

Saglam, B. (2016). ICT diffusion, R&D intensity, and economic growth: a dynamic panel data approach. *Journal of the Knowledge Economy, 9*, 1–13.

Saidi, K., Mbarek, M. & Amamri, M. (2018). Causal dynamics between energy consumption, ICT, FDI, and economic growth: case study of 13 MENA countries. *Journal of the Knowledge Economy, 9*, 228–238.

Salehan, M., Kim, D. & Lee, J. (2018). Are there any relationships between technology and cultural values? A country-level trend study of the association between information communication technology and cultural values. *Information & Management*, 1–51.

Shahiduzzaman, M. & Alam, K. (2014). Information technology and its changing roles to economic growth and productivity in Australia. *Telecommunications Policy, 38*, 125–135.

Sims, C. (1980). Macroeconomics and reality. *Econometrica*, 1–48.

Stiroh, K. (2002). Are ICT spillovers driving the new economy? *Review of Income and Wealth, 48*, 33–57.

Turedi, S. (2013). Bilgi ve Iletisim Teknolojilerinin Ekonomik Buyumeye Etkisi: Gelismis Ve Gelismekte Olan Ulkeler Icin Panel Veri Analizi. *Gumushane Universitesi Sosyal Bilimler Elektronik Dergisi, 4*, 298–322.

Van Ark, B. & Monnikhof, E. (2000). *Productivity and unit labour cost comparisons: a data base.* International Labour Organization.

Van Ark, B., Stuivenwold, E. & Ypma, G. (2005). Unit labour costs, productivity and international competitiveness. *Research memorandum GD-80 Groningen Growth and Development Centre Bermuda Government*, 1–36.

Wangwe, S. (2007). A review of methodology for assessing ICT impact on development and economic transformation. *African Economic Research Consortium Working Papers*, 1–31.