

## EXAMINATION OF THE CONTRIBUTION OF INFORMATION AND COMMUNICATION TECHNOLOGIES TO ECONOMIC GROWTH

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### Abstract

*Information and Communication Technologies (ICT) can be defined as the integrity of all hardware and software used in the processes of creating, operating, storing, distributing and managing information and knowledge. Economic growth refers to the expansion of the production capacity in an economy. The aim of this study is to determine the correlation between ICT and economic growth.*

*ICT has drawn a thick line between the past and the future by initiating digital transformation in the individual, corporate and public sphere. This thick line represents the beginning of fundamental changes in business models and production processes. In addition to saving time and space, ICT is the basis of digitalization, which enables the elimination of human-induced errors, prevention of resource waste and acceleration of all business processes. Countries that cannot benefit from digitalization sufficiently will have difficulties in transforming new ideas and technologies into commercial opportunities. This will result in lower income and growth rates as it will reduce job opportunities. From this point of view, one of the important determinants of economic growth is ICT, while moving from the industrial society that measures value with capital to the information society that says that real value is information.*

*In this study, the relationship between development factors in the field of information and communication technologies and economic growth performance has been examined. The period examined covers the years 2000-2020. The country studied is Turkey. National income per capita was selected as the dependent variable in this study, representing economic growth. Independent variables are mobile penetration, personal computer penetration, internet penetration and the digital maturity index (WEF-NRI) prepared by the World Economic form. According to the findings obtained from the correlation analysis, it is understood that there is a positive relationship between Information and Communication Technologies and economic growth.*

**Keywords:** *Information and Communication Technology, Economic Growth*

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## 1. INTRODUCTION

The most important added value created by digital transformation is that it enables the sustainability of technological progress by almost completely eliminating the costs of accessing information. It also helps to reduce inequality by allowing masses, who do not have adequate access to services such as education, health and finance, to access these services without requiring too much infrastructure cost. In this way, the welfare level of societies increases and at the same time, improving effects occur in the competitive conditions of countries. The positive effects that arise in the areas where digital transformation is taking place also act as a catalyst in other areas, creating an accelerating effect on the old social and economic dynamics and helping the transformation to spread wave by wave.

Although the digital transformation has begun, how this process will end depends on how the transformation process will be managed. First of all, the government's digital transformation vision and economic growth vision should be compatible with each other. It is also very important that the digital transformation vision is adopted by the private sector. However, if the cost of the transformation remains only on the private sector, it may take a long time to see the expected impact. For this reason, the state should encourage digitalization starting from the sectors it deems priority. The problems caused by the state's lack of vision in the field of ICT are summarized in the TUBISAD 2019 report as follows:

- Low social awareness about digital transformation affects the digital transformation process negatively.
- Current laws are not implemented effectively.
- Laws regarding Information and Communication Technologies cannot meet the needs.
- The legal system does not work effectively in resolving disputes.

## 2. LITERATURE REVIEW

As a result of the widespread use of ICT and becoming an integral part of economic and social life, it has been recognized by all countries that digitalization has a critical role in achieving the goal of economic growth. For this reason, the contribution of information and communication technologies to economic development, which has become a strategic tool for national development and increasing international competitiveness, has become the focus of attention of researchers. For example, Kriz and Quereshi (2009) investigated the role of public policies in the contribution of information and communication technologies to economic growth. In their research, they examined Singapore and Malaysia for the period 1977-2007 using the Principal Components Analysis method. As a result of their work, they found that the impact of public policies applied in the use of ICT on economic growth is different for the two countries. They explained the cause of this difference as, information and communication technologies has been started to use before Malaysia and the government's ICT investments are more than Malaysia.

Aytun (2012) discussed the impact of information and telecommunication technologies on economic growth in terms of developed and developing countries. For this purpose, the effects of these technologies on economic growth in a total of 138 countries in five different income groups in the period of 1991-2009 were examined with a dynamic panel data analysis. In his study, he concluded that information and telecommunication technologies are positive and significant determinants of economic growth for all income groups. He stated that this positive effect is higher in less developed countries.

Türedi (2012) examined the effect of ICT on economic growth in 53 developed and developing countries, including Turkey, by using the panel data method. In his research, he found that ICT alone is not enough to affect economic growth for Turkey. However, he found that there is a positive relationship between ICT and economic growth in all countries.

Şen and Akdeniz (2012) compared the performance of Turkey in ICT usage with OECD countries between 2000-2009. They found that Turkey's performance lags far behind OECD countries.

Farhadi, Ismail, Sarmidi and Kasimin (2013) examined the effect of ICT use on economic growth for 159 countries between 2000 and 2009, using the Generalized Method of Moments method. As a result of their studies, they found a positive relationship between the real GDP increase rate per capita and the use of ICT. They also argued that the impact of ICT use on economic growth was greater in the group of high-income countries.

Katz, Koutrompis and Callorda (2013) investigated the impact of ICT use and digitalization on economic growth in 184 countries for the period 2004-2011. For the research, they created an index consisting of six factors and 24 sub-indicators: ubiquity, affordability, reliability, speed, usability and skill. Researchers have concluded that digitalization contributes to economic growth.

Bankole, Bryson and Brown (2015) analyzed the efficiency of ICT use and its contribution to economic growth in Africa. They concluded that the most effective region in Africa, which they divided into four regions, is the North African Region. They found that the reason for the difference in the use of ICT between regions is the ICT infrastructure costs.

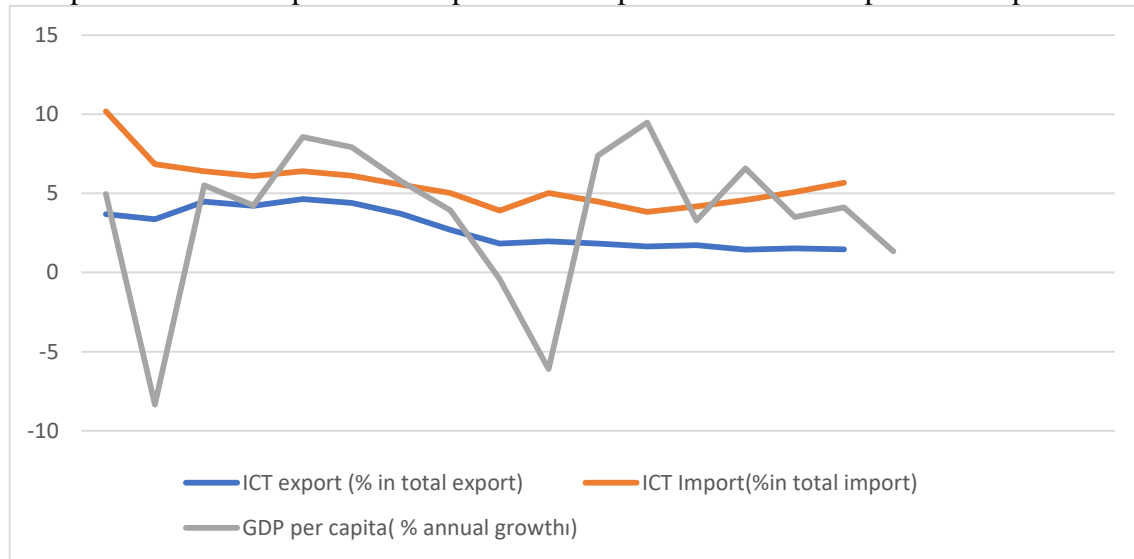
Erumban and Das (2016) examined the sources of growth in the Indian economy on the basis of ICT for the period 1980-2015. In their studies, they examined the effect of ICT on economic growth in two different ways, as direct and indirect effects. They found that the increase in total factor productivity in sectors using ICT indirectly positively affected economic growth. They also found that the use of ICT in the manufacturing sector contributed directly to economic growth. The researchers concluded that the increase in ICT investments has a positive effect on economic growth in India.

### **3. ICT AND ECONOMIC GROWTH**

ICT has an effect that simplifies and accelerates the business processes of all industries in the economy and increases their productivity by reducing their costs. The opportunity to produce in a shorter time and at a cheaper cost and to reach wider markets in a more digital environment are factors that encourage companies to increase production. Developments in the ICT field, which provide this opportunity to companies, are of key importance for economic growth measured by the increase in production. The sectors whose productivity has increased by making extensive use of ICT are developing and their share in the country's economy is increasing. In this way, the country's total factor productivity and hence the economic growth rate are increasing.

The most important contribution of digital transformation to economic growth is the investments made in the field of ICT. Companies that want to increase their market share have to follow innovations closely and take part in the digital world. The investments they will make in this field mean an increase in the investment expenditures of the private sector. Since economic growth is measured by the increase in Gross Domestic Product (GDP), the increase in private sector investment expenditures, which is a component of GDP, will also increase economic growth. According to the aggregate demand approach, the increase in public expenditures will also positively affect growth. The state also makes significant investments for digitalization in all sectors, especially education and health and affects the GDP and therefore the economic growth through the increase in public expenditures, which is another component of GDP. Considering that ICT is used in all areas of life, it is seen that the demand for ICT products among households is increasing day by day. Increasing consumption expenditures due to the increase in demand for goods such as computers, mobile phones, tablets and services such as internet and telephone lines will have a significant contribution to economic growth. The impact of the developments in the ICT field on the economic growth through the net export channel is related to the development level of the countries. For technologically advanced, high-income countries, export revenues, which increase with the sale of ICT products and services to less developed and developing countries, will have a positive effect on economic growth. Countries with a low technological level, on the other hand, will meet their needs through imports since they do not have the opportunity to produce ICT products or produce them cheaply as developed countries. If the increase in import expenditures of these countries cannot be balanced with the increase in the export revenues of other sectors, the effect of net exports, which will create a foreign trade deficit and have a negative value, on economic growth will also be negative.

Graph-1: Share of exports and imports of ICT products in total export and import rates



Source: Turkish Statistical Institute

The graph shows the share of Turkey's export and import of ICT products for the years 2010-2019 in total export and import rates. Exports of ICT products have always been more than imports during the period. This is one of the obstacles to both digitalization and income growth with digitalization for all developing countries, including Turkey. Being dependent on imports in the field of ICT increases the cost of ICT products and delays digital transformation, causes Turkey to fall behind in international competition and its growth performance is adversely affected due to the foreign trade deficit.

The ICT sector will have indirect effects as well as direct effects on economic growth. For example, as the ICT sector develops, the need for qualified workforce in this field will increase, and those who want to expand their job opportunities will invest more in themselves. The transformation of the society with increasing education level and qualifications into an information society will increase the productivity of the country. While the ICT sector develops, it will also pave the way for the formation of subsidiary industries connected to it. The emergence of new business lines and the increase in the variety of goods and services produced will both expand employment opportunities and support the growth of the economy. The greater the variety of products produced, the more production of complementary products will increase. Another indirect effect of the ICT sector on economic growth is related to physical infrastructure investments. The expenditures made by the state and private sector for infrastructure investments will not only increase GDP, but also increase the development level of the country and will create a basis for other technological innovations. Infrastructure investments will especially increase the service quality of ICT products and positively affect the user experience. The increase in customer satisfaction will ensure the continuity of the development of the sector by increasing the demand for ICT products. Continuity will support sustainable growth.

### 3.1. Other Macroeconomic Effects Of Information And Communication Technologies

Macro effects of information and communication technologies in an economy can be analyzed with the parameters of employment, productivity, foreign trade and income distribution.

The positive and negative effects of ICT on employment are among the current economic discussion topics. The most important transformation created by ICT in the field of employment is that it has revealed the remote working model. In this way, the importance of the concepts of time and space has decreased, and many costs for both employees and employers have been eliminated. Thus, a larger part of the income obtained has turned into profit and disposable income. It can be said that the remote working model has a positive effect on employment, as it allows individuals with disabilities and mothers or fathers who cannot go to work because they are responsible for the care of their children (Uçkan,2006: 32). The debates in the literature on whether the relationship between technology and

employment is complementary or substitute emphasizes the negative effect of ICT on employment. The general opinion in the literature is that technological progress increases the demand for qualified laborforce and decreases the demand of unqualified workforce (Kelleci,2003: 24). When evaluated from this point of view, we can say that ICT has a positive effect on employment if qualified labor stock is in majority in an economy, and negative effect on employment if unqualified labor force is in the majority.

In economies where ICT is heavily utilized, especially the prevalence of internet use increases productivity significantly (Akyazı and Kalça,2003: 225). The companies selling over the Internet and the goods and services supplied by these companies have become easily comparable by consumers. Consumers, who can do market research without any cost or inconvenience, force companies to be more competitive. Increasing competition also supports the increase in productivity. ICT also increases productivity as it enables more effective management of business processes, saving time and minimizing errors in the sectors where it is used.

Thanks to ICT, communication costs have decreased, distances have been shortened, distribution has been facilitated with integrated networks, financial markets have become active almost 24/7, allowing uninterrupted payments and foreign trade volume has expanded. ICT, which increases online payment opportunities and enables the spread of electronic commerce, has played a critical role in foreign trade. Thanks to ICT, companies have the opportunity to reach wider markets. In parallel with the increasing trade volumes, companies that want to increase their competitiveness have started to invest more in ICT. From this point of view, there is a two-way cause-effect relationship between ICT and foreign trade.

It is stated that in our age of intense technological developments, income distribution is in favor of developed countries that use technology intensively and produce technology. It is stated that this situation prevents countries from benefiting equally from the economic opportunities brought by the knowledge economy and makes the income distribution inequalities between rich and poor countries even more pronounced (Kapur,2002: 3). In other words, the earnings obtained due to the structure of ICT are not evenly distributed. The benefit and added value created is mostly seen in sectors where activities based on high technology and knowledge such as sophisticated production, modern services, research and development are carried out intensively. This situation creates a negative consequences for less developed countries in income distribution. Among the reasons for this are the insufficiency of technological facilities and resources in these countries, insufficient support for R&D activities and scientific studies, inadequate income from idea generation and inventions, and the inability of qualified workforce to work with low wages and use their skills adequately. As a result, the development differences between developed and underdeveloped countries become more evident and cause the income distribution between countries to be adversely affected.

#### **4. RESEARCH METHODOLOGY**

In this study, the relationship between development factors in the field of information and communication technologies and economic growth performance has been examined. The period examined covers the years 2000-2020. The country studied is Turkey.

National income per capita was used as the dependent variable. National income shows the economic strength of a country, while national income per capita shows the level of prosperity of people living in the country. It is possible to increase national income per capita in two ways. The first is that the economic growth rate is higher than the population growth rate. The other is that the population is declining while the national income is constant. In Turkey, the population shows a growing trend, and the increase in national income per capita is related to economic growth. For this reason, national income per capita was selected as the dependent variable in this study, representing economic growth. Independent variables are mobile penetration (mobile), personal computer penetration (pc), internet penetration (internet) and the digital maturity index (WEF-NRI) prepared by the World Economic form.

The mobile penetration rate is found by dividing the number of mobile line subscribers by the population. The increase in the number of transactions that can be made via mobile phones is an important indicator of digitalization. The mobile penetration rate, included in the model as the first independent variable, is 101% in Turkey in 2020 and is expected to be in a positive relationship with economic growth.

PC penetration refers to the prevalence of personal computers in a country. Since PC usage is one of the important indicators of the ICT industry, it is included in the model as another explanatory variable. Internet penetration is the ratio of internet users to the population and shows the prevalence of internet usage in the country. Internet penetration is 74% in Turkey in 2020. Turkey is above the world average of 59% in this regard. The prevalence of Internet use is included in the model as an explanatory variable due to its relevance to the level of economic development.

The last explanatory variable used in the model is NRI (Networked Readiness Index) prepared by the World Economic Forum (WEF). Stating that information and communication technologies have positive effects on growth and development, WEF uses the NRI index to measure the digitization level of countries. The index has four components: environmental conditions, preparedness, use and created impact. As a result of the values of these components, the strengths and weaknesses of the country's IT sector are determined. The analysis was made with the SPSS package program. The relationship between variables was investigated by correlation analysis.

## 5. FINDINGS

Correlation analysis is a statistical method that serves to determine the direction and degree of the relationship between variables. The correlation coefficient (r) takes values between -1 and +1. A strong and negative relationship between variables is considered if r is close to -1, and a strong and positive relationship is considered if it is close to +1. If r is zero, it is understood that there is no statistical relationship between the variables. If the variables fit the normal distribution, Pearsan method, if not, Spearman method can be selected for Correlation Analysis. In this study, the study of normality was tested with Kolmogorov-Smirnov and Shapiro-Wilk Tests.

**Table-1: Normality Test**

	Kolmogorov-Smirnov			Shapiro-Wilk		
	statistic	df	significance	statistic	df	significance
Mobil	0,143	20	0,200	0,947	20	0,329
Pc	0,130	20	0,200	0,958	20	0,504
Internet	0,138	20	0,200	0,936	20	0,262
WEF-NRI	0,145	20	0,200	0,956	20	0,607

According to Table-1, it was decided to apply Pearsan Correlation Test since all variables conform to the normal distribution condition.

**Table-2: Correlation Test**

Variable	Distrubition	P=0,007	Pearson r	Correlation
Mobil	Normal	Significant	0,564	Positive-weak
Pc	Normal	Significant	0,691	Positive-medium
Internet	Normal	Significant	0,876	Positive-strong
NRI	Normal	Significant	0,983	Positive-very strong

Since the p value showing the significance of the coefficients is different from zero, the correlation coefficients are statistically significant at 1% significance level. We can solve the general significance of the model with the Anova Test.

**Table-3: Anova Test**

Dependent variable	Independent variable	F-statistics	Significance
National Income	Mobil	239,181	0,000
National Income	Pc	149,333	0,000
National Income	Internet	90,988	0,000
National Income	WEF-NRI	12,583	0,005

According to the significance of the F statistic, the model is significant as a whole.

## 6. CONCLUSION

According to the findings obtained from the correlation analysis, it is understood that there is a positive relationship between Information and Communication Technologies and economic growth. The strongest correlation between economic growth and ICT belongs to the NRI index. This finding confirms that the WEF's views, which suggest that ICT is one of the most important indicators of digitalization and contributes positively to countries' economic performance by affecting their productivity levels, also valid for Turkey. It is seen that there is a strong and positive relationship between internet use and economic growth. The prevalence of internet use contributes to the development of societies by reducing the costs of accessing information. The economic performances of economies that have turned into information societies are also increasing. Personal computer and mobile penetration also contribute positively to economic growth, but their contribution rates are not very high. The research findings are compatible with the general literature.

Due to the increasing digitalization, especially after the pandemic process, both business and social lifestyles have changed and the use of ICT has increased. Intensive use of information and communication technologies commonly will direct the economic growth of the country. According to the results of this research, which supports the studies in the literature, applications for information and communication technologies are extremely critical to sustain economic growth.

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