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IMPACT OF INFORMATION AND COMMUNICATION TECHNOLOGIES ON TURKISH ECONOMIC GROWTH AND POLICY RECOMMENDATIONS

Levent Kemal AKKOÇ

Supervisor
Prof. Dr. Yeşim Rabia KUŞTEPELİ

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University	: Dokuz Eylül University
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Name and Surname	: Levent Kemal AKKOÇ
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EXAMINING COMMITTE MEMBERS

Title, Name and Surname	University	Signature
Prof.Dr.Yeşim Rabia KUŞTEPELİ	DOKUZ EYLÜL ÜNİVERSİTESİ	
Prof.Dr.Sedef AKGÜNGÖR	DOKUZ EYLÜL ÜNİVERSİTESİ	
Prof.Dr.Aykut LENGER	EGE ÜNİVERSİTESİ	

Unanimity (X)
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The thesis titled as "**Impact of Information and Communicaton Technologies on Turkish Economic Growth and Policy Recommendations**" prepared and presented by Levent Kemal AKKOÇis accepted and approved.

Prof.Dr. Utku UTKULU
Director

DECLERATION

I hereby declare that this master thesis titled as ‘Impact of Information and Communication Technologies on Turkish Economic Growth and Policy Recommendations’ has been written by myself in accordance with the academic rules and ethical conduct. I also declare that all materials benefited in this thesis consist of the mentioned resources in the reference list. I verify all these with my honour.

Date

…/…/…….

Levent Kemal AKKOÇ

ABSTRACT

Graduate Thesis

Impact of Information and Communication Technologies on Turkish Economic Growth and Policy Recommendations

Levent Kemal AKKOÇ

Dokuz Eylül University

Graduate School of Social Sciences

Department of Economics in English

Economics in English Program

This study analyses the effect of information and communication technologies to the growth of economy of Turkey and gives policy recommendations in the direction of obtained results. Gross domestic product per capita, unemployment, internet users per 100 people, mobile cellular subscriptions per 100 people and gross domestic product per capita growth for the years between 1993 to 2012 are used as variables. Time series analysis is used for investigating the relation between the variables and Augmented-Dickey Fuller Test is used for investigating whether the variables are stationary or not. In times series analysis, firstly, the relationship of the gross domestic product per capita with unemployment, mobile cellular subscriptions per 100 people and internet users per 100 people is investigated and then the relationship of the gross domestic product per capita growth rate with unemployment, mobile cellular subscriptions per 100 people and internet users per 100 people is analyzed. In addition, in the study, information is given about history and current state of information and communication technologies for Turkey and the World. Results show that information and communication technologies have positive impact on economic growth.

Keywords: Information and Communication Technologies, Gross Domestic Product per Capita, Unemployment, Internet Users per 100 People, Mobile Cellular Subscriptions per 100 People, Gross Domestic Product per Capita Growth Rate, Augmented-Dickey Fuller Test.

ÖZET

Yüksek Lisans Tezi

Bilgi ve İletişim Teknolojilerinin Türkiye Ekonomisinin Büyümesi Üzerine Etkisi ve Politika Önerileri

Levent Kemal AKKOÇ

Dokuz Eylül Üniversitesi
Sosyal Bilimler Enstitüsü
İngilizce İktisat Anabilim Dalı
İngilizce İktisat Programı

Bu çalışma, bilgi ve iletişim teknolojilerinin Türkiye ekonomisinin büyümesi üzerine etkisini araştırmakta ve çıkan sonuçlar doğrultusunda politika önerilerini içermektedir. 1993-2012 yılları arası için kişi başına düşen gayrisafi yurtiçi hasıla, işsizlik, 100 kişi başına düşen internet kullanıcısı sayısı, 100 kişi başına düşen mobil telefon abonesi sayısı, kişi başına düşen gayrisafi yurtiçi hasıla büyüme oranı, değişkenler olarak kullanılmıştır. Değişkenler arasındaki ilişkiyi araştırmak için zaman serisi analizi ve değişkenlerin durağanlıklarını araştırmak için Augmented-Dickey Fuller Testi kullanılmıştır. Zaman serisi analizinde ilk önce kişi başına düşen gayrisafi yurtiçi hasılanın, işsizlik, 100 kişi başına düşen mobil telefon abonesi sayısı ve 100 kişi başına düşen internet kullanıcısı sayısı ile ilişkisi araştırılmıştır. Daha sonra, kişi başına düşen gayrisafi yurtiçi hasıla büyüme oranının işsizlik, 100 kişi başına düşen mobil telefon abonesi sayısı ve 100 kişi başına düşen internet kullanıcısı sayısı ile ilişkisi incelenmiştir. Çalışmada ayrıca, bilgi ve iletişim teknolojilerinin hem Türkiye hem Dünya için tarihçesi ve mevcut durumları ile ilgili bilgi verilmiştir. Sonuçlar, bilgi ve iletişim teknolojilerinin, ekonomik büyümeye olumlu etkisi olduğunu göstermektedir.

Anahtar Kelimeler: Bilgi ve İletişim Teknolojileri, Kişi Başına Düşen Gayrisafi Yurtiçi Hasıla, İşsizlik, 100 Kişi Başına Düşen İnternet Kullanıcı Sayısı, 100 Kişi Başına Düşen Mobil Telefon Abonesi Sayısı, Kişi Başına Düşen Gayrisafi Yurtiçi Hasıla Büyüme Oranı, Zaman Serisi Analizi, Augmented-Dickey Fuller Test

IMPACT OF INFORMATION AND COMMUNICATION TECHNOLOGIES ON TURKISH ECONOMIC GROWTH AND POLICY RECOMMENDATIONS

CHAPTER TWO

LITERATURE SURVEY

CHAPTER THREE

EMPIRICAL ANALYSIS

ABBREVIATIONS

ADSL	Asymmetric Digital Subscriber Line
ARIMA	Autoregressive Integrated Moving Average
GAP	Southeastern Anatolia Project
GDP	Gross Domestic Product
IAT	Informatics Association of Turkey
ICT	Information and Communication Technology
IU	Internet Users
MCS	Mobile Cellular Subscriptions
NCSS	National Cyber Security Strategy
OECD	Organization for Economic Cooperation and Development
TUENA	Turkish National Information Infrastructure
TUBITAK	The Scientific and Technological Research Council of Turkey
UBTYS	Ulusal Bilim, Teknoloji ve Yenilik Stratejisi

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INTRODUCTION

In today's world, information and communication technologies became very important. They both effect living of people and statue of countries. People are able to get in touch with the rest of the World from the chair they sit and countries advance in these technologies provide superiority against other countries both in economic, politic and military terms.

The reason why information and communication technology on Turkey's economic growth is chosen is that, it becomes more important day by day in our daily living and Turkish people's interest on information and communication technology tools. Target of the study is to determine the importance of the information and communication technology on Turkish economic growth and provide policies on the bases of the results.

In the study, firstly, Augmented-Dickey Fuller test is used to determine whether the variables used are stationary or not and then two hypotheses which were mobile cellular subscriptions per 100 people lead to economic growth and internet users per 100 people lead to economic growth are tested by time series analysis for the years between 1993 and 2012.

In the first part of the study, information about history of information and communication technologies both in Turkey and the World is given and current state of information and communication technologies both in Turkey and the OECD countries is given from the perspective of some indicators.

In the second part of the study, literature survey about information and communication technologies is analyzed, firstly discussing studies which found no relation between information and communication technologies and economic growth and then giving information about studies that found positive relation.

In the third part, relation between information and communication technologies and economic growth is analyzed with regression analysis by using time series and it is tried to find out whether variables used in the study are stationary or not by using

Augmented-Dickey Fuller test. Third part concludes by giving policy recommendations for Turkish information and communication technologies.

CHAPTER ONE
INFORMATION AND COMMUNICATION TECHNOLOGY

1.1. INFORMATION AND COMMUNICATION TECHNOLOGY HISTORY

1.1.1. Information and Communication Technology History in Turkey

In analyzing the history of information and communication technology in Turkey, it is useful to give information about information and communication technology institutions in Turkey together with the historical perspective.

In 1971, Informatics Association of Turkey (IAT) was founded. It has two bodies which are IAT Centre and IAT Regional Branches. Today, branches that are located in Istanbul, Izmir, Ankara, Eskisehir, Bursa, Antalya and Samsun are operating fully. The aim of the IAT is to give support to all information system workers and other workers who get in touch with information systems during their working life. IAT sets up committees or work groups that are in control to investigate, to report, to formulate or to recommend a policy in terms of main lines or specific functions that are determined by the General Assembly or by the Governing Board.

Important advances in the history of information and communication technology in Turkey are Informatics and Economic Modernization Report which was prepared by the World Bank in 1993; Turkish National Information Infrastructure (TUENA) Master Plan prepared by the Ministry of Transportation and The Scientific and Technological Research Council of Turkey (TUBITAK) in 1999; e-Trade Coordination Council under the secretariat of the Prime Ministry for Foreign Trade between 1998 and 2002; Turkish Informatics Congress which was hold on May 2002, e-Turkey Initiative applied by the Prime Ministry from 2001 to 2002; Vision 2023 prepared by TUBITAK between 2002 and 2004 and e-Transformation Project of Turkey which started in 2003.

'Turkish Science and Technology Policy 1993-2003' report prepared by TUBITAK on 3 February, 1993 is an important step in Turkey's information and communication technology policy.

In the report, four targets were aimed: to increase researcher per ten thousand people from seven to fifteen; to make research and development expenditure to national income ratio more than one percent; to increase Turkey's place from fortieth place to thirtieth place in order to contribute to the universal science and lastly to increase private sector's share of research and development expenditure from eighteen percent to thirty percent.

In order to increase researcher per thousand people from seven to fifteen, some steps are mentioned. These are, coordination of the foreign doctorate scholarship programs under a center roof that are carried out by different institutions, motivating students to choose programs related to science for their undergraduate education and continuing of the bringing scientist program by enlarging its scope which was implemented by the TUBITAK in 1992.

In order to make research and development expenditure to national income more than one percent, creating demand and competition in the domestic market by public purchases, using of the big investment's offsets which are performed with the foreign country partners under the coordination and/or via the TUBITAK in order to create additional resource for realizing the targets, supporting of the public research and development projects from one hand via the TUBITAK as far as possible and if this is not possible, coordinating the public research and development expenditures with the TUBITAK for suitability to the prior areas that have been detected, transferring additional resource to the TUBITAK from the Progress and Support Fund for carrying out international projects that it is a part along with its' routine activities, realizing of the choosing of the technology and know-how that is going to enter to Turkey by a 'Technology Assessment Center' which the TUBITAK is going to have an active role were aimed.

In order to increase Turkey's place from fortieth place to thirtieth place, three steps were determined. These were, establishing Centers of Excellence. For this

purpose, establishing Theoretical Study Center was planned and establishment work was given to the TUBITAK. A leading decision was taken about establishing a similar center in the field of biotechnology in the area of Southeastern Anatolia Project (GAP). For increasing Turkey's place in the World, establishing Turkish Academy of Sciences which was going to cover both positive and social sciences and encouraging scientific publication activities at the international level were planned.

In order to increase private sector's share of research and development expenditure from eighteen percent to thirty percent, encouraging research and development expenditures at the small and medium sized businesses, encouraging multinational corporations that make investment in Turkey for setting up research and development departments, finalizing works about legal regulation which encourage improving venture capital corporations by the help of private sector in order to ensure the establishment of venture capital market, carrying out techno park activities which is an important tool in improving the cooperation between the universities-research institutions and the industry in coordination with the TUBITAK, encouraging unique design rather than production that is based on license agreements, updating the Patent and Intellectual Property legislation and taking it into the frame of software industry's Intellectual Property Law were planned (TUBITAK, 1993: 6-7).

In 1995, due to state contribution to the research and development expenditures of the private sector, there was an increase in the research and development activities of the private sector. Establishment of the national network and informatics infrastructure master plan was made possible too. Electric Coordination Committee was founded by the TUBITAK and the coordination was given to Undersecretary of Foreign Trade. Institutions such as Telekom A.Ş., Parliament Information Technology Commission, Internet Top Board, Electronic Commerce Coordination Committee, Kamu-Net, Okul-Net and Kobi-Net were founded with the aim of creating infrastructure of the national information.

On June 26, 2001, Technology Development Zones Law was approved. The aim of the law was to construct and to put into operation techno-parks and technological development zones by providing financial support for land, infrastructure and

construction costs. Financial support mechanism was provided by the Ministry of Science, Industry and Technology.

E-Transformation Project of Turkey started in 2003 with becoming part of the e-Europe+ Initiative which was prepared for the European Union candidate countries in 2001. The aim of the project was to accomplish the transformation process into an information society in a way which embraces all society, public sector and private sector by rearranging policy and legislations about information and communication technology within the framework of European Union legal acquis and to identify necessary strategies for the information and communication technology sector in order to compete in the international markets. The responsible State Planning Organization and the e-Transformation Turkey Executive Board were responsible from the implementation of the project. State Minister and Deputy Prime Minister, Minister of Transportation, Ministry of Industry and Trade, important bureaucrats, non-governmental organizations and Advisory Council participated to the project. The project led to the adoption of the 'Turkey's Information Society Transformation Policy' by the e-Transformation Turkey Executive Board.

At the early times of 2004, Electronic Signature Law was legislated. The aim of the law was to facilitate the use of e-signatures by determining the principles concerning their legal and technical aspects.

Scientific cooperation with the United States, European Union and Japan was practiced until a certain level. Positive developments happened about technology support and development center; but, on the other hand, purchasing policies could not be used as a technology supporting tool. Even if intellectual property rights came closer to international standards with legal regulations, necessary steps could not be taken about electronic legislation of intellectual property. In 2004, effective legislation work started in technology policies with the aim of European Union membership. A circular was prepared in 2004 for orientation with the content of the 6th European Framework Program and in addition to this, as a result of the workings of the TUBITAK, National Science and Technology Policies 2003-2023 strategy plan was prepared. (Seyrek and Sarıkaya)

On April 15, 2005, a memorandum of understand was signed between Turkey and South Korea, to make progress in the field of technical development and to enlarge the markets of information and communication technology.

In 2008, Supporting Research and Development Activities and Electronic Communication Law were put into force. The aims of the Supporting Research and Development Activities were to provide economic advantage with the help of innovation and technology generation and it lead to reduction in tax, social security contribution aids, capital supports and grants to the research and development expenditures made by the private sector. Some examples for these advantages were exemption of tax that resulted from the research and development expenditure and exemption of the 80 percent of the income tax that resulted from the wages of the research and development staff. The Electronic Communication Law targeted to provide competition and efficiency in the sector of telecommunication, to cover more areas in the electronic communication services in the country and to stimulate technological development in the area of electronic telecommunication area.

In the 'National Science, Technology and Innovation Strategy 2011-2016' report which was approved in 15 December 2010, nine strategic purposes are stated and these were divided to vertical axes and horizontal axes. Vertical axes have three strategic purposes and horizontal axes have six strategic purposes. Target oriented approaches in the areas where research and development capacity and innovation capacity are strong, need oriented approaches in the areas which Turkey needs to gain acceleration and approaches from floor to up are the three vertical strategic purposes.

In the target oriented approaches in the areas where research and development capacity and innovation capacity are strong, the aim is increasing research and development and innovation resourced gains where research and development and innovation capacity is strong.

In the need oriented approaches, the acceleration of the research and development and innovation capacity is targeted.

In the approaches from floor to up, enhancing present supports and supporting researches which form a basis for the newly developing technologies are proposed.

From the perspective of horizontal strategic purposes, developing human resource in the information and communication technology, supporting transformation of research results to commercial good and service, popularizing multi-player and multi-discipline research and development cooperation culture, strengthening role of the small and medium sized businesses which are in the system of national innovation, increasing contribution of research infrastructure's to Turkey research area's knowledge generation power and becoming effective of the international information and communication technology cooperation for the benefit of Turkey were the six horizontal strategic purposes.

In developing human resource in the information and communication technology, the aims were enhancing sectoral distribution together with increasing information technology human resource, improving research culture and experience and talent of the researchers, enhancing working environment of the information technology human resource, increasing circulation of the researchers and improving employment capacity of the research and development staff.

In the supporting transformation of research results to commercial good and service, the aim is creating value-added from new products, processes and services of the research results.

In popularizing multi-player and multi-discipline research and development cooperation culture, it is planned to divert system interactions to sectoral and interdisciplinary. In strengthening role of the small and medium sized businesses which are in the system of national innovation, the focus is on adding more small and medium sized businesses to businesses which make research and development and innovation.

In increasing contribution of research infrastructure to Turkish knowledge generation power, the aim is providing a basis of the present and new research infrastructures to National Science, Technology and Innovation Strategy 2011-2016 report's strategic approach. In becoming effective of the international information and communication technology cooperation for the benefit of Turkey, the aim is supporting of the National Science, Technology and Innovation Strategy 2011-2016 report's strategic frame by the international information and communication technology

cooperation with giving importance to Turkey's multilateral commitment. (TUBITAK, 2010: 7)

On October 20, 2012, 'Execution, Management and Coordination of National Cyber Security' was declared in the Official Gazette and became effective due its declaration. It was prepared for the term 2013 and 2014. Its' content was to establish safety measures for cyber security and to approve and to guarantee realization and coordination of plans, schedules, reports, procedures, principles and standards that were arranged. Safety measures for cyber security would maintain cyber security of all services, data and practices brought by the organizations and agencies of the public which use information technology, maintaining cyber security of information systems of critical bases that are under the operation of public and private sectors, minimize the consequences of cyber security incidents and determine the important cyber security movements in order to put back the systems to their usual functional states as early as possible after the incident occurred.

1.1.2. Information and Communication Technology History in the World

In 1876, telephone was invented by Alexander Graham Bell. Bell imagined the telephone as a device which carried music and news to homes. In 1877, phonograph was invented. It immobilized human voice and music.

Technological developments in the area of communication are created together with the innovations in the communication with the help of digital technology and fiber optic and laser technology and also created together with the developments in the communication hardware such as smart terminal, telephone and fax which create renewal in the office hardware. Information and communication age began in the last 30-40 years of the industrial society with the usage of transistor, color TV, recorder, video, computer and satellite. New and fast developments in these areas that happened in the 1980s and 1990s created first steps of present day's information society.

Transition from colored TV to cable TV, TV participated conferences and satellite broadcast constitute the crucial examples.

In 1912 in the U.S.A., Wireless Act passed into law which led to proper structure of the social usage and legal arrangement of the radio in every country.

In 1945, Vanner Bush published an article about the idea of web from a computer. In this article, he mentioned a machine system which constituted every kind of information about humanity and made it possible to make research from that machine system. This system was going to be an intricate system which would provide associative contact between the files.

The internet resists on computer network which is called 'Arpanet'. It was established by the United States of America Advanced Research Projects Agency in 1969. The aim of the agency was to stimulate the research conducted by the universities for the needs of the military. This aim became successful in a short period of time and a communication system idea was developed by the Rand Corporation which worked for the Pentagon. The communication system was planned as a system which would stay strong against a possible nuclear war. In 1969, first computer network was established between various universities and research agencies.

In 1972, this network was introduced at an international conference and with time, necessary infrastructure and protocols that lead to communication between the computers were developed with the help of various foundations. However, the root of the Internet relies on a study which was made in 1940 by George Stibitz with IBM Model 1. The study made communication possible between the computers.

In 1970s, Bulletin Board System, which can be regarded as the ancestor of today's internet was put into place. MODEM system which led to file exchange between the computers started in 1977 and Usenet News system which lead to news share between the interesting groups started in 1980.

In the U.S.A., until the 1980's, broadcasting was arranged according to a system based on commercial advertisement financing. In Europe, it was arranged according to public service financing. Even if the application of broadcasting was different, telecommunication was under state control nearly everywhere.

1.2. INFORMATION AND COMMUNICATION TECHNOLOGY CURRENT STATE

1.2.1. Information and Communication Technology Current State in the Organization for Economic Cooperation and Development (OECD) Countries and in Turkey

In this part, information and communication technology in the OECD countries and Turkey is summarized. Aside from Turkey, there are thirty three members of the OECD which are Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea Republic, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, United Kingdom and United States.

For the comparison between Turkey and the OECD countries, telephone lines per 100 people, mobile cellular subscriptions per 100 people, internet users per 100 people, fixed broadband internet subscribers per 100 people and research and development expenditure as a percentage of gross domestic product (GDP) indicators are used.

More telephone lines, more mobile phone subscriptions, more internet usage and more fixed broadband internet subscription mean more chance to communicate between the borders of a country from rural area to urban area. If there is an increase in the incomes of citizens in a country, telecommunication sector is expected to be among the recent and contemporary expenditures. As the demand for telecommunication services increases, existing telephone lines are going to be insufficient and there is going to be need for more telephone lines, also, mobile phone subscription is going to increase. This means an increase in the GDP per capita which will have direct impact on the GDP of a country.

Internet usage and fixed broadband internet subscription are important for the GDP of a country. With the help of internet, companies are able to reach more

customers. More customers mean an increase in the sales and export of that company which have direct contribution to GDP of that country. Also, with the help of internet, ordinary people can work at home and commercialize their work through the world.

More research and development expenditure means production of advanced goods. This in turn brings advantage to a country at the international markets. Customers living abroad will prefer those goods and exports of the country producing more qualified good will increase which means an increase in the GDP of a country.

In the comparison of Turkey with other countries, OECD countries are chosen because Turkey is a member of OECD and between the OECD countries there are countries with strong economic positions.

Before giving information about information and communication technology of both Turkey and other OECD countries, looking at some economic indicators is helpful. In the below tables, information about inflation, unemployment, GDP and GDP per capita is given for the years 2002, 2007 and 2012 for Turkey and other OECD countries.

Table 1: Economic Indicators for Turkey and OECD Countries in 2002

	Turkey	**OECD**
Inflation	45%	2.84%
Unemployment	10.4%	7.02%
GDP	232 billion $	832 billion $
GDP per Capita	3.576 $	21.971 $

www.worldbank.org, (05.01.2015)

Table 2: Economic Indicators for Turkey and OECD Countries in 2007

	Turkey	**OECD**
Inflation	8.2%	2.77%
Unemployment	10.3%	5.71%
GDP	647 billion $	1.253 billion $
GDP per Capita	9.312 $	39.087 $

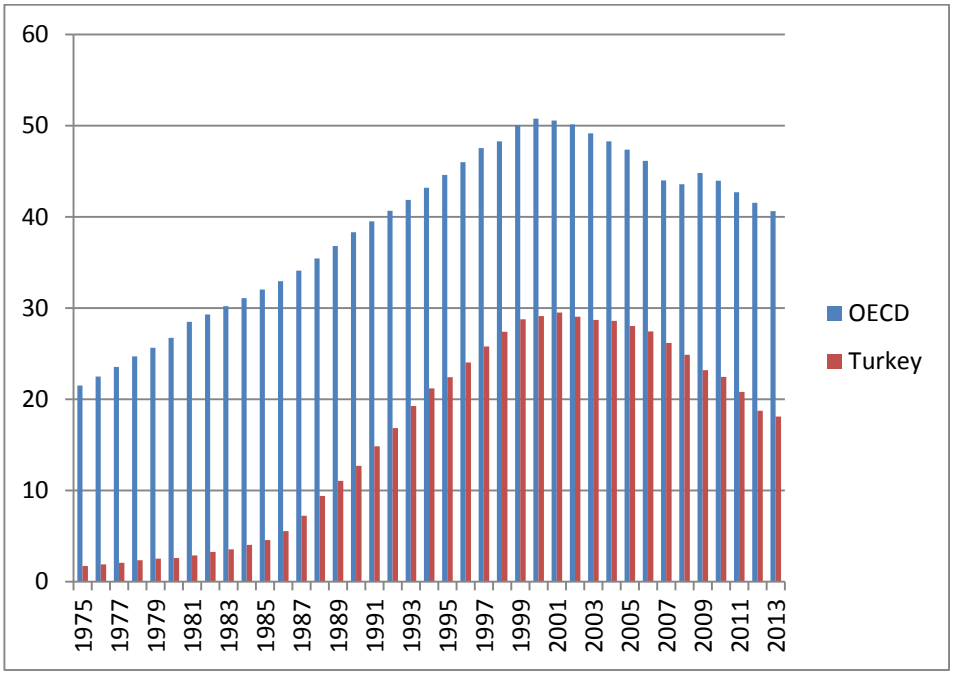
www.worldbank.org, (05.01.2015)

Table 3: Economic Indicators for Turkey and OECD Countries 2012

	Turkey	**OECD**
Inflation	8.9%	2.43%
Unemployment	9.2%	8.2%
GDP	788 billion $	1.413 billion $
GDP per Capita	10.661 $	40.221 $

www.worldbank.org, (05.01.2015)

Figure 1: Telephone Lines (per 100 people)

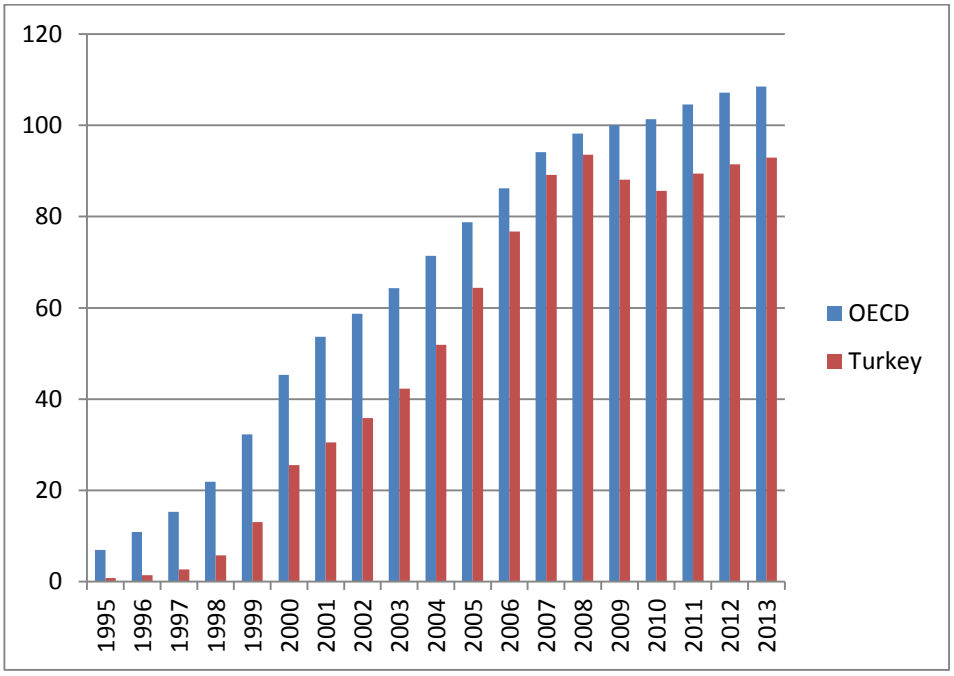


Source: www.worldbank.org, (05.01.2015)

Figure 1 shows that telephone lines per 100 people increased from 1975 to 2013 both in Turkey and in the OECD countries. The reasons behind this increase can be that telephone is faster than writing a letter or sending messages; it makes people more social and it increases the interaction between the people. Some issues such as sensitivity and confidentiality may need a personal phone call. Without the opportunity for a two-way communication, the issue may be misunderstood and wrong decisions may be taken. From the perspective of business people, for marketing their products

they use telephone rather than face-to-face communication. By this way, business people reach more people and increase their chance of sales and profit. As quality of the telecommunication infrastructure increases, there is an improvement in the productivity, competitiveness of firms and there is a reduction in the cost of capital and cost of doing business (Kaur and Malhotra, 2014:41).

Figure 2: Mobile Cellular Subscriptions (per 100 people)



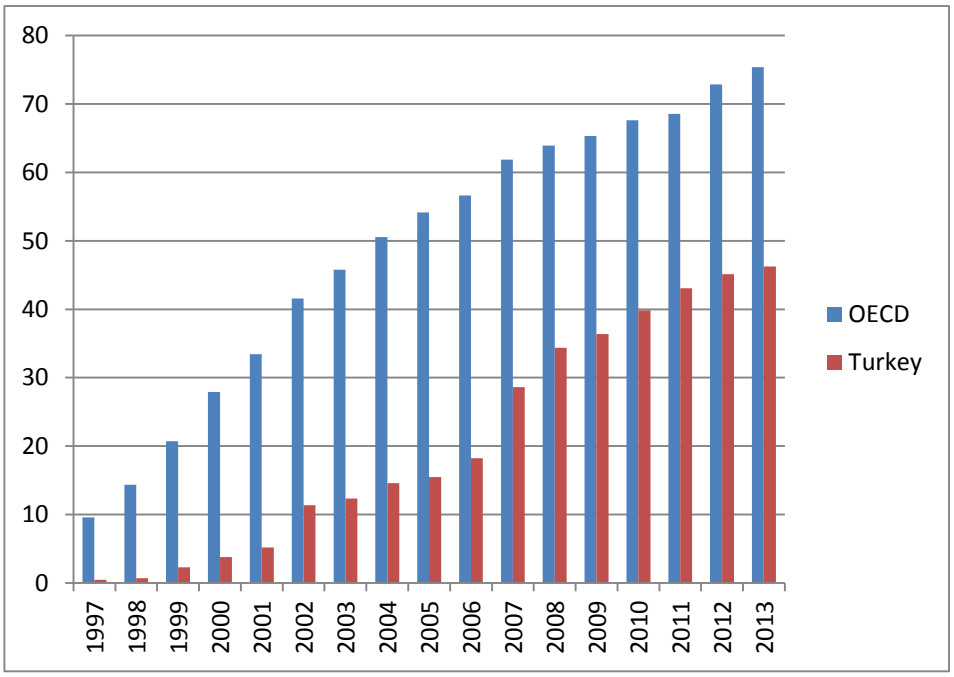
Source: www.worldbank.org, (09.01.2015).

Figure 2 shows that mobile cellular subscriptions per 100 people increased from 1995 to 2013 both in Turkey and in the OECD countries. This is because, mobile cellular phones brought advantages such as giving the chance to have continuous contact with the family members and business co-workers and being able to access the emails without having need to personal computers. Also, their ability to store data and to take photo made them precious which led to increase of their usage. To give an example to continuous contact, when they are lost while travelling by their car or when their car breaks down. If they have a mobile phone with them, they can immediately call their friends and family rather than going to their home. By this way, they save time.

Mobile phones can be used for listening to music too which makes long journeys fun. With the help of mobile phones, parents are able to reach their kids whenever they want.

Mobile cellular subscription introduced people with a term called m-commerce. M-commerce brings advantages in areas such as banking and financial institutions, paying receipts for things such as power or gas and buying tickets for services such as trains, taxis and online shopping (Kaur and Malhotra, 2014:32).

Figure 3: Internet Users (per 100 people)



Source: www.worldbank.org, (10.01.2015).

Figure 3 shows that internet users per 100 people increased from 1997 to 2013 both in Turkey and in the OECD countries. With the presence of internet, people had the chance to reach to information quickly and easily which helped them to reach more resources for the students and finalize business deals in a shorter time. By the help of the internet, people became able to watch television programs online. With the help of internet, people met with a new term called e-banking. E-banking lets people handle their banking operations from their home without going to banks. Governments are now

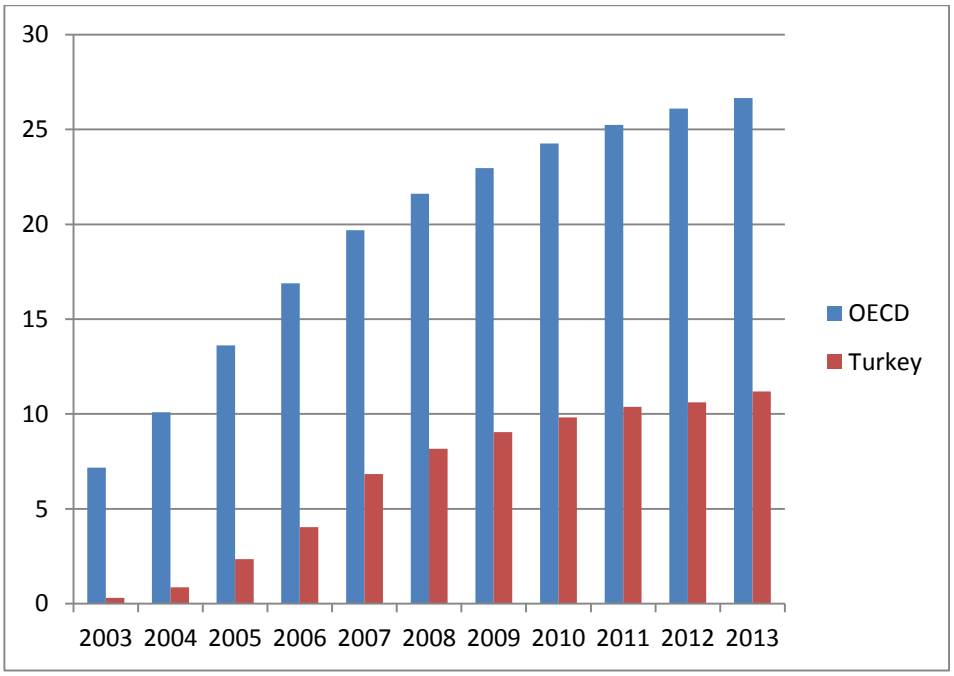
providing e-services for their citizens. By this way, people do not have to wait in queues.

Internet usage brings advantages in the area of tourism too. Processes and value chains in the industries such as tourism, travel, hospitality and catering can be handled on-line (Kaur and Malhotra, 2004:41).

Internet usage makes information to be stored on-line which leads to less hard copy. E-books are emerging and consequently, less physical material needs to be stored in libraries (Tisdell, 2014:6-7).

Internet leads to e-learning which leads to reduction in teaching and lecturing to large classes. As a result of this, in the area of teaching, economies of scale are becoming possible. As the number of lecturers and materials prepared at houses for teaching decreases, there is a decrease in the staff employed for this purpose. This staff can be moved to areas to supply more tutorials and demonstrations (Tisdell, 2014:14).

Figure 4: Fixed Broadband Internet Subscribers (per 100 people)



Source: www.worldbank.org, (05.02.2015).

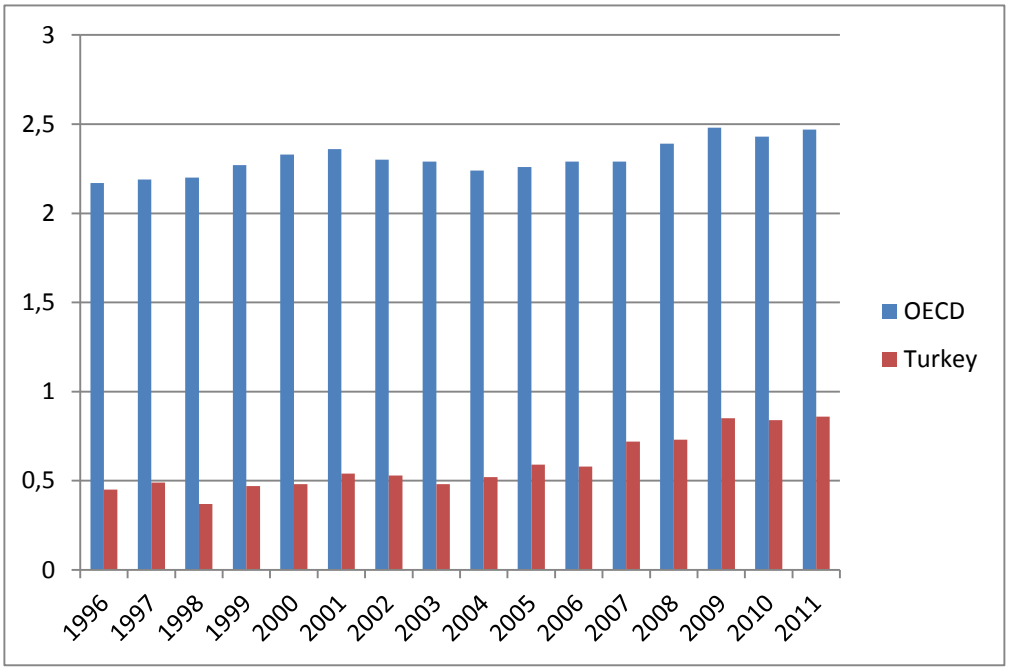
Figure 4 shows that there was an increase in the fixed broadband internet subscribers per 100 people from 2003 to 2013 both in Turkey and in the OECD countries. Fixed broadband internet allows users to connect to the internet at faster speeds than a normal internet connection. With the help of this advantage, people are able to download large files at a shorter time. Fixed broadband internet made easy to reach to healthcare services for the people who live far away from the place where the healthcare services are provided. With the help of social media, people can take photos, write about their opinions about daily life or share the music that they like. Fixed broadband internet is also helpful for people who are lost. By the fixed broadband internet, security forces can communicate between each other faster and reach to the lost person in a shorter period of time which saves life.

In addition, goods can be produced in a lesser time and services can be delivered efficiently and faster. Increased use of land, labor, capital and business resources and increased productivity of resources are among possible positive effects. (Kaur and Malhotra, 2014:41).

Internet helps to reduce input costs and causes a decrease in market transaction costs, material and transport costs and also causes an increase in the sort of available commodities (Tisdell, 2014:1).

Moreover, people can increase their knowledge about prices of goods via internet and this may lead to more competition between companies (Tisdell, 2014:7).

Figure 5: Research and Development Expenditure (percentage of GDP)



Source: www.worldbank.org, (05.02.2015).

Figure 5 shows that the ratio of research and development expenditures to GDP increased from 1996 to 2011 both in Turkey and in the OECD countries. Research and development causes an increase in sales. For a country, this means an increase in exports because research and development leads to better produced goods which means more attraction at the international markets. Another reason can be that research and development expenditure leads to competitive advantage. More research and development expenditure may lead to cheaper products which will bring price advantage at the international markets.

From the perspective of Turkey, government policies that are applied have an important role. Turkish Science and Technology Policy 1993-2003, Law on Supporting Research and Development activities, Ninth Development Plan and National Science, Technology and Innovation Strategy 2011-2016 are some important policy initiatives. To sustain competitiveness in the World, continuous research and development expenditure is a must. Governments which invent something that the other countries do not, can go one step further and increase the welfare of their citizens. Also, they can sell

their knowledge without giving all the secrets about their innovation and create resources for their countries.

CHAPTER TWO
LITERATURE SURVEY

In this part, studies about the effect of information and communication technology on economic growth are summarized. The general result from the research on this topic is that, information and communication technology has positive effect on economic growth.

Hardy (1980) examined the effect of telephone on economic development by using cross sectional time series data for 60 nations for a period of 13 years. According to path analysis and cross-lagged correlation techniques, telephone does not have any effect on economic growth.

Beil et al. (2003) investigated the relationship between telecommunications investment and economic growth in the United States for the years 1947 to 1996 by using Granger-Sims causality tests. They found that investment in the area of telecommunication does not lead to economic activity and policies proposed for accelerating the economic activity by increasing telecommunications investment may not be successful.

Bozkurt and Dursun (2006) performed a study about interaction between the information and communication technologies and foreign direct investment flows in Turkey for the years between 1980 and 2004 with a co-integration analysis. Foreign direct investment was the dependent variable and openness to abroad, GDP per capita and information and communication technology investment was independent variable. Bozkurt and Dursun (2006) found that information and communication technology do not have any indirect impact on the economic growth by attracting more foreign direct investment.

Cronin et al. (1991) investigated the relationship between telecommunications investment and economic growth for the United States by using time series data for years between 1958 and 2008. Writers found that telecommunications investment had an impact on economic activity and economic activity had an impact on telecommunications investment.

Pohjola (2000) examined the relationship between information technology and economic growth by using the neoclassical growth model for thirty nine countries for the years between 1980 and 1995 with a cross country approach. In the study, real gross domestic product per working age population, compound average annual growth rate of working age population, average annual ratios of real domestic investment to real gross domestic product, average share of working age population in secondary school and average of annual ratios of spending on information technology to nominal gross domestic product were used as variables. The results showed that information technology had a positive impact on gross domestic product growth but it was not significant. In addition, information technology's impact on economic growth was stronger for the twenty three developed countries out of thirty nine countries.

Oulton (2001) examined the connection between information and communication technology and productivity growth in the United Kingdom by using growth accounting approach for both aggregate input and aggregate output. He found that for both, contribution of information and communication technology had positive impact; on the other hand, impact of information and communication technology on both labor productivity and total factor productivity was moderate.

Röller and Waverman (2001) investigated the impact of telecommunication infrastructure on economic development. In their study, non-residential capital stock, total labor force, penetration rate (main lines per capita), gross domestic product, price of telephone service, geographic area, government surplus or deficit, waiting list for main lines, investment in telecom infrastructure, dummy variable for U.S. and Canada and time trend were used as the variables. The results signaled that telecommunication infrastructure led to economic growth.

Van Ark et al. (2003) analyzed the relationship between information and communication technology (ICT) investment and economic growth for the European Union for the years between 1980 and 2000. They found that the impact of the production of information and communication technology on growth of total factor productivity was lower in the European Union compared to United States and there was difference between the European Union countries in terms of information and

communication technology capital and contribution of information and communication technology service flows to growth of productivity.

Basu et al. (2004) investigated if information and technology explained the reasons behind the productivity increase both in the United Kingdom and United States. They found that in the United States, ICT capital growth led to total factor productivity growth when there were lags of five to fifteen years. For the United Kingdom, after 1995, ICT investment was positively related with productivity growth.

Piatkowski (2004) analyzed the impact of the information and communication technologies on the output and labor productivity growth for the Central and Eastern European countries (Bulgaria, Czech Republic, Hungary, Poland, Romania, Russia, Slovakia and Slovenia) for the period between 1995 and 2001. He found that information and communication technologies had an important contribution to the GDP and labor productivity growth in the Central and Eastern European Countries.

Agarwal and Datta (2004) investigated the relationship between telecommunications and economic growth by using the panel data approach for the twenty two OECD countries. In the study, gross domestic product, population, government consumption and investment were used as the variables. They found strong and positive correlation between telecommunications infrastructure and economic growth.

Kim (2004) found that information technology had contribution to growth of productivity in growth accounting and led to factor saving in input-output analysis and also information technology industries had impact in reduction of inflation.

Mas and Quesada (2005) prepared a study about the information and communication technology and economic development for Spain which analyzed the quantification of productivity growth in Spain for the years between 1985 and 2002. They computed the effect of employment, non ICT and ICT capital, labor qualification and total factor productivity to output and labor productivity growth. In the mid-1990s, information and communication technology capital had a positive effect to the sustainment of the labor productivity.

Oulton and Srinivasan (2005) analyzed the productivity growth in the UK industries between 1970 and 2000 from the perspective of structural change and the role of the information and communication technologies. Their dataset included 34 industries from the Bank of England and, they used growth accounting method. They found that ICT capital had contributed to labor productivity growth in the market sector.

Ding and Haynes (2006) examined the effect of telecommunications infrastructure in regional economic development in China for 29 regions between 1986 and 2002 with a dynamic fixed effects model. They found that telecommunications infrastructure was an important factor for explaining regional economic development of China and regions at early stage of development had more chance to gain from telecommunications infrastructure.

Heshmati and Yang (2006) prepared a study about the contribution of ICT to the Chinese economic growth. They used GDP, capital stock, labor and ICT capital stock as their data. Growth accounting and regression analysis were the two methods used in their study. They found that information and communication technologies had a positive impact on the Chinese economic growth.

Jorgenson and Vu (2007) analyzed the impact of information technology in World economic growth for the years between 1989 and 2004. In their study, fourteen major economies were included from seven regions. They found that, among the G7 countries, United States had the best results for the information technology's contribution to economic growth. After 1995, information technology investment had higher contribution to the economies of developing Asia, Latin America, Eastern Europe, North Africa, Middle East and Sub-Saharan Africa.

Koçak and Yamak (2007) investigated effects of knowledge economy expenditures on economic growth for the years between 1993 and 2005 for the fifty developed and developing countries by using panel data analysis. They found that for the G-8 countries, information technology expenditures have a strong and positive effect for the economic growth but from the perspective of developing and developed countries, information technology had zero or negative effect on the economic growth. Also, it was found that for the years between 2001 and 2005, the effect of expenditures

on information technology economic growth was strong for industrialized countries and weak for the developing countries.

Sobhani (2008) investigated the impact of information technology on productivity from the perspective of telecommunication industry of Iran. He found that information technology investment had positive effect on Telecommunication Company of Tehran and business process engineering was the supplementary investment for developing, supporting and stabilizing the positive information technology effects.

Erdil et al. (2009) prepared a study about whether the information and communication technologies led to sustainable economic growth in the underdeveloped and developing countries. The dataset covered the years between 1995 and 2006 and 131 underdeveloped and developing countries. Economic growth rate was the dependent variable and high technology exports, the percentage share of the value of high technology exports in manufactured exports and information and communication technology stock and one-year lagged value of gross domestic product were the independent variables. Erdil et al. found that information and communication technology had a positive impact on economic growth.

Ismail and Kooshki (2011) examined the impact of information and communication technologies on economic growth of the ten newly industrialized countries which were Mexico, Brazil, China, India, South Korea, Malaysia, Singapore, Philippines, Thailand and Turkey for the years between 1990 and 2008 with an endogenous production growth model by using panel data. The results showed that information and communication technology had a significant positive effect on economic growth of the ten countries.

Yıldız (2012) investigated the effect of telecommunications investment on economic growth of the OECD countries by panel data approach for the years 1990 and 2009. In the study, real gross domestic product, real gross domestic product per person, annual investment in the telecommunication sector, ratio of public expenditure to gross domestic product, annual fixed capital investment, foreign trade and annual telecommunication revenue were used as variables. According to the study, telecommunications investment had a positive impact to economic growth.

Yurtkur and Zeren (2012) prepared a study about the impact of telecommunication infrastructure to economic growth for Turkey by using the geographically weighted regression approach. In the analysis, logarithmic per capita gross domestic product was the dependent variable and logarithmic per person telephone airtime minutes, logarithmic industrial production, high school enrollment rate and logarithmic urban population were the independent variables. According to the analysis, per person telephone airtime minutes had a positive impact on the gross domestic product.

Abounoori et al. (2012) analyzed the impact of information technology on productivity of labor in small manufacturing firms in Semnan province of Iran for the years between 2001 and 2007. They found that growth rate of information technology capital, non-information technology capital, human capital and total factor productivity have positive and meaningful effect on labor productivity. Even if the tow period-lagged growth rate of information technology capital was positive and meaningful, it was not significant on the growth rate of labor productivity.

Türedi (2013) prepared a study about the impact of the information and communication technologies to economic growth for the developed and developing countries. In the study, panel data analysis was used. Per capita gross domestic product was the dependent variable and fixed capital investment per person, enrollment at the high school level and information and communication technology indicator which consisted of personal computer, mobile and fixed line subscriber, internet users and installed telephone lines were the independent variables. The study found that information and communication technologies had a positive impact on the economic growth.

Farhadi et. al (2013) prepared a study about the relation between the information and communication technology use and economic growth for 159 countries. In the model, generalized method of moment estimator was used. GDP capita was the dependent variable and internet user penetration, fixed broadband penetration and mobile broadband penetration were the independent variables. They found that

information and communication technology use had a significant effect on the economic growth of the analyzed countries.

Artan et al. (2014) prepared a study about the effects of information and communication technologies on economic growth of the transition economies for the years between 1994 and 2011. In the study, gross domestic product was the dependent variable and phone line per 100 people, internet usage per 100 people, trade as a percentage of gross domestic product, population growth rate as annually change, higher education schooling and gross fixed capital formation as annually change were the independent variables. The study found that information and communication technologies had a positive impact on the economic growth.

Skare and Tomic (2014) examined the relationship between innovation, productivity and growth for twenty five OECD countries for the period between 1950 and 2013. In their study, they used the autoregressive integrated moving average (ARIMA) modeling techniques and Beveridge-Nelson univariate decomposition. They found that technological innovation led to growth even if it showed difference from the perspective of intensity and time between the countries.

Binuyo and Aregbeshola (2014) investigated the effect of information and communication technology on performance of the commercial banks of South Africa for the years between 1990 and 2012 by using panel data with the help of Pedroni and Kao methods. Writers found that information and communication technology usage boosted return on capital employed and asset return.

As a result, it can be said that although the impact changes from country to country or region to region, information and communication technology is found to have positive effects on economic growth.

CHAPTER THREE
EMPIRICAL ANALYSIS

3.1. DATA AND METHOD

The analysis aims to investigate the impact of information and communication technology on economic growth and consequently the hypotheses of the study is that information and communication technology has positive effect on economic growth. Time series data is used in the analysis.

In the analysis of the impact of information and communication technology on economic growth, mobile cellular subscriptions per 100 people, internet users per 100 people, unemployment, GDP per capita and GDP per capita growth were used as variables.

Augmented Dickey-Fuller unit root test can be used in various situations. These are, during the situations time series is flat and has a slow turning around zero; under circumstances when time series is flat and has a slow turning around a value which is not zero and lastly, when time series has a trend in itself and has potentially slow turning around a trend line which can be drawn with the help of data.

A) The equation which time series is flat and has a slow turning around zero is as follows:

$$\Delta z_t = \theta z_{t-1} + \alpha_1 \Delta z_{t-1} + \alpha_2 \Delta z_{t-2} + \cdots + \alpha_p \Delta z_{t-p} + \alpha_t$$

In this equation, augmenting laps which are denoted by p are determined by two ways. These are minimization of the Schwartz Bayesian information criterion and minimization of the Akaike information criterion or dropping the lags until the last lag becomes statistically significant. The null hypothesis for this equation is

$H_0: \theta = 0$, data should be differenced to be stationary.

$H_1: \theta < 0$, data should not need to be differenced because it is stationary.

B) The equation which time series is flat and has a slow turning around a value which is not zero is shown as:

$$\Delta z_t = \alpha_0 + \theta z_{t-1} + \alpha_1 \Delta z_{t-1} + \alpha_2 \Delta z_{t-2} + \cdots + \alpha_p \Delta z_{t-p} + \alpha_t$$

In this equation, minimization of the Schwartz Bayesian information criterion, minimization of the Akaike information criterion and dropping lags until the last lag becomes statistically significant are the indicators for the determination of the augmenting laps. To determine whether data should be differenced to make it stationary or not, t-statistic on θ coefficient is used. Test is left-tailed.

$H_0: \theta = 0$, data should be differenced to be stationary.

$H_1: \theta < 0$, data should not need to be differenced because it is stationary.

C) The following is the equation which time series has a trend in itself and has potentially slow turning around a trend line which can be drawn with the help of data.

$$\Delta z_t = \alpha_0 + \theta z_{t-1} + \gamma t + \alpha_1 \Delta z_{t-1} + \alpha_2 \Delta z_{t-2} + \cdots + \alpha_p \Delta z_{t-p} + a_t$$

In this equation, minimization of the Schwartz Bayesian information criterion, minimization of the Akaike information criterion and dropping lags until last lag becomes statistically significant are the indicators for the determination of the augmenting laps as the former two equations and to determine whether data should be differenced to make it stationary or not, t-statistic on θ coefficient is used as the former equation and the equation is again left-tailed.

$H_0: \theta = 0$, data should be differenced to be stationary.

$H_1: \theta < 0$, trend of the data is stationary and an analysis is needed with the help of usage of a time trend.

3.2. AUGMENTED DICKEY-FULLER TEST RESULTS

Table 4: Augmented –Dickey Fuller Results

	GDP per Capita	Unemployment	GDP per Capita Growth	Internet Users per People	Mobile Cellular Subscriptions per 100
Test Statistic	0.068292	-1.408768	-4.638347	1.670506	-1.091137
1% Level	-3.831511	-3.831511	-3.831511	-3.831511	-3.857386
5% Level	-3.029970	-3.029970	-3.029970	-3.029970	-3.040391
10% Level	-2.655194	-2.655194	-2.655194	-2.655194	-2.660551

To determine whether variables used in regression analysis are stationary or not, Augmented-Dickey Fuller test is used. The results showed that, GDP per capita, unemployment, internet users per 100 people and mobile cellular subscriptions per 100 people are non-stationary because their test statistic values are not less than 1%, 5% and 10% level values and prob. values are more than 0.05, on the other hand, GDP per capita growth is stationary because its' test statistic value is more than 1%, 5% and 10% level.

Internet users per 100 people and mobile cellular subscription per 100 people are strongly related with the information and communication technologies. It is believed that combining these two with unemployment, GDP per capita and GDP per capita growth is going to give logical results. In order to test relation of information and communication technology with economic growth, we first regressed GDP per capita growth on change in mobile cellular subscriptions per 100 people, change in internet users per 100 people, change in unemployment and change in GDP per capita and then we regressed change in GDP per capita on change in mobile cellular subscriptions per 100 people, change in internet users per 100 people, change in unemployment and GDP per capita growth.

3.3. REGRESSION RESULTS

Our hypotheses are:

H_1: Mobile cellular subscriptions per 100 people leads to economic growth and higher income per capita.

H_2: Internet users per 100 people leads to economic growth and higher income per capita.

We use Cobb-Douglas production function to estimate the effect of ICT on economic growth:

Y=F (K, L)

Where Y is GDP, K is capital and L is labor force. Our analysis adds ICT variables to the Cobb-Douglas production function:

Y= F (K, L, MCS, IU) where MCS is mobile cellular subscription per 100 people and IU is internet users per 100 people.

So the production function is as follows:

$Y=A.K^{\alpha}L^{1-\alpha}MCS^{\beta 1}IU^{\beta 2}$

When we take the logarithm of the functions:

$LogY= logA+\alpha logK+(1-\infty)logU+B_1 logMCS+B_2 logIU$

Unemployment is used as a proxy to labor force. Data is not available for labor force.

Table 5: Descriptive Statistics (1993-2012)

	Mean	**Standard Deviation**	**Median**
GDP per Capita	6621.565	1055.165	6148.885
GDP per Capita Growth	2.667	5.022	4.930
Unemployment	9.340	1.978	9.500
MCS per 100 People	44.431	37.191	39.080
IU per 100 People	15.608	16.294	11.855

Table 5 gives information about mean, standard deviation and median of GDP per capita, GDP per capita growth, unemployment, mobile cellular subscriptions per 100 people and internet users per 100 people.

Mean of GDP per capita, GDP per capita growth, unemployment, mobile cellular subscriptions per 100 people and internet users per 100 people is 6621.565, 2.667, 9.340, 44.431 and 15.608 respectively.

Standard deviation of the variables is 1055.165 for GDP per capita, 5.022 for GDP per capita growth, 1.978 for unemployment, 37.191 for mobile cellular subscriptions per 100 people and 16.294 for internet users per 100 people.

Median value of GDP per capita is 6148.885, GDP per capita growth is 4.930, unemployment is 9.500, mobile cellular subscriptions per 100 people is 39.080 and lastly internet users per 100 people is 11.855.

Table 6: Correlation Matrix for MCS per 100 People and IU per 100 People

	MCS per 100 People	**IU per 100 People**
MCS per 100 People	1.000000	0.943817
IU per 100 People	0.943817	1.000000

Table 6 shows that mobile cellular subscriptions per 100 people and internet users per 100 people are correlated with each other. Because of this, these variables are going to be used one-by-one in the regressions.

Table 7: Regression Results for GDP per Capita

	Regression 1	**Regression 2**
C	6876.150 (17.529)	6490.438 (13.608)
Unemployment	-190.567 (-3.791)***	-101.965 (-1.761)*
MCS per 100 People	34.330 (12.841)***	-----
IU per 100 People	-----	69.420 (9.878)***
R-Squared	0.936	0.898
F-Statistic	0.000	0.000

***=significant at %1
**=significant at %5
*=significant at %10

Table 7 shows regression results for the dependent variable GDP per capita for sample years between 1993 and 2012. In regression 1, GDP per capita growth is regressed on unemployment and mobile cellular subscriptions per 100 people. Unemployment and mobile cellular subscriptions per 100 people have significant effect but mobile cellular subscriptions per 100 people have positive effect compared to unemployment.

In regression 2, GDP per capita is regressed on unemployment and internet users per 100 people for sample years between 1993 and 2012.. There is evidence of negative and insignificant relation between unemployment and GDP per capita, on the other hand, positive and significant relationship is seen between GDP per capita and internet users per 100 people.

Table 8: Regression Results for GDP per Capita Growth

	Regression1	**Regression 2**
C	6.807 (0.936)	5.967 (0.847)
Unemployment	-0.604 (-0.648)	-0.447 (-0.523)
MCS per 100 People	0.034 (0.682)	-----
IU per 100 People	-----	0.056 (0.542)
R-Squared	0.029	0.019
F-Statistic	0.780	0.848

***=significant at %1
**=significant at %5
*=significant at %10

Table 8 shows regression results for the dependent variable GDP per capita growth. In regression 1, GDP per capita growth is regressed on unemployment and mobile cellular subscriptions per 100 people for sample years between 1993 and 2012. Unemployment has negative and insignificant effect on GDP per capita growth and there is positive and insignificant relation between GDP per capita growth and mobile cellular subscriptions per 100 people.

In regression 2, GDP per capita is regressed on unemployment and internet users per 100 people for sample years between 1993 and 2012. Between GDP per capita growth and unemployment, there is negative and insignificant relationship and there is evidence of positive and insignificant relationship between GDP per capita growth and internet users per 100 people.

CONCLUSION

The aim of this study is to investigate the contribution of information and communication technology to economic growth of Turkey with the help of the following variables; mobile cellular subscriptions per 100 people, internet users per 100 people, unemployment, GDP per capita and GDP per capita growth. Mobile cellular subscriptions per 100 people, internet users per 100 people and GDP per capita are in absolute values, unemployment and GDP per capita growth are in percentage values..

In the empirical analysis section, Augmented–Dickey Fuller Test is applied first in order to determine whether the variables are stationary or non-stationary and then in order to test the hypotheses GPD per capita and GDP per capita growth are regressed on the variables for the period between 1993 to 2012.

The Augmented-Dickey Fuller Test shows that GDP per capita, internet users per 100 people, mobile cellular subscriptions per 100 people and unemployment are non-stationary, on the other hand, GDP per capita growth is stationary.

In the regression analysis that GDP per capita is the dependent variable, results show that in regression 1, there is evidence of negative relationship between GDP per capita and unemployment at 1% significance level and there is positive relation between GDP per capita and mobile cellular subscriptions per 100 people at 1% significance level. In regression 2, there is evidence of positive relationship between GDP per capita and internet users per 100 people at 1% significance level and there is negative relationship between GDP per capita and unemployment at 10% significance level.

In order to go further in information and communication technologies, there are some steps that can be taken. In the area of research and development, mechanisms that encourage research and development collaborations between universities, industrial or public institutions and individual researchers can be made more functional (2010, UBTYS:12).

In order to increase information technology staff and improving sectoral distribution, directing young people to research and development areas, increasing

number of technician and equal staff, popularizing science and technology culture in the society are advised (2010, UBTYS:10).

In the area of small and medium sized enterprises, it is advised that small technology tendency and management talent should be improved, mechanisms related with innovation and research and development human resource employment should be improved, in research infrastructures, requirements of these enterprises should be taken into consideration and usage of the infrastructures by these enterprises should be activated (2010, UBTYS:13).

For Turkey, in the area of internet, creation of Cyber Incidents Response Organization is planned for detecting threats occurring in cyber space as soon as possible and for developing and sharing cautions in order to remove or reduce potential incident effects (NCSS:18).

Information security management program in critical infrastructures is planned. With this plan, determination of the important infrastructures which can be main target of cyber threats, methods of sectoral risk analysis, requirements of sectoral emergency action plans and determination and implementation of sectoral business continuity plans and sectoral security protections are planned (NCSS:28).

It is decided that priority should be given to informatics, advanced technology materials, biotechnology, nuclear technology and space technology to reach to targets as soon as possible.

It is believed that in order to increase competitiveness in supply of internet services, internet service providing firms should be able to reach to necessary infrastructures in the supply of internet services with moderate prices and regulations should be put in practice in reaching to local network which is necessary in the supply of broadband Asymmetric Digital Subscriber Line (ADSL) service.

For increasing share of private sector in research and development activities, it is suggested that financial resource should be created for research and development activities in private companies, establishing research and development units should be encouraged for multinational companies that make investment in Turkey, unique design

should be encouraged rather than production based on license agreement and patent and intellectual property legislation should be updated.

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