T.C.
ISTANBUL AYDIN UNIVERSITY
INSTITUTE OF GRADUATE STUDIES

A PANEL DATA ANALYSIS OF INFORMATION AND COMMUNICATION TECHNOLOGIES EFFECTS ON INTERNATIONAL TRADE

MASTER'S THESIS

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Department of Business
Business Administration Program

FEBRUARY, 2021

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ONAY FORMU (APPROVAL)

DECLARATION

I hereby declare that this master's thesis titled "A Panel Data Analysis of Information and Communication Technologies Effects on International Trade" has been written by myself following 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 honor.

Noorullah MOHAMMADI

To my family for their encouragement, belief, and love for life.

FOREWORD

First of all, I thank God most warmly for having provided me the wisdom, energy, knowledge, and devotion to this mission successfully. Second, I would like to convey to my advisor Dr. ÖZGÜL UYAN my sincere gratitude for the valuable guidance and understanding during the course of the research.

I want to thank my family in particular for their overwhelming support and their unreserved contribution as well as praying for me throughout all my life.

February, 2021 Noorullah MOHMMADI

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ABBREVIATIONS

BRICS : Brazil, Russia, India, China, and South Africa

Cont'd : Continued

ed. : Edition

e.g. : Exempli gratia (for example)

et al. : Et alia (and others)

etc. : Et cetera (and so on)

EU : European Union

FDI : Foreign Direct Investment

GCI : Global Competitiveness Index

GII : Global Innovation Index

ICT : Information and Communication Technology

IT : Information Technology

IT-CI : Information Technology Industry Competitiveness Index

ITU : International Telecommunication Union

MIS : Measuring Information Society

NRI : Network Readiness Index

OECD : Organization for Economic Cooperation and Development

SME : Small and Medium Size Enterprise

SCM : Supply Chain Management

UK : United Kingdom

UN : United Nations

UNESCO : United Nations Educational, Scientific and Cultural Organization

USA : United States of America

WWW : World Wide Web

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A PANEL DATA ANALYSIS OF INFORMATION AND COMMUNICATION TECHNOLOGIES EFFECTS ON INTERNATIONAL TRADE

ABSTRACT

The rapid development of information and communication technology (ICT) and is one of the main factors in increasing the efficiency, productivity, and overall performance of a system, has encouraged a growing number of researchers to study and measure the effects of this technology on economic growth, this thesis also aims to explore the increasing importance of ICT usage in international trade which one of the key factors in economic growth. Different indexes in measuring ICT usage are reviewed with their pillars and the top country rankings. Taking the Global Competitiveness Index 2019 as the source, this study examines the effects of ICT on the integration of countries in international trade by considering the Trade/GDP ratio as an indicator of their integration. The panel data is generated by taking 21 countries and ten years into account without time lag and eight years with two years of time lag. The results show that there is a significant positive relationship between ICT usage and a country's Trade/GDP ratio. Especially, the Individuals using the internet, University-industry collaboration in research and development (R&D), and Availability of scientists and engineers are seen to be three of the most influential factors to affect the Trade/GDP ratio positively, while on the other hand, firms' FDI and technology transfer and Government procurement of advanced technology products are the most negatively sub-pillars of ICT usage. Additionally, the University-industry collaboration in research and development also seems to be candidates for being influential factors for the Trade/GDP ratio in the long run.

Keywords: *Economic Growth, ICT, International Trade*

BİLGİ VE İLETİŞİM TEKNOLOJİLERİNİN ULUSLARARASI TİCARET ÜZERİNDEKİ ETKİLERİ ÜZERİNE BİR PANEL VERİ ANALİZİ

ÖZET

Bilgi ve iletişim teknolojisinin (ICT) hızlı gelişimi ve bir sistemin verimliliğini, üretkenliğini ve genel performansını artırmada ana faktörlerden biri olması, artan sayıda araştırmacıyı bu teknolojinin etkilerini incelemeye ve ölçmeye teşvik etmiştir. Bu tez aynı zamanda ekonomik büyümede kilit faktörlerden biri olan uluslararası ticarette BİT kullanımının artan önemini araştırmayı amaçlamaktadır. BİT kullanımının ölçülmesindeki farklı endeksler, bileşenleri ve en üst ülke sıralamaları ile incelenmektedir. 2019 Küresel Rekabet Edebilirlik Endeksi'ni kaynak olarak alan bu çalışmada, ICT'nin ülkelerin uluslararası ticarete entegrasyonuna etkileri, entegrasyonların bir göstergesi olarak Ticaret / GSYİH oranını dikkate alarak incelenmektedir. Panel verileri, 21 ülke ve on yıl gecikmesiz, sekiz yıl iki yıllı gecikmeli olarak dikkate alınarak oluşturulmuştur. Sonuçlar, BİT kullanımı ile bir ülkenin Ticaret / GSYİH oranı arasında önemli bir pozitif ilişki olduğunu göstermektedir. Özellikle internet kullanan bireyler, araştırma ve geliştirmede üniversite sanayi işbirliği (Ar-Ge) ve bilim insanı ve mühendislerin mevcudiyeti Ticaret / GSYİH oranını olumlu yönde etkileyen en etkili faktörlerden üçü olarak görülürken, diğer yandan, firmaların DYY ve teknoloji transferi ile ileri teknoloji ürünlerinin Devlet tarafından satın alınması, BİT kullanımının en olumsuz alt bileşenleridir. Ek olarak, araştırma ve geliştirmedeki Üniversite-sanayi işbirliği, uzun vadede Ticaret / GSYİH oranı için etkili faktörler olmaya aday görünüyor.

Anahtar Kelimeler: *Ekonomik Büyüme, BİT, Uluslararası Ticaret*

1 INTRODUCTION

1.1 Background of the Study

Until 1960, communication was used only between one to another person. But over the past decade, ICT had eye-catching growth in the global arena (Leon & Leon, 1999), which made it researchers, merchants, students, and academic personals easy to access required data, the data which are processed and collected from various sources using different computer languages such as C, C++, Java...etc and called computer-based data which can be easily stored. Computer-based information is used in solving intricate scientific problems in some sectors such as art, cultural, historical, accounting, financial, domestic sector, and medical sector. Hence, we can say that all dimensions of our day-to-day life got impacted by computers with ICT. Unesco defines ICT Diverse set of technological tools and resources used to transmit, store, create, share or exchange information. These technological tools and resources include computers, the Internet (websites, blogs, and emails), live broadcasting technologies (radio, television, and webcasting), recorded broadcasting technologies (podcasting, audio, and video players and storage devices), and Telephony (fixed or mobile, satellite, Visio/video-conferencing, etc (Unesco, n.d.).

For centuries humans used to exchange their necessities with each other where people exchange something they had extra for something which they don't have which formed the trade but after centuries the form of these exchanges changed, nowadays people can easily exchange their good with people abroad which is called international trade, in the simple way international trade is export or import of capital, services, and goods across the globe.

In the past exchange of goods between countries was not that easy it used to take months to trip a country and sell or buy, merchants needed to travel overseas and visit countries one by one to find the goods they need and sell the good they carry with, but these days with ICT and computers help people don't need to travel overseas and visit countries one by one, because they can find whatever they need from a place called the internet and also they can sell easily their goods and services, it also helps

customers and merchants to contact and track their goods easily in simple words we can say that international trade has got fully affected by ICT.

Every country is ranked by its capabilities and there are too many pillars to compare a country's capability with another so an organization called the World Economic Forum take a step to bring all these pillars under 12 main pillars and it can help to compare a country's capability with others and ICT capability is also one of these pillars and we will compare all 11 pillars and ICT with Trade to GDP ratio to know how ICT impacts the trade to GDP ratio of countries and up to which level.

1.2 Purpose and Significance of the Study

From the 1st day of ICT usage, it has taken intention of many researchers, merchants, academic personals and students attention on it because of its importance and growth in usage and many researchers, academic personals and the student did researches and wrote about its importance on almost every sector, however bypassing time and invention of new technologies and methods it gains to its importance, in this thesis the importance of ICT in international trade explained, unlike other studies this study tried to go deeper and tried to introduce the high potential and effective sub-pillars of ICT and other pillars which has a direct effect on international trade. Thus the main purpose of this study is to know if there is any relationship between ICT and international trade or not, and if there is a relationship with which sub-pillar of ICT, or whether other main pillars have more effect on international trade.

1.3 Research Method

In this thesis, GCI data of 21 countries including developed and developing countries for 10 years (from 2009 to 2019) is used to form the independent variable, and trade to GDP ratio is used for the dependent variable, a Pearson correlation is taken to know and remove the high correlated pillars which could cause confusion, then Hausman test is applied for developed and developing countries separately to know which panel analysis is appropriate for the research, and for all these analyses STATA is used as analyzing software.

1.4 Thesis Outline

Chapter one is a chapter of a brief introduction about ICT, International trade, the relation between ICT and international trade, the purpose, and the Conceptual Model and outline of the research are also described.

Chapter two reviews the research literature and explanations of the variables studied by other researchers.

The third chapter covers Research philosophy, research design, data collection, sampling design, research instrument, and data analysis methods.

Chapter fourth mainly analyzes the results using STATA 13 software for descriptive analysis, scale measurement.

Chapter five examines the results of the statistical analysis and discusses important findings.

2 LITERATURE REVIEW

2.1 ICT

Information and communication technology is a way to capture data, store information, Data processing, data transfer, data retrieval, and data display and Results by model or feature or by combination via Computer, Thus ICT is a collective form of combining the context of computers and various information systems to find the desired solutions for users, and this has affected every stage of human life at the local, national and global levels. If a person or organization strives to achieve specific goals, it cannot be far from the impact of the development of information and communication technology. In such situations, the role of ICT varies from place to place, person to person, and organization to organization at different levels. Its nature, function, and impact depend on the personal or organizational need for information (Prasad & Prasad, 2009)

ICT has revolutionized the whole range in which people live and work. It has changed all aspects of human life and lifestyle. The digital revolution has enabled the processing of data related to a variety of information with greater accuracy Manipulation and simulation. These capabilities are creating a complete world in and around the physical world. Computers and communications are becoming a staple of our lives.

Until 1960, people-to-person communication was used. But over the past decade, the global arena has seen tremendous growth in ICT (Leon & Leon, 1999)

Rapid advances in communication media technologies such as television, computers, the Internet, printing, and publishing enable us to quickly access the information we need. Computers with different computer languages such as C, C ++, Java, .Net, etc. make it easier to process data collected from different sources. Government agencies, business organizations, scientists, and academics retrieve all computer-based information. Computer-based information is used to solve complex scientific problems in the artistic, cultural, historical, accounting, financial, medical, and even domestic fields. Therefore, computers with information and communication technology have a

significant impact on all aspects of our daily lives, for example, booking plane and railway tickets, buying and selling items on the Internet, e-marketplace, online banking, entertainment, education, Communications, reservations, and so on. ICT has replaced conventional methods for solving technical and operational problems by providing much faster and easier methods based on the ability to access a large and complex data set. At first, the computer could only process information in text format. A text is written with letters, numbers, and other characters that you can read. He later learned that information in the form of images, animations, sounds, and videos could also be processed.

The urgent demand for data storage and retrieval, represented in various forms such as text, image, animation, graphics, audio, video, has given a new direction to computer scientists and computer technologists to process data stored in multiple formats. All of this has revolutionized ICT.

ICT is a generic name for the following functions:

- Information / data representation.
- Information / data storage.
- Information/data retrieval and processing.
- Information / data communication.

2.1.1 Scope of ICT

Information and communication technology consists of two converging technologies:

- Computing Technology: Provides the ability to process data into information.
- Communication Technology: Enables encryption and transmission of required information by communication channel for intended users.

Information and communication technology is a combination of a computing system, communication technologies, and the process of information production and dissemination. This synergistic combination is achieved by convergence for computer and electronic communications. Hence, information and communication technology is not only a single technology but also a comprehensive approach to the use of computing and communication technologies. Computers represent computing technologies and other processing systems, while communication technologies are

represented by a combination of methods and modes for the transmission of electronic data (Gupta & Srivastava, 2008).

Information and communication technology can help identify important areas of competitive advantage for business organizations. Competitive advantages may be achieved with the help of various techniques in business and with the help of information and communication technology. This can help manage the value chain by strategically aligning the critical business process. Assists managers in decision-making and operational control.

2.1.2 Impact of ICT

The impact of information technology can be seen positively and negatively at the local, national, regional, and global levels. The following are affected due to the major information technology of the regions.

- Administration
- Academics
- Society
- Business
- Medical

As trade is considered as a part of business this paper will study the impact of ICT on international trade.

2.1.3 Indices measuring countries' ICT ability

This chapter includes various indexes and their indicators that are used to measure the use of ICT, innovation ability, and knowledge of countries.

- ICT Development Index (IDI)
- Measuring Information Society (MIS)
- Network Readiness Index (NRI)
- Global Competitiveness Index (GCI)

2.1.3.1 ICT Development Index (IDI)

The IDI one of and most important indexes to measure the use of ICT which is published by the United Nations International Telecommunication Union (ITU). Based on 11 indicators, the IDI covers 176 economies and ranks countries according

to their performance in two consecutive years. It is an important tool that allows governments, researchers, companies, and agencies to have benchmarks on the IDI indicators. Mainly, the IDI ranks countries according to their ICT access, usage, and skills, which are composed of 11 different pillars, as indicated in Table 2.1.

Transformation of being an ICT country divides into three substantial stages by IDI, which are:

- ICT readiness
- ICT intensity
- ICT impact

First of all, access to technology is maintained by creating the necessary infrastructure and network systems. Then the level of use of information and communication technology is increased and the skill of using those technologies is developed. Finally, in the third stage, the successful outcomes and intensity of information and communication technology create positive outputs, and the country successfully manages the impact phase of ICT by reflecting the short-term and long-term monetary and non-monetary results.

Table 2.1: ICT Development Index Indicators

Dimensions	Indicators	Reference value	%
ICT Access (Weight 40%)	1. Fixed telephone lines per 100 inhabitants	60	20
	2. Mobile cellular telephone subscriptions per 100 inhabitants	120	20
	3. International Internet bandwidth (bit/s) per Internet user	2'158'212*	20
	4. Proportion of households with a computer	100	20
	5. Proportion of households with Internet access at home	100	20
ICT Use (Weight 40%)	1. Internet users per 100 inhabitants	100	33
	2. Fixed broadband Internet subscribers per 100 inhabitants	60	33
	3. Mobile broadband subscribers per 100 inhabitants	100	33
ICT Skills (Weight 20%)	1. Adult literacy rate	15	33
	2. Secondary gross enrollment ratio	100	33
	3. Tertiary gross enrolment ratio	100	33

Source: ITU (2017a).

The IDI is divided into the following three sub-indices, as shown in Table 2.1 above. the first stage is the Access sub-index, which is ICT readiness. The Use sub-index includes ICT intensity measures, and finally, the 3rd stage is the Skills sub-index, which is ICT impact on society. According to the study's results shown in Table 2.2, the top 10 countries consist of Northern European and Asian countries.

Table 2.2:ICT Development Index

Top 10 Countries	Rank	Developing Countries	Rank
Iceland	1	Turkey	67
Korea Rep.	2	Brazil	66
Switzerland	3	Mexico	87
Denmark	4	Russia	45
United kingdom	5	India	134
Hong Kong	6	Indonesia	111
Netherland	7	China	80
Norway	8	South Africa	92
Luxemburg	9		
Japan	10		

Source: ITU (2017a).

As it can be seen in Table 2.2 above developing countries achieve relatively low rankings, while the Russian Federation has the highest ranking. Although according to research made by STATISTA China with 20.67% of the world and 37.13% of Asia-pacific and India with13.55% of the world and 24.34% of Asia-pacific together constitute 34.23% of the world's Internet users and 61.47% of Asia-Pacific Internet users, they achieve relatively low rankings, particularly India. Due to the income differences between the countries, the penetration rate differs.

Table 2.3, Table 2.4, and Table 2.5 show the rankings to illustrate the advantages and disadvantages that the countries have in terms of sub-indices. In comparison with other indices, Turkey has a higher ranking with 40th in the Skills sub-index, while India with 121th has the lowest ranking in the Skills sub-index. Russia ranks 13th in the Skills sub-index. Since the Skills sub-index has a weight of 20% in the IDI calculations, the important point is to achieve higher rankings in the basic indices which are the Access and the Use-indices.

Table 2.3:ICT Access Sub-Index

Top 10 Countries	Rank	Developing Countries	Rank
Luxembourg	1	Turkey	78
Iceland	2	Brazil	80
Hong Kong, China	3	Mexico	94
United Kingdom	4	Russia	50
Malta	5	India	137
Germany	6	Indonesia	105
Korea (Rep.)	7	China	89
Switzerland	8	South Africa	90
Japan	9		
Netherlands	10		

Source: ITU (2017a).

Table 2.4: ICT Use Sub-Index

Top 10 Countries	Rank	Developing Countries	Rank
Denmark	1	Turkey	73
Switzerland	2	Brazil	57
Norway	3	Mexico	76
Korea (Rep.)	4	Russia	51
Iceland	5	India	144
Sweden	6	Indonesia	115
United Kingdom	7	China	69
Luxembourg	8	South Africa	95
Netherlands	9		
Hong Kong, China	10		

Source: ITU (2017a).

Table 2.5: ICT Skill Sub-Index

Top 10 Countries	Rank	Developing Countries	Rank
Australia	1	Turkey	40
Korea (Rep.)	2	Brazil	71
United States	3	Mexico	95
Greece	4	Russia	13
Belarus	5	India	121
Denmark	6	Indonesia	109
New Zealand	7	China	91
Slovenia	8	South Africa	93
Iceland	9		
Finland	10		

Source: ITU (2017a).

Table 2.6 gives the world-wide, averages of the sub-indices and the standard deviations and Developed and developing countries Average value, according to Table 2.6 in all sub-indices, Turkey has a higher value than world averages and it is approximately one and a half points away from the average of the developed countries' IDI score, while it is approximately two-point in front of the mean of the developing countries.

Table 2.6:Average Value and Standard Deviation of Sub-Indices and Turkey

	World		Developed Countries	Developing countries	Turkey's Value
	Average value	St. Dev.			
IDI	5.11	2.22	7.52	4.26	6.08
Access sub-index	5.59	2.14	7.83	4.8	6.3
Use sub-index	4.26	2.49	6.91	3.32	4.92
Skill sub-index	5.85	2.18	8.12	5.05	7.97

Source: ITU (2017a)

Unfortunately, the Internet usage and IDI ranks of Turkey are really low in regional comparisons. Europe's IDI average was 7.50 in 2017, while Turkey's score remained lower by 6.08 (Figure 2.1).

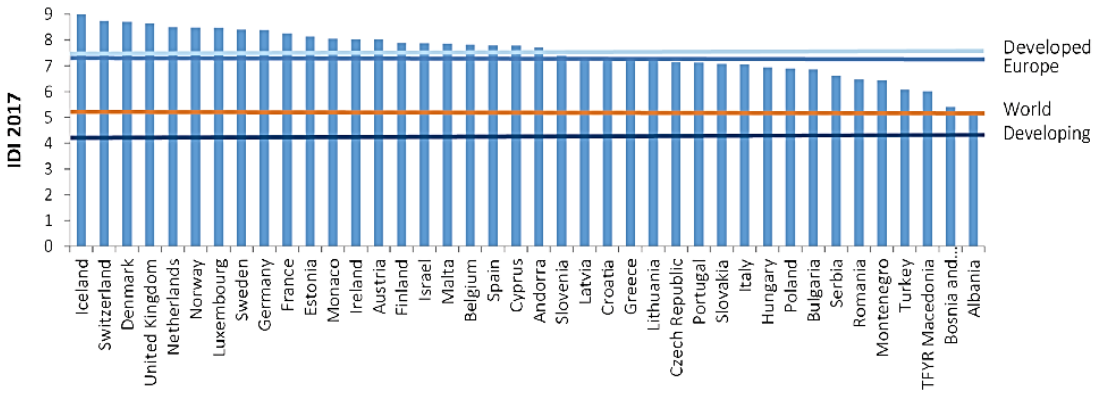

Figure 2.1: IDI values compared with the global, regional, and developing/developed-country averages for Europe in 2017

Source: ITU (2017a).

2.1.3.2 Measuring the Information Society (MIS)

Measuring the Information Society (MIS) used to be published yearly since 2009, until 2017 after last publication board members wanted to change the way to calculate the IDI for 2018 publication but because of some problems even after having an election to change or not the way the of calculation it didn't publish, in addition to the IDI facts and data, ICT Price Basket (IPB) has been presented in 2017 edition with the latest results along with the first complete price data set for mobile and fixed prepaid and after-paid broadband services ITU (2017b). Price indices as a percentage of GNI are important because they indicate a reasonable price and competition in the communications sector for the benefit of the consumer. In addition, a higher percentage of GNIs provide a brief understanding of the weak penetration of the Internet and mobile services, as it is more important to stabilize basic assets for families and individuals.

Table 2.7: Prepaid Mobile Broadband Prices as % of GNI P.C.(Lowest to Highest)

Top 10 Countries	Rank	Developing Countries	Rank
Poland	1	Turkey	42
Sweden	2	Brazil	72
Norway	3	Mexico	90
Macao	4	Russia	19
Austria	5	India	109
Estonia	6	Indonesia	93
Singapore	7	China	52
Luxembourg	8	South Africa	91
Finland	9		
Liechtenstein	10		

Source: ITU (2017b)

Table 2.8: Fixed Broadband Prices as % of GNI P.C. (Lowest to Highest)

Top 10 Countries	Rank	Developing Countries	Rank
Macao	1	Turkey	38
United Kingdom	2	Brazil	75
Kuwait	3	Mexico	81
Liechtenstein	4	Russia	16
Mauritius	5	India	119
Monaco	6	Indonesia	147
Norway	7	China	83
Singapore	8	South Africa	105
Andorra	9		
United Arab Emirates	10		

Source: ITU (2017b)

2.1.3.3 Network Readiness Index (NRI)

Network Readiness Index (NRI) which offers a comprehensive assessment of the present state of network readiness in the world published together by INSEAD Business School and WEF, NRI plays an important role in publishing The World Economic Forum's (WEF) Global Information Technology Report and presents the state of network readiness in the world by putting together a detailed inquiry about the relationship of ICT and growth (GITR, 2014). The NRI index of 2019 covers 121 economies accounting for more than 98% of the world's GDP with a record high and analyzes those countries relying on four sub-indexes with 12 different indicators, listed in Table 2.9, along with 62 particular indicators.

The report which shows countries cannot rely only on ICT development to be more competitive is the most important key findings of NRI (NRI, 2019), Rather, the ICT benefits will be fully beneficial when a country implements and uses a new and unique strategy to which aims to create conditions and opportunities for entrepreneurship and skill innovation to make and achieve modern infrastructure (NRI, 2019).

Table 2.9: NRI sub-index and pillars

NRI Sub-index	Pillars
Technology Sub-index	1. Access 2. Content 3. Future technologies
People Sub-index	1. Individuals 2. Businesses 3. Governments
Governance Sub-index	1. Trust 2. Regulation 3. Inclusion
Impact Sub-index	1. Economy 2. Quality of Life 3. SDG contribution

Source: Portulans Institute (2019).

Table 2.10 below shows that Northern European countries and Asian countries constitute the top 10 in NRI 2019

Table 2.10:Network Readiness Index

Top Ten Countries	Rank	Developing Countries	Rank
Sweden	1	Turkey	51
Singapore	2	Brazil	59
Netherland	3	Mexico	57
Norway	4	Russia	48
Switzerland	5	India	79
Denmark	6	Indonesia	76
Finland	7	China	41
United States	8	South Africa	72
Germany	9		
United Kingdom	10		

Source: Portulans Institute (2019).

In NRI 2016, Turkey ranked 48th among 139 countries with a score of 4.4, while in 2019, although Turkey achieved a higher score of 5.37 overall, it ranked 51st. This shows that Turkey remains relatively slow in terms of applying necessary regulations, investing in technology, developing human capital, and acknowledging the new technologies in government and business. The rankings in Figure 2.2 below reveal that also in comparison with upper-middle-income and developed countries Turkey has a Regulation advantage. According to the sub-pillars of the Regulation pillar, Turkey ranks as the top country in the E-commerce legislation and Ease of doing business and according to sub-pillar of Technology, Turkey ranks second in 4G mobile network coverage and Households with internet access which is high competition in the market and reflected in prices and the affordability of fixed and mobile services.

In the Infrastructure and Digital Content pillar, Turkey has a higher score in comparison with the upper-middle-income countries because it ranks as the 1st country in terms of mobile network coverage by covering 100% of the population. Unfortunately, Turkey could not maintain this high performance in the pillars of Skills, Individual Usage, Business Usage, Government Usage, and Economic and Social Impact.

Figure 2.2: Comparing Turkey's NRI pillar scores with Europe and Upper-Middle Income countries

Source: Portulans Institute (2019)

The rankings in Table 2.11 show the strongest and weakest indicators, lower rank in Freedom to make life choices, Pollution and Extent of staff are the biggest reason to make turkey rank 51st among 121 countries. Also, the ratio of individuals using the Internet indicator is comparatively low and this low ratio of using the Internet has a negative impact on the Business Use, Government Online Service Impact, and E-participation index. If individuals do not have access to the Internet or do not use the Internet efficiently in their daily lives, then the services presented online by businesses and government are not processed effectively either.

The important part here for the study is that the indicators of the pillars where Turkey performs particularly well are E-commerce legislation, Use of clean fuels and technology, and the ICT regulatory environment. but, the economy's weakest indicators include Freedom to make life choices, Pollution, and the Extent of staff training, which strongly needs development.

Table 2.11: The strongest and weakest NRI indicators of Turkey

Strongest indicators	Rank	Weakest indicators	Rank
E-commerce legislation	1	Rule of law	80
Use of clean fuels and technology	1	Income inequality	80
ICT regulatory environment	8	Happiness	83
Computer software spending	19	Intellectual property receipts	86
Government online services	27	Handset prices	88
Cybersecurity	22	High-tech exports	94
Ease of doing business	32	Company investment in emerging technology	97
Labor productivity per employee	33	The extent of staff training	9
Robot density	35	Pollution	106
PCT patent application	35	Freedom to make life choices	121

Source: Portulans Institute (2019)

2.1.3.4 Global Competitiveness Index (GCI)

GCI by assessing the competitiveness landscape of countries and by providing a platform between governments, civil society, and business for their dialogues and by providing insight into the drivers of their productivity and prosperity considered as the world's most comprehensive report. The GCI examines and presents the data under 12 main pillars and classifies these pillars according to the nature of their economies driver which not only determines the productivity but also determines the competitiveness of a country and published annually, the latest publications of GCI assesses the competitiveness landscape of 141 economies (WEF, 2019).

Table 2.12:Global Competitiveness Index

Top 10 Countries	Rank	Developing Countries	Rank
Singapore	1	Turkey	61
United States	2	Brazil	71
Hong Kong	3	Mexico	48
Netherlands	4	Russia	43
Switzerland	5	India	68
Japan	6	Indonesia	50
Germany	7	China	28
Sweden	8	South Africa	60
United Kingdom	9		
Denmark	10		

Source: WEF (2019).

To generate the index, the GCI uses statistical data obtained from internationally recognized agencies such as the Cultural Organization (UNESCO), Scientific, United Nations Educational, the International Monetary Fund (IMF), and the World Health Organization (WHO). It also obtains comparable data from WEF's Executive Opinion Survey for the part that requires a cross-country comparison. (WEF, 2019).

According to the data in Table 2.12, the most competitive countries in 2018-2019 are Singapore, United States, Hong Kong, Netherlands, Switzerland, Japan, Germany. Sweden, United Kingdom, and Denmark. BRICS countries, also, have relatively good rankings, while Turkey has a low ranking than few BRICS countries, except South Africa and India, with a rank of 61. In addition, while Turkey maintained its ranking in the GCI 2016 Report, Russia increased its ranking from 53rd to 43rd, India also increased from 71st to 68th.

Since the GCI 2019 Report covers 12 pillars with 117 indicators, it is important to base our analysis on the report. Since our study focuses on ICT usage and internationalization of the firms, it is essential to focus on infrastructure, technological readiness, competitiveness in the market, and the export capabilities.

Briefly analyzing the current capabilities of Turkey should be the priority. According to the GCI 2019 Report, Turkey improved by +0.5 points over last year by ranking 13th in big market size, 14th in human capital, 12th in transport connectivity, and sophistication factors. Figure 2.3 gives a brief idea of Turkey's pillars' rankings in comparison to the average of emerging and developing countries in Europe. According to the figure, Turkey achieved higher performance in the Innovation capability (due to the high population), business sophistication, institution, ICT adoption, labor market, and product market development, while it achieved lower scores in health and primary education, Market size and infrastructure.

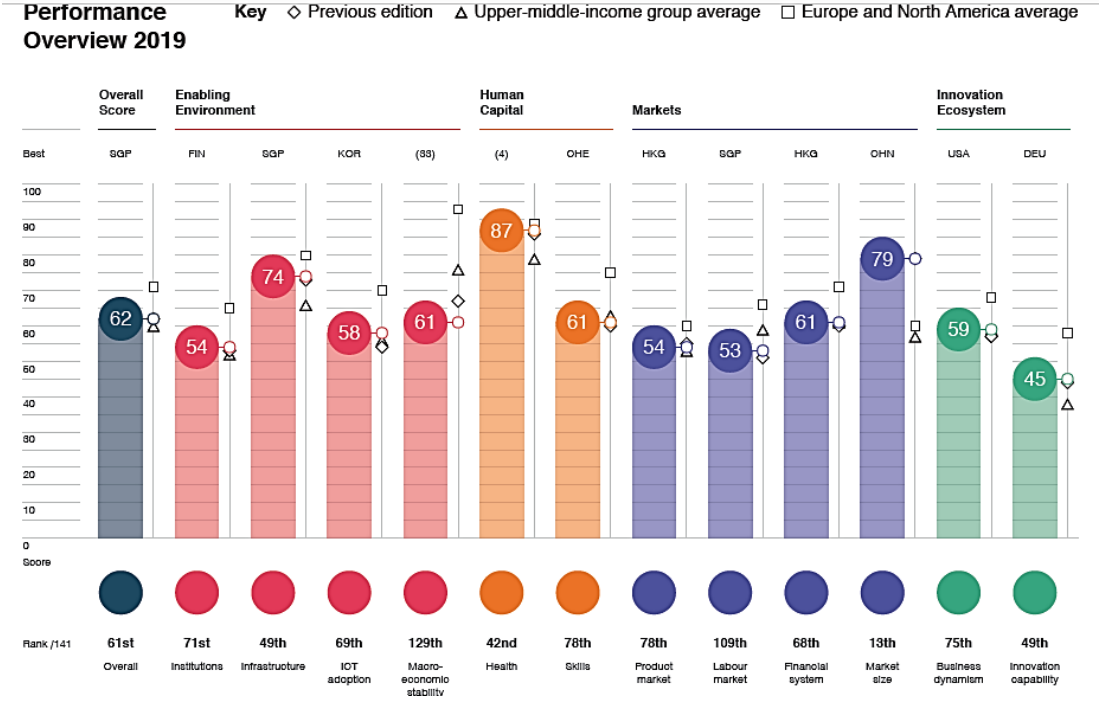

Figure 2.3: Comparison of Turkey, Upper-middle income group, Europe and North

Source: WEF (2019)

The rankings in Table 2.13 indicate the changes in Turkey in specific pillars between 2015 and 2018 (comprising three GCI Reports). Turkey could not achieve an upward trend in rankings but a back-and-forth performance on average. The number of individuals using the Internet deteriorated, while mobile Internet subscriptions increased due to the penetration of smartphones and the shift from fixed broadband Internet subscriptions to mobile Internet subscriptions. Since consumer habits change as technology changes, the technological pillars reflect those changes.

Table 2.13: Turkey's Ranks in Selected Indicators between 2015 and 2017

Indicators	**2015-2016**	**2016-2017**	**2017-2018**
Quality of electricity supply	80	84	88
Mobile telephone subscriptions	103	101	103
Electricity and telephony infrastructure	84	87	90
2nd pillar: Infrastructure	53	48	53
Intensity of local competition,	10	12	9
Prevalence of trade barriers,	42	44	45
Burden of customs procedures,	82	74	80
Degree of customer orientation,	36	39	37
Buyer sophistication,	57	66	66
6th pillar: Goods market efficiency	45	52	53
Efficiency	44	63	66
Availability of latest technologies,	55	62	57
Firm-level technology absorption,	36	48	46
FDI and technology transfer	52	64	61
Technological adoption	45	57	53
Individuals using Internet	67	71	70
Fixed broadband Internet subscriptions	61	61	59
Int'l Internet bandwidth,	62	59	61

Source: WEF (2015), WEF (2016) & WEF (2017)

Table 2.14 and Table 2.15 below show the 2009-2019 Global Competitiveness Index rankings for BRICS countries, as well as Indonesia, Romania, and Turkey to make a comparison for 12 different main pillars, and Table 2.15 shows the change in the rankings from 2009 to 2019. Positive numbers in Table 2.15 show a development in the pillar and indicate higher rankings while negative numbers show a deterioration in the pillar and decrease in the rankings.

Table 2.14:BRICS, Indonesia, Romania, and Turkey Pillar Rankings 2009 and 2017

	2009-2010								2017-2018							
Main Pillars and Ranking	Brazil	Russia	India	China	South Africa	Indonesia	Romania	Turkey	Brazil	Russia	India	China	South Africa	Indonesia	Romania	Turkey
1st pillar: Institutions	93	114	54	48	45	58	84	96	109	83	39	41	76	47	86	71
2nd pillar: Infrastructure	74	71	76	46	45	84	110	62	73	35	66	46	61	52	83	53
3rd pillar: Macroeconomic environment	109	36	96	8	68	52	75	64	124	53	80	17	82	26	38	50
4th pillar: Health and primary education	79	51	101	45	125	82	63	74	96	54	91	40	121	94	92	84
5th pillar: Higher education and training	58	51	66	61	65	69	52	73	79	32	75	47	85	64	70	48
6th pillar: Goods market efficiency	99	108	48	42	35	41	61	56	122	80	56	46	54	43	92	53
7th pillar: Labor market efficiency	80	43	83	32	90	75	79	120	114	60	75	38	93	96	89	127
8th pillar: Financial market development	51	119	16	81	5	61	56	80	92	107	42	48	44	37	88	80
9th pillar: Technological readiness	46	74	83	79	65	88	58	54	55	57	107	73	54	80	51	62
10th pillar: Market size	10	7	4	2	24	16	41	15	10	6	3	1	30	9	41	14
11th pillar: Business sophistication	32	95	27	38	36	40	83	52	56	71	39	33	37	32	116	67
12th pillar: Innovation	43	51	30	26	41	39	70	69	85	49	29	28	39	31	96	69

Source: WEF (2009) & WEF (2017).

Table 2.15: 2009-2017 Change in Rankings

Main Pillars and Ranking	Brazil	Russia	India	China	South Africa	Indonesia	Romania	Turkey
1st pillar: Institutions	-6	40	-5	-10	-10	7	32	25
2nd pillar: Infrastructure	-4	21	6	10	-24	12	55	13
3rd pillar: Macroeconomic environment	-6	-7	53	-31	9	-2	19	-65
4th pillar: Health and primary education	4	-46	-9	5	7	76	-20	32
5th pillar: Higher education and training	-38	-3	-41	-3	-25	4	-20	-5
6th pillar: Goods market efficiency	-25	21	-53	-12	-34	-8	-3	-22
7th pillar: Labor market efficiency	-125	-19	-20	-40	27	-10	22	11
8th pillar: Financial market development	-4	24	-24	52	-14	3	-30	12
9th pillar: Technological readiness	-21	52	-37	61	-24	16	26	-15
10th pillar: Market size	0	1	1	1	-11	9	0	2
11th pillar: Business sophistication	-35	42	-42	2	-24	11	11	-23
12^{th} pillar Innovation	3	19	-5	2	-5	-35	15	20

Source: WEF (2009) & WEF (2017)

According to Table 2.15, all developing countries show a development in the Market size and Infrastructure except South Africa, and this development indicates the necessary infrastructural and policy-based reforms and strategies. On the other hand,

developing countries have a deterioration in the Goods Market Efficiency, except Russia, and this underlines that the goods markets move towards monopolistic markets while the labor market is exploited. The important pillars for this study are Infrastructure, Macroeconomic Environment, Financial Market Development, Technological Readiness, Market Size, Business Sophistication, and Innovation.

2.2 International Trade

2.2.1 Trade

Trade is an economic organization or system in which goods and services are exchanged with each other or with money. Every transaction requires some kind of investment and a sufficient number of customers that can be produced to sell to him on a regular basis for profit.

2.2.2 International trade

Don & Wendell M. (1999) defined International trade as all business activities, including the creation and transfer of resources, goods, services, knowledge, skills, and information that transcend national borders.

Resources may include raw materials, energy, technical knowledge and patents, capital, and organizational skills.

Goods include manufactured parts, subsets, and assemblies.

Services may include accounting, finance, law, consulting, import and export, healthcare, and transportation.

Technical knowledge may include product, process, copyright, trademark, and brand technology innovations.

Skills may include organizational and managerial skills.

Information includes databases as well as information networks.

International trade is a trade whose activities include crossing national borders. This definition includes not only international trade and foreign products, but also the growing service industry in areas such as transportation, tourism, banking, advertising, construction, retail, wholesale, and mass communications Donald & Wendell (1999).

In most countries, international trade accounts for a significant share of GDP. This is at a time when international trade has already existed throughout history (e.g. Uttarapatha, Silk Road, Amber Road, scramble for Africa, The Atlantic slave trade (salt roads), its economic, social, and political importance has been increasing in recent centuries.

2.2.3 International trade forms

Three forms of international trade (based on three kinds of trade strategies) Donald, Geringer, Frantz, & Minor, (2005)

- **Expanding the domestic market with exports:** Companies that follow this strategy find all production performance and, as far as possible, marketing performance in their own country. Export managers should be aware of any differences between internal and external environmental forces that may affect the marketing mix.
- **Multi-house company:** An organization looking for companies affiliated with several countries that understand their business strategies based on market differences. Similar to a Holding Company - Strict financial control of the workplace, but its subsidiaries have considerable independence in formulating their business strategies based on perceived differences in the market, with central office managers retaining a veto.
- **Global company:** An organization that strives to perform standardization and integration operations worldwide in all areas of operation. Global corporate governance views the global economy as a single market. There is a strong central authority with global executives in performance areas such as marketing and manufacturing, etc. who try to standardize their activities around the world and there is no international division. Management functions such as strategic planning and budgeting are performed globally.

2.3 ICT and International Trade Relation

The importance and high position of new technologies and the important role of communication in various social categories, has turned the current era into a "communication era". New technologies in various cultural, political, and economic fields have now emerged to the point, where not considering or less considering them

today will cause backwardness. On the other hand, new technology is based on information and communication, which today has left amazing and unique effects in the information and communication industry for various purposes. Now the innovations of scientists and researchers are based on these new technologies of collecting, accumulating, and disseminating information, and in the meantime, any media that has the ability to transmit and move information and aims to communicate is in the realm of communication technology. Information and communication, however, are intertwined and in fact pursue a single progressive goal, which is awareness, growth, and development. from the beginning Information and communication technologies(ICT) had importance in human development history, through this history ICT played a role by implicating the economic, social and cultural interaction among human, from collecting, producing, exchanging, and storing to distributing and supplying, especially after 1990 with the increase of internet usage ICT started being used in all type of human activities especially in economic activities from infant industries to advanced production process by public and private production. Because of the mentioned reasons and based the opportunities which give countries and companies access to bigger and larger markets, let them extend their customer support, increase their productivity and raise profit ICT has known one of the most considered factors for increasing productivity, efficiency, and overall performance of a system, new information and communication technologies have created a great change in the economy and network of commercial markets, and has facilitated trade exchanges and the achievement of goals and the development of business plans; as a large part of business transactions are now done online.

The development of information and communication technology has accelerated dramatically in the last decade globally, and according to this event, the "global economy" has accelerated and on the other hand, has fueled the leap of information and communication technology. (Ahmad & Ridzuan, 2013)

ICT has extremely changed and reshaped every system and activities which operate under it, ICT has made a huge impact on trade which is part of economic activities, especially on international trade which is an important and valuable factor key for economic growth, providing employment, raising living standards and giving citizens or consumers enjoyment by providing a greater variety of products, by giving local companies easy and faster access to bigger and broad markets, this strange

phenomenon of the present century has accelerated the process of globalization and increased the desire to invest in this technology in developed and developing countries.

This study mainly examines the impact of the use of information and communication technology (ICT) on the integration of countries with global trade and investigates a model that examines the relationship between the use of information and communication technology(ICT) countries and their Trade/GDP ratio. At this stage, it is important to define the usage of information and communication technology of countries. The indicators for measuring the ICT capability of countries are examined in detail in Chapter 3. The main pillars of the indices include sub-columns of 3 variables. In Chapter 4, the Global Competitiveness Index (GCI) is selected as an index, which is widely used in the literature, and economic analysis to evaluate the effects of each sub-pillar of the GCI index on the Trades/GDP ratio. In the fifth chapter, the pattern which is achieved interpreted and the reasons and results of the apparent relationship between the use of information and communication technology and integration with global trade is discussed.

2.4 Empirical Past Studies

The first studies on the impact of ICT usage in international exports and trade date back to the late 1990s and early 2000s. Freund & Weinhold, (2004) mainly examine the impact of the Internet on international trade. This study claims that companies and individuals from around the world are beginning to transform their business models from local to international operations. The researchers found that the use and development of the Internet help explain the growth of international trade.

Brynjolfsson & Hitt (2000) In their study, discuss the economic impact of information technology and its productivity on firms since the late 1980s when the positive impact of computers and information technology on the economy was questioned. particular Company-level studies show that computers, rather than being indirectly unproductive, had an impact on economic growth that is much larger than their share of investment or capital stocks, and this impact is likely to grow further in the upcoming years, in this sense, Brynjolfson and Hitt support literature. As new business processes, new skills, and new organizational and industrial structures are created using information technology, these intangible assets have become the main driver of IT share and a new cycle that is constantly improving has started.

Colecchia & Schreyer (2001) emphasize that economic growth is achieved by increasing the use of capital and labor by improving multi-factor productivity. With the increasing use of information and communication technology, a new factor of productivity has been formed. In their study, they compared the impact of ICT capital accumulation on manufacturing growth in France, Australia, the United Kingdom, Canada, Finland, Germany, Italy, Japan, and the United States. The results show that over the past two decades, ICT, depending on the country, has contributed between 20/100 to 50/100 percent per year in economic growth. In the second half of the 1990s, this share rose to 30/100 to 90/100 percent per year.

In addition, Scupola (2003) emphasizes the positive impact of using Internet-based technologies on increasing market power and competitiveness of SMEs. Scupola (2009), after studying Italian SMEs, continued to research in Denmark and Australia and their e-commerce usage. As a result, both studies showed that the availability and quality/ of ICT consulting services have a significant impact on the acceptance of e-commerce from medium and medium-sized companies.

In recent studies, the low level of technology of companies has been considered as an indicator of export barriers. Dhanaraj & Beamish (2003), in their resource-based study, found that technology intensity is a good predictor of export strategy, which approaches the export performance of small and medium-sized American and Canadian exporters, which also has a positive effect on company's performance.

According to Özkanlı, Benek, & Akdeve (2006), while high-tech companies tend to move internationally, the enormous impact of ICT use on exports has led to Companies with lower technology levels should demand in domestic markets or less from foreign markets. In addition, Dhanaraj & Beamish (2003) also confirm that technology is a key resource for a company that can be used by a company to take advantage of its presence in foreign markets.

Tektaş, Günay, Karataş, & Kuyucu, (2008) emphasize that large companies have the ability to tackle the dynamics of intense global competition, while smaller companies face challenges in the process of adopting and using innovation. They are Arguing that ICT adoption capacity provides a first step towards using innovation among SMEs, the results of their study show that SMEs with IT adoption capabilities and higher communications have higher interest rates for innovation in the Organized Industrial Zone in Istanbul. The results of this survey also indicate the importance of using

information and communication technology in medium and medium enterprises, especially that the reasons for the use of the Internet by small and medium enterprises as improving competition and productivity (42%), relationships Supply chain (33%), e-commerce (27%) and production growth (21%)

A study by Mathews & Bianchi (2010) found that websites and e-sales were significantly associated with export growth in a group of Australian companies. In addition, Matteo & Binanci (2010) argue that the Internet has indirect effects on a group of Chilean companies by improving the flow of information and business relationships. The New Zealand Statistics defines ICT as any electronic technology for processing, collecting and storing or transmitting information in the form of sound, images, or details, including the Internet, computers, software, and global positioning systems(GPS) and argue that the export rate for those who use ICT is the size of all jobs. As a result, they emphasize that the use of an ICT business and its growth-related activities participation are strongly linked in New Zealand, although some differences between business growth activities can be attributed to the nature of Explained their industry or size.

Banomyong, Ruth (2010) argues that the development of communication technologies and logistics services has created a global market and transformed supply chain management. Supply chain management shows the easiest way and guides the manufacturers, suppliers, and distribution centers to deliver all the products under the right conditions to the right place at the right time (Christopher & Towill, 2001). With the development of supply chain management, the potential of integrated supply chains is being realized, and this development in supply chain management depends on the company's ability to use information and communication technology effectively and efficiently.

Bascavusoglu-Moreau & Colakoglu (2011) also emphasize in their study that once a company becomes an innovator, its desire for innovation no longer depends on the use of technology or information and communication technology. According to the Global Innovation Index, this is particularly important in the context of Turkey's transition from an efficiency-oriented country to an innovation-based one. On the other hand, the export stocks of medium technology and advanced technology products in total exports can be considered whether our firms are currently innovators or not. They also argue that innovative efforts are closely linked to R&D investment, exports, and tool

models. Employee education level, outsourcing, use of intensive production processes of technology, and information and communication technology are also considered important factors of innovative efforts.

According to Didonet & Diaz (2012), the main challenge of supply chain management (SCM) practices is firms integrating with customers and suppliers. Therefore, the use of information and communication technology in SCM is a basic condition to ensure interaction between suppliers and customers in order to coordinate activities and transactions while maintaining the information flow to and between the involved departments and companies (Didonet & Diaz, 2012; Bayraktar et al., 2009; Kauremaa, Kärkkäinen & Ala-Risku, 2009). The important question here is whether only large multinational corporations have the ability and resources to access and implement ICT, or small and local corporations do the same. According to Egan, Clancy, & O'Toole (2003), there is a managerial lack of commitment to small and medium-sized corporations, a low understanding of technology, and a poor ability to maintain skills, while Damaskopoulos & Evgeniou (2003) emphasize a lack of financial resources. They emphasize. As a barrier to the adoption of ICT (Information and Communication Technology). Eliminating these barriers and investing in the long run by adopting information technology in internal and external processes can reduce operational costs and increase agility in transferring information to its suppliers, in addition to providing unique products and services to customers. Benefit from companies themselves. Sustainable competitive advantage over time (Didonet & Diaz, 2012).

Research by the Boston Consulting Group (2013) examines more than 4,000 SMEs in five countries (US, Germany, China, India, and Brazil) and shows that SME technology leaders are far superior to their market counterparts. In this research which has done using Microsoft surveys, "technology leader" is defined as a company that not only uses different combinations of technology such as online customer relationship management software, cloud services, and big data analysis but also wants to achieve the latest technology and the ability to create custom software always. According to the research, the SME leader in technology adoption from 2010 to 2012 created twice as fast as other SMEs and also grew faster than the economy as a whole. In addition, the study also predicts that technology adopters will increase revenue 15% faster than low-tech companies.

Altomonte, Aquilante, Bekes, & Ottoviano (2013) also show that innovation leads to productivity growth, and their study emphasizes that there is a strong link between globalization and corporate innovation. Since the literature shows that the usage of information and communication technology is directly related to innovation capabilities, it can be concluded that the usage of ICT also has a positive correlation with globalization and growth.

Lecerf (2012) examines 335 French SMEs and their ability to globalize with indicators affecting their capabilities. These results confirm the strong correlation between technology allocation in international SMEs and their trade growth and also show that technology resources are a common driver of innovation and globalization activities.

Kotnik & Hagsten (2013), in their study of countries ICT and export capabilities, show that in a number of European countries there is a positive relationship between ICT use and corporate exports - where The use of information and communication technology is measured by online presence, the use of online transactions, the intensive human capital of information and communication technology and the ratio of employees with quick access to Internet capacity. In addition, previous studies also show that exports can be decisive as an important factor for creation and development for the country (Giunta & Triviera, 2007; Haller & Siedchlag, 2011)

3 RESEARCH METHODOLOGY AND DATA

In this study, the data were derived from the Global Competitiveness Index from 2009 to 2019 in order to maintain consistency in the data. In addition, as the sample set, BRICS, Greece, Indonesia, Mexico, Nigeria, Poland, Romania, Turkey, and Vietnam are chosen for the developing countries, and France, Germany, Iceland, Ireland, Japan, Netherlands, South Korea, and the United States are chosen for the developed countries.

Many scholars studied the relationship of the information and communication technologies usage or technological readiness and export capabilities of countries or the globalization of the firms in a country. These studies historically are grounded on technology usage's positive correlation with innovation capabilities and export capacity of the country due to increasing innovativeness and effectiveness.

ICT has become very important in modern economics and its effects on economic growth come from two channels: the production of ICT industries and the output of industries using ICT. The first production was integrated as input to the ICT manufacturing industries (Toader, Firtescu, Roman, & Anton, 2018). To identify the effects of ICT on productivity and economic growth, a production function can be considered in the following equation:

$$Y_t = Y(Y_t^{ICT}, Y_t^O) = A_t F(C_t, K_t, H_t, L_t) \quad (1)$$

where: Y (aggregate value-added, at time t) is assumed to consist of ICT goods and Services Y_t^{ICT}, as well as of other production Y_t^O. The aggregate inputs are produced from ICT capital C, other (i.e., non-ICT) physical capital K, human Capital H, and labor L The technology level is shown here using parameter A in the form of neutral amplification or Hicks output. Concerning the first approach, assuming that this function assumes the simple Cobb-Douglas form with suppression of the time index:

$$Y = AC^{a_c}K^{a_k}H^{a_h}L^{a_l} \quad (2)$$

The following equation results if the natural logarithm has taken from both side:

$$lnY = lnA + a_c lnC + a_k lnK + a_h lnH + a_l lnL \quad (3)$$

When the difference on the term of Equation 3 within time respect applied, gives the illustration of growth representation where variables indicate the rate of change:

$$\dot{Y} = \dot{A} + a_c\dot{C} + a_k\dot{K} + a_h\dot{H} + a_l\dot{L} + a_n\dot{N} \quad (4)$$

By considering equations number three and number four, the panel models of the data can be estimated using fixed, random, first-segmented, or dynamic options, as described below.

3.1 The Linear Panel Data Models-An Overview

The basic model of a linear panel can be defined using some suitable constraints of the following general model presented in the equation

$$y_{it} = \alpha_{it} + \beta_{it}x_{it} + \mu_{it} \quad (5)$$

where i = 1, 2 ... n is the individual group (country) index, t = 1, 2 . . . T is the time index and $\mu_{it}$is a random disturbance term of mean 0. While μ_{it} is not estimable with N = n*T data points, a number of assumptions (restrictions) are usually made, the most common being parameter homogeneity, which means α_{it} = α, for all i, t and β_{it} =β, for all i, t. The resulting model is standard linear pooling for all the data across i and T

$$y_{it} = \alpha + \beta x_{it} + \mu_{it} \quad (6)$$

For modeling individual heterogeneity of individual groups (in this model country), error It is assumed that the term has two separate components, each of which is specific to the individual (country) that does not change over time. This model is shown in the following equation called unobserved effects.

$$y_{it} = \alpha + \beta x_{it} + \mu_{it} + \varepsilon_{it} \quad (7)$$

Time effects may also be modeled (one symmetric state, Equation (8)) or both, so that the error has three components (described in Equation (9)).

$$y_{it} = \alpha + \beta x_{it} + \tau_{it} + \varepsilon_{it} \quad (8)$$

$$y_{it} = \alpha + \beta x_{it} + \mu_{it} + \tau_{it} + \varepsilon_{it} \quad (9)$$

The appropriate estimation method for these models depends on the characteristics of the two error values, Usually the specific error ε_{it} is assumed to independent and have no relation with both regressors x_{it} and the individual error component μ_{it}, The individual component error is independent or correlated with x_{it}.

In the first case when the individual error μ_{it} has a correlation with x_{it} the ordinary least square (OLS) estimator would be incompatible, Thus μ_{it} is evaluated as another set of n parameters. This model is called the fixed effect (within or least squares dummy variables) model which gives consistent estimates for β.

In the second case when the individual error μ_{it} has no correlation with x_{it}, the model used in this situation is called the Random-effects model in which not only individual error μ_{it} but overall (Individual + specific) error ($\mu_{it} + \varepsilon_{it}$) are uncorrelated with x_{it}, thus the OLS estimator is compatible. Usually, the specific error component over individuals persuades correlation across the composite error terms, which makes OLS estimation inefficient, because of that the generalized least squares (GLS) estimators are used.

The choice between the above models (fixed and random effects) is based on Hausman type tests or the Mundlak approach. The Hausman test, commonly used in the literature, compares two estimators without any significant difference: if this is not rejected, a more efficient (random effects) estimator is selected.

The main purpose of this study is the following: null hypothesis in this study considered as there is no relationship between Information and communications technology and International Trade. The alternative hypothesis is that there is a positive relationship between Information and communications technology and International Trade.

The following general linear regression model for panel data is considered:

$$IT_{i,t} = \alpha + \beta_1 ICT_{i,t} + \beta_2 X_{i,t} + \mu_{i,t} + \varepsilon_{i,t} \quad (10)$$

For the dependent variable the ratio of Trade to a country's GDP ($IT_{i,t}$) is chosen, while the pillars of competitiveness index the effects of institutions, infrastructure, macroeconomic environment, health and primary education, higher education and training, goods market efficiency, labor market efficiency, financial market development, market size, business sophistication, and innovation capabilities as $X_{i,t}$ and technological readiness as $ICT_{i,t}$ were chosen as the independent variables.

The scores for the independent variables are derived from the Global Competitiveness Index, and each score of the independent variable consists of the average score of a set of sub-indicators, as indicated in Table 3.1.

Table 3.1: Independent Variables Used in the Model and Sub-Indicators in the Global Competitiveness Index

Main Pillars/Independent Variables	Sub Indicators by GCI 2017
1st pillar: Institutions	1.1. Property rights, 1-7 (best)
	1.2. Intellectual property protection, 1-7 (best)
	1.3. Diversion of public funds, 1-7 (best)
	1.4. Public trust in politicians, 1-7 (best)
	1.5. Irregular payments and bribes, 1-7 (best)
	1.6. Judicial independence, 1-7 (best)
	1.7. Favoritism in decisions of government officials, 1-7 (best)
	1.8. Efficiency of government spending, 1-7 (best)
	1.9. Burden of government regulation, 1-7 (best)
	1.10. Efficiency of legal framework in settling disputes, 1-7 (best)
	1.11. Efficiency of legal framework in challenging regs., 1-7 (best)
	1.12. Transparency of government policymaking, 1-7 (best)
	1.13. Business costs of terrorism, 1-7 (best)
	1.14. Business costs of crime and violence, 1-7 (best)
	1.15. Organized crime, 1-7 (best)
	1.16. Reliability of police services, 1-7 (best)
	1.17. Ethical behavior of firms, 1-7 (best)
	1.18. Strength of auditing and reporting standards, 1-7 (best)
	1.19. Efficacy of corporate boards, 1-7 (best)
	1.20. Protection of minority shareholders' interests, 1-7 (best)
	1.21. Strength of investor protection, 0–10 (best)*

Table 3.1 (Cont'd)

Main Pillars/Independent Variables	Sub Indicators by GCI 2017	
2nd pillar: Infrastructure	2.1.	Quality of overall infrastructure, 1-7 (best)
	2.2.	Quality of roads, 1-7 (best)
	2.3.	Quality of railroad infrastructure, 1-7 (best)
	2.4.	Quality of port infrastructure, 1-7 (best)
	2.5.	Quality of air transport infrastructure, 1-7 (best)
	2.6.	Available airline seat km/week, millions*
	2.7.	Quality of electricity supply, 1-7 (best)
	2.8.	Fixed telephone lines/100 pop.*
	2.9.	Mobile telephone subscriptions/100 pop.*
3rd pillar: Macroeconomic environment	3.1.	Government budget balance, % GDP*
	3.2.	Gross national savings, % GDP*
	3.3.	Inflation, annual % change*
	3.4.	General government debt, % GDP*
	3.5.	Country credit rating, 0–100 (best)*

Table 3.1 (Cont'd)

Main Pillars/Independent Variables	Sub Indicators by GCI 2017	
4th pillar: Health and primary education	4.1.	Business impact of malaria, 1-7 (best)
	4.2.	Malaria cases/100,000 pop.*
	4.3.	Business impact of tuberculosis, 1-7 (best)
	4.4.	Tuberculosis cases/100,000 pop.*
	4.5.	Business impact of HIV/AIDS, 1-7 (best)
	4.6.	HIV prevalence, % adult pop.*
	4.7.	Infant mortality, deaths/1,000 live births*
	4.8.	Life expectancy, years*
	4.9.	Quality of primary education, 1-7 (best)
	4.10.	Primary education enrollment, net %*
5th pillar: Higher education and training	5.1.	Secondary education enrollment, gross %*
	5.2.	Tertiary education enrollment, gross %*
	5.3.	Quality of the education system, 1-7 (best)
	5.4.	Quality of math and science education, 1-7 (best)
	5.5.	Quality of management schools, 1-7 (best)
	5.6.	Internet access in schools, 1-7 (best)
	5.7.	Availability of research and training services, 1-7 (best)
	5.8.	Extent of staff training, 1-7 (best)

Table 3.1 (Cont'd)

Main Pillars/Independent Variables	Sub Indicators by GCI 2017
6th pillar: Goods market efficiency	6.1. Intensity of local competition, 1-7 (best)
	6.2. Extent of market dominance, 1-7 (best)
	6.3. Effectiveness of anti-monopoly policy, 1-7 (best)
	6.4. Effect of taxation on incentives to invest, 1-7 (best)
	6.5. No. procedures to start a business*
	6.6. No. days to start a business*
	6.7. Agricultural policy costs, 1-7 (best)
	6.8. Total tax rate, % profits*
	6.9. Prevalence of trade barriers, 1-7 (best)
	6.10. Prevalence of foreign ownership, 1-7 (best)
	6.11. Business impact of rules on FDI, 1-7 (best)
	6.12. Burden of customs procedures, 1-7 (best)
	6.13. Imports as a percentage of GDP*
	6.14. Trade tariffs, % duty*
	6.15. Degree of customer orientation, 1-7 (best)
	6.16. Buyer sophistication, 1-7 (best)

Table 3.1 (Cont'd)

Main Pillars/Independent Variables	Sub Indicators by GCI 2017	
7th pillar: Labor market efficiency	7.1.	Cooperation in labor-employer relations, 1-7 (best)
	7.2.	Hiring and firing practices, 1-7 (best)
	7.3.	Flexibility of wage determination, 1-7 (best)
	7.4.	Effect of taxation on incentives to work, 1-7 (best)
	7.5.	Redundancy costs, weeks of salary*
	7.6.	Pay and productivity, 1-7 (best)
	7.7.	Reliance on professional management, 1-7 (best)
	7.8.	Country capacity to retain talent, 1-7 (best)
	7.9.	Country capacity to attract talent, 1-7 (best)
	7.10.	Women in labor force, ratio to men*
8th pillar: Financial market development	8.1.	Financial services meeting business needs, 1-7 (best)
	8.2.	Affordability of financial services, 1-7 (best)
	8.3.	Financing through local equity market, 1-7 (best)
	8.4.	Ease of access to loans, 1-7 (best)
	8.5.	Venture capital availability, 1-7 (best)
	8.6.	Soundness of banks, 1-7 (best)
	8.7.	Regulation of securities exchanges, 1-7 (best)
	8.8.	Legal rights index, 0–10 (best)*

Table 3.1 (Cont'd)

Main Pillars/Independent Variables	Sub Indicators by GCI 2017
9th pillar: Technological readiness	9.1. Availability of latest technologies, 1-7 (best)
	9.2. Firm-level technology absorption, 1-7 (best)
	9.3. FDI and technology transfer, 1-7 (best)
	9.4. Individuals using Internet, %*
	9.5. Fixed broadband Internet subscriptions/100 pop.*
	9.6. Int'l Internet bandwidth, kb/s per user*
	9.7. Mobile broadband subscriptions/100 pop.*
10th pillar: Market size	10.1. Domestic market size index, 1–7 (best)*
	10.2. Foreign market size index, 1–7 (best)*
	10.3. GDP (PPP$ billions)*
	10.4. Exports as a percentage of GDP*

Table 3.1 (Cont'd)

Main Pillars/Independent Variables	Sub Indicators by GCI 2017
11th pillar: Business sophistication	11.1. Local supplier quantity, 1-7 (best)
	11.2. Local supplier quality, 1-7 (best)
	11.3. State of cluster development, 1-7 (best)
	11.4. Nature of competitive advantage, 1-7 (best)
	11.5. Production process sophistication, 1-7 (best)
	11.6. Control of international distribution, 1-7 (best)
	11.7. The extent of marketing, 1-7 (best)
	11.8. Value chain breadth, 1-7 (best)
12th pillar: Innovation	12.1. Capacity for innovation, 1-7 (best)
	12.2. Quality of scientific research institutions, 1-7 (best)
	12.3. Company spending on R&D, 1-7 (best)
	12.4. University-industry collaboration in R&D, 1-7 (best)
	12.5. Gov't procurement of advanced tech products, 1-7 (best)
	12.6. Availability of scientists and engineers, 1-7 (best)

Source: WEF (2017).

Table 3.2: Correlation between the Main Pillar

	Y	X1Institution	X2Infrastructure	X3Macroeco ENV.	X4Health and primary EDU	X5Higher Education	X6Good market Eff.	X7labor Market Eff.	X8Financial	X9Technology RDNS	X10Market	X11Business	X12innovation
Y	1												
X1Institution	0.365	1											
X2Infrastructure	0.190	0.754	1										
X3Macroeco ENV.	0.112	0.086	0.243	1									
X4Health and primary EDU	0.348	0.562	0.751	0.141	1								
X5Higher Education	0.299	0.772	0.874	0.150	0.801	1							
X6Good market Eff.	0.353	0.844	0.618	0.043	0.439	0.682	1						
X7labor Market Eff.	0.286	0.672	0.441	0.058	0.346	0.565	0.585	1					
X8Financial MRKT. Dev.	-0.128	0.482	0.330	0.301	0.022	0.224	0.399	0.315	1				
X9Technology RDNS	0.327	0.755	0.848	0.074	0.683	0.898	0.676	0.533	0.231	1			
X10Market size	-0.463	-0.054	0.151	0.249	0.021	-0.025	0.064	-0.022	0.375	-0.135	1		
X11Business Soph.	0.121	0.863	0.793	0.164	0.489	0.729	0.797	0.616	0.586	0.730	0.249	1	
X12innovation	0.144	0.842	0.832	0.205	0.586	0.799	0.794	0.685	0.516	0.775	0.256	0.925	1

Firstly, the correlation between the pillars (Table 3.2) was checked and the pillars that correlated at higher than 0.8 with at least one other pillar were excluded, depending on which pillar was less correlated with the dependent variable, Y. The excluded pillars were the pillars less correlated with Y except for Goods Market Eff which has the highest correlation with Y. Four pillars were excluded out of 12 and the following Eight pillars remained in the panel data:

X3 Macroeco. Env.

X4 Health and Prim. Edu.

X6 Goods Mar. Eff.

X7 Labor Mar. Eff.

X8 Fin. Mar. Dev.

X9 Tech. Red.

X10 Market size

X12 Innovation

The Hadri LM unit root test was applied to the panel data (Table 3.3), to see if the panel data is stationary. The result gives a P-Value equal to 0.0000, which rejects our H0 hypothesis and confirms H1 which means some data have a unit root.

As the model, the linear regression model (absorbing one categorical variable -country-) was used. First of all, a multiple regression was applied for all countries. Then the countries were categorized as developing countries and the differences in the regression results were analyzed. Each independent variable's effect was measured by applying a linear regression for all countries. Stata 13 is the software used to make statistical calculations.

In the model, a time lag was also applied as ICT adoption has a possibility to show its positive outputs on the productivity or the efficiency of the countries after a specific number of years. As the inputs may not lead to an immediate change in the output, a time lag is introduced to the literature, usually two years or three years (Griliches, 1979; Goto & Suzuki, 1989). Hagsten (2014) uses all explanatory variables lagged for one year. The present study also uses a model with no time lag for the first observation

part and a two-year time lag model. The overall scores for each country in the model with the two-year time lag and no time lag are listed in Appendix A in alphabetic order.

Table 3.3: Unit root test for the main pillars panel data

Hadri LM test for y

Ho: All panels are stationary	Number of panels = 21
Ha: Some panels contain unit roots	Number of periods = 10
Time trend: Included	Asymptotics: T, N -> Infinity
Heteroskedasticity: Not robust	sequentially
LR variance: (not used)	

	Statistic	p-value
z	5.6408	0.0000

4 EMPIRICAL ANALYSIS

The results obtained from this study can be grouped as:

Multiple linear regression analysis for all countries

Multiple linear regression analysis for developing countries

Multiple linear regression analysis with two years' lag for all countries

Simple linear regression analysis for each pillar

First of all, the Hausman test has applied for the data (Appendix), and from its result where Chi-Square is >0.05 so the null hypothesis (Random-effects model is appropriate) accepted and Regarding the construction of our model (based on Equation (10)) and codification for our variables, the estimated equations for the panel data Random-effects model would be:

$$Y(^{Trade}/_{GDP}) = C(1) + C(2)TehRed + C(3)MacroEcoEnv + C(4)Heal\&Pri.Edu + C(5)GdsMarkEff + C(6)LabMarkEff + C(7)FinMarkDev + C(8)MarkSi + C(9)Innovation \quad (11)$$

Firstly, by conducting the multiple linear regression analysis for all countries (developed and developing), we have the following results (Table 4.1):

Prob>chi test value, which is equal to 0.0000, shows that the model is working properly and applicable. On another side, we can see that R-sq(rho) is equal to 95.18% (>95%), which shows that the independent variables used in the model have a great influence to explain the dependent variable Y. Table 4.1 also shows that some independent variables like Macroeconomic environment, Health and primary education, Financial market development and Technological readiness are the main influencing factors of the model, which have z values > 1.96 or < (-1.96) and at the same time P values < 0.05.

For the developing countries, the results are also similar and we still see that the independent variables can well explain the variance on the dependent variable. R-

sq(rho) value in Table 4.2 is 4.6% lower for the developing countries, but still even for the dependent variable is well explained, as can be seen in Table 4.2.

Table 4.1: Multiple linear regression analysis for all countries

y	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
x3macroecoenv	3.941	1.106	3.56	0	1.774	6.108	***
x4healthandprimedu	10.269	3.085	3.33	.001	4.222	16.315	***
x6goodsmrkteff	-3.791	3.558	-1.07	.287	-10.765	3.183	
x7labormrkteff	-1.445	4.226	-0.34	.732	-9.728	6.838	
x8finmrktdev	-4.565	2.021	-2.26	.024	-8.526	-.603	**
x9techredd	6.501	1.797	3.62	0	2.98	10.023	***
x10marketsize	-5.365	4.787	-1.12	.262	-14.746	4.017	
x12innovation	-.151	3.314	-0.05	.964	-6.646	6.344	
Constant	37.829	41.743	0.91	.365	-43.986	119.644	
Mean dependent var		74.348	SD dependent var			46.608	
Overall r-squared		0.244	Number of obs			210.000	
Chi-square		49.239	Prob > chi2			0.000	
R-squared within		0.194	R-squared between			0.248	

*** p<.01, ** p<.05, * p<.1

Table 4.2: Multiple linear regression analysis for developing countries

y	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
x3macroecoenv	4.361	1.507	2.89	.004	1.407	7.314	***
x4healthandprimedu	12.097	3.274	3.70	0	5.681	18.513	***
x6goodsmrkteff	2.583	4.69	0.55	.582	-6.608	11.775	
x7labormrkteff	-11.235	4.951	-2.27	.023	-20.939	-1.531	**
x8finmrktdev	1.893	2.571	0.74	.461	-3.146	6.933	
x9techredd	7.618	2.058	3.70	0	3.584	11.651	***
x10marketsize	-13.111	5.065	-2.59	.01	-23.038	-3.184	***
x12innovation	-12.953	4.253	-3.05	.002	-21.289	-4.616	***
Constant	88.821	46.593	1.91	.057	-2.499	180.141	*
Mean dependent var		63.611	SD dependent var			36.714	
Overall r-squared		0.184	Number of obs			130.000	
Chi-square		57.748	Prob > chi2			0.000	
R-squared within		0.350	R-squared between			0.175	
*** p<.01, ** p<.05, * p<.1							

Apart from the yearly analysis, the results show that the dependent variable (Y) is better explained when a time lag of two years is applied to the model (Table 4.3). The overall Rho increases up to 0.83%, but at this point, it can be seen that the independent variables influencing the dependent variable change.

For the model without a time lag, according to the t and P values, the dependent influencing variables are:

X3 Macroeconomic environment

X4 Health and primary education

X8 Financial market development

X9 Technology readiness

However, with the time lag of two years, we have the following ones as new influencing variables:

It can be seen from this analysis that technology readiness and health and primary educations are key factors for the trade ratio of a country, and add these two factors also affect the Trade ratio of the country years from now. It is also an expected result that the market size and innovation pillars are influencing factor only with the time lag effect, as these are the kind of variables that shows its effects after a few years.

According to equation 11 now we can have several equations for the following analysis, where Yt represents the Trade/GDP ratio:

For the multiple regression analysis for all countries, we have:

$$Y_t = 37.82 + 3.94X_{3t} + 10.27X_{4t} - 4.56X_{8t} + 6.5X_{9t} \quad (12)$$

For developing countries, we have:

$$Y_t = 88.82 + 4.36X_{3t} + 12.1X_{4t} - 11.23X_{7t} + 7.62X_{9t} - 13.11X_{10t} - 12.95X_{12t} \quad (13)$$

Finally, with a two-year lag for all countries in all pillars:

$$\mathrm{Y_{t-2}} = 31.73 + 17.52\mathrm{X_{4t-2}} + 6\mathrm{X_{9t-2}} - 14.1\mathrm{X_{10t-2}} + 13.42\mathrm{X_{12t-2}} \quad (14)$$

According to the results, there is a difference in 2 years lag model and two independent variables (Market size and Innovation) which effect usually appears after a period, have significant influence.

We see that, as the most related pillar with ICT usage Technology readiness is an extremely influencing positive factor on the country's Trade/GDP ratio with its t value of 3.62 and a P value of 0.000, which can be seen in Table 4.2. This also brings with itself that the other highly correlated pillar (Innovation) also have similar positive effects on the dependent variable; we can therefore say that Technology readiness has instant and Innovation have late effects on the Trade/GDP ratio.

In terms of having an idea of ICT usage, after seeing that Technological Readiness instantly and Innovation after a period of time can have a positive influence on Trade/GDP, we can say that the sub-pillars which are making part of the main pillar also have an effect on a country's Trade/GDP ratio. That is the same case for the Higher Education pillar also, which can more instantly influence a country's statistics than primary education.

Table 4.3: Multiple linear regression analysis with two years lag for all countries

y3	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
x3macroecoenv	1.333	1.492	0.89	.373	-1.616	4.282	
x4healthandprimedu	17.522	4.165	4.21	0	9.287	25.757	***
x6goodsmrkteff	-7.849	5.679	-1.38	.169	-19.077	3.38	
x7labormrkteff	-7.824	4.772	-1.64	.103	-17.26	1.612	
x8finmrktdev	-.595	2.491	-0.24	.812	-5.52	4.331	
x9techredd	6.017	2.561	2.35	.02	.954	11.08	**
x10marketsize	-14.109	6.58	-2.14	.034	-27.119	-1.098	**
x12innovation	13.425	5.04	2.66	.009	3.46	23.39	***
Constant	31.739	53.075	0.60	.551	-73.2	136.677	

Mean dependent var	73.385	SD dependent var	44.958
R-squared	0.313	Number of obs	168.000
F-test	7.919	Prob > F	0.000
Akaike crit. (AIC)	1112.329	Bayesian crit. (BIC)	1140.445

*** p<.01, ** p<.05, * p<.1

Table 4.4: Sub-pillars about direct ICT usage

Main Pillars	**Sun-Pillars**
9th pillar: Technological readiness	9.1. Availability of latest technologies, 1-7 (best)
	9.2. Firm-level technology absorption, 1-7 (best)
	9.3. FDI and technology transfer, 1-7 (best)
	9.4. Individuals using Internet, %*
	9.5. Fixed broadband Internet subscriptions/100 pop.*
	9.6. Int'l Internet bandwidth, kb/s per user*
	9.7. Mobile broadband subscriptions/100 pop.*
12th pillar: Innovation	12.1. Capacity for innovation, 1-7 (best)
	12.2. Quality of scientific research institutions, 1-7 (best)
	12.3. Company spending on R&D, 1-7 (best)
	12.4. University-industry collaboration in R&D, 1-7 (best)
	12.5. Gov't procurement of advanced tech products, 1-7 (best)
	12.6. Availability of scientists and engineers, 1-7 (best)

Table 4.5:Correlation between the ICT usage sub-pillars

	y	**x1**	**x2**	**x3**	**x4**	**x5**	**x6**	**x7**	**x8**	**x9**	**x10**	**x11**	**x12**	**x13**
y	1													
x1	0.126	1												
x2	0.065	0.945	1											
x3	0.387	0.465	0.433	1										
x4	0.323	0.709	0.611	0.160	1									
x5	0.275	0.734	0.604	0.159	0.919	1								
x6	0.271	0.441	0.414	-0.030	0.520	0.470	1							
x7	0.115	0.569	0.542	0.170	0.778	0.700	0.349	1						
x8	0.095	0.746	0.747	0.438	0.601	0.601	0.272	0.630	1					
x9	0.203	0.864	0.815	0.507	0.685	0.721	0.333	0.607	0.872	1				
x10	0.067	0.741	0.762	0.438	0.554	0.590	0.185	0.600	0.935	0.898	1			
x11	0.187	0.798	0.834	0.550	0.522	0.536	0.276	0.487	0.841	0.916	0.884	1		
x12	-0.005	0.379	0.479	0.282	0.159	0.242	-0.009	0.174	0.584	0.537	0.718	0.692	1	
x13	0.066	0.651	0.578	0.247	0.498	0.624	0.202	0.473	0.574	0.654	0.641	0.544	0.432	1

The previous analysis results lead us to a new one. It is obvious from the analysis results that ICT usage is related to the Trade/GDP ratio, but to go further, the sub-pillars of the ICT-related pillars should also be analyzed in order to understand which sub-pillars are the most influencing.

Regarding the data availability and the correlation between the sub-pillars, the sub-pillars to be used in the analysis were determined. The related data can be found in Appendix B. The following three sub-pillars are excluded from the analysis because of relatively insufficient data:

X6: Int'l Internet bandwidth

X7: Mobile broadband subscriptions/100 pop.

The following sub-pillars are also excluded as they have a high correlation with other sub-pillars (Table 4.5):

X2: Firm-level technology absorption

X5: Fixed broadband Internet subscriptions

X8: Capacity for innovation

X9: Quality of scientific research institutions

X10: Company spending on R&D

In the end, six sub-pillars out of 13 are available to be included in the new regression analysis. These sub-pillars are:

X1: Availability of latest technologies

X3: FDI and technology transfer

X4: Individuals using the Internet

X11: University-industry collaboration in R&D

X12: Gov't procurement of advanced tech products

X13: Availability of scientists and engineers

A unit root test should be applied for this panel data as well in order to see if the data is stationary. The Hadri LM unit root test was applied to the data. Table 4.6 shows the results, which show a p-value of 0.0000 and that means the Null hypothesis "H0: All the panel is stationary" rejected and there are some unit roots in our data.

Table 4.6: Unit root test for ICT usage related sub-pillars

Hadri LM test for y

Ho: All panels are stationary		Number of panels =	21
Ha: Some panels contain unit roots		Number of periods =	10
Time trend:	Included	Asymptotics: T, N -> Infinity	
Heteroskedasticity: Not robust		sequentially	
LR variance:	(not used)		
	Statistic	p-value	
z	5.6408	0.0000	

Also for sub-pillars Hausman test has been applied (Appendix) and unlike the main-pillars null hypothesis is rejected and the Fixed effect model has been chosen for sub-pillars analysis.

We can see that there are some highly regressed ICT-based sub-pillars related to the Trade/GDP ratio after the linear regression results were obtained from these sub-pillars (Table 4.8). Regarding their t and P values, two sub-pillars related to the main pillar (Technology readiness) have a positive effect on Trade/GDP ratio and one sub-pillar FDI and technology transfer has a negative effect on it, the sub-pillar Availability of the latest technologies is the most influencing sub-pillar as result. So we can say that these are the sub-pillars that affect our dependent variable directly, most, and positively.

Secondly, from the late effecting pillar (Innovation), Gov't procurement of advanced tech products has negative and Availability of scientists and engineers which is one of the most critical sub-pillars indicating a country's growth penetration indirectly has a positive effect on Trade/GDP ratio.

We mentioned that Government Procurement of Advanced Tech Products and the FDI and technology transfer have negative effects on the Trade/GDP ratio. This may be the reality for many of the times as these two sub-pillars need already-settled technological infrastructure, which means, for the countries not producing high-tech finished goods, an increase in the high-tech import.

Equation (15) for the Trade/GDP with no time lag can be determined as follows:

$$Y_t = 42.4 + 6.6X_{1t} - 6.45X_{3t} + 0.12X_{4t} - 4.51X_{12t} + 4X_{13t} \qquad (15)$$

The definition of the unknowns for Equation (15) can be found in Table 4.7 below:

Table 4.7: Definitions of the unknowns in the equations (5), (6), and (7)

Unknown	Definition
Y	Trade/GDP
X1	Availability of latest Technology
X3	FDI and technology transfer
X4	Individuals using Internet
X11	University-industry collaboration in R&D
X12	Gov't procurement of advanced tech products)
X13	Availability of scientists and engineers
t	Year of observation

Table 4.8:Multiple linear regression analysis with ICT-related sub-pillars for all countries

y	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
x1	6.601	3.062	2.16	.032	.559	12.644	**
x3	-6.459	3.056	-2.11	.036	-12.488	-.43	**
x4	.119	.059	2.03	.044	.003	.234	**
x11	4.836	2.757	1.75	.081	-.604	10.276	*
x12	-4.512	1.981	-2.28	.024	-8.42	-.603	**
x13	4	1.82	2.20	.029	.409	7.591	**
Constant	42.4	17.267	2.46	.015	8.332	76.468	**

Mean dependent var	74.348	SD dependent var	46.608
R-squared	0.236	Number of obs	210.000
F-test	9.440	Prob > F	0.000
Akaike crit. (AIC)	1453.850	Bayesian crit. (BIC)	1477.280

*** p<.01, ** p<.05, * p<.1

As these sub-pillars instant effects are already questionable, so, at the first, a time lag of one year was applied to the model, specifically to these sub-pillars (Table 4.9). For the dataset with a one-year lag to the six sub-pillars, the results show that with the one-year lag, the effect of the three sub-pillars (University-industry collaboration in R&D, Individual using the internet, and Gov't procurement of advanced tech products) increased slightly while the other three sub-pillars (Availability of latest technologies, FDI and technology transfer, and Availability of scientists and engineers) becomes less effective compared to the analysis with no-lag data. Equation (16) shows the equation for the one-year lag model.

$$Y_{t-1} = 25.76 + 0.17X_{4t-1} + 12.67X_{11t-1} - 9.62X_{12t-1} \quad (16)$$

Secondly, a time lag of two years was applied to the six sub-pillars. It can be seen that the three sub-pillars (University-industry collaboration in R&D, Individual using the internet, and Gov't procurement of advanced tech products) increased compared to the one-year lag model and no lag model (Table 4.10) which means two of these sub-

pillars have an instant and long-term effect on Trade/GDP ratio and one sub-pillar(University-industry collaboration in R&D) has only long term effect, in another hand, three sub-pillars (Availability of latest technologies, FDI and technology transfer and Availability of scientists and engineers) have been decreased, which means these sub-pillars have an only instant effect on Trade/GDP ratio and they do not affect or have less effect on this ratio in a long time.

The equation for the Trade/GDP ratio obtained from the analysis with two-years of time lag is Equation (17), where the definitions for the unknowns can be found in Table 4.7:

$$Y_{t-2} = 42.91 + 0.19X_{4t-2} + 16.46X_{11t-2} - 11.76X_{12t-2} \qquad (17)$$

Table 4.9: Multiple linear regression analysis with ICT-related sub-pillars (with a one-year time lag for five sub-pillars

y1	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
x1	6.097	3.36	1.81	.071	-.537	12.731	*
x3	-6.146	3.662	-1.68	.095	-13.377	1.085	*
x4	.171	.067	2.57	.011	.04	.303	**
x11	12.665	3.807	3.33	.001	5.148	20.182	***
x12	-9.624	2.805	-3.43	.001	-15.163	-4.085	***
x13	3.838	3.385	1.13	.259	-2.846	10.523	
Constant	25.765	20.062	1.28	.201	-13.852	65.383	

Mean dependent var	73.777	SD dependent var	45.939
R-squared	0.228	Number of obs	189.000
F-test	7.994	Prob > F	0.000
Akaike crit. (AIC)	1293.414	Bayesian crit. (BIC)	1316.107

*** p<.01, ** p<.05, * p<.1

Table 4.10: Multiple linear regression analysis with ICT-related sub-pillars (with a two-year time lag for five sub-pillars)

y2	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
x1	2.935	3.478	0.84	.4	-3.941	9.811	
x3	-4.169	3.686	-1.13	.26	-11.455	3.117	
x4	.19	.08	2.39	.018	.033	.347	**
x11	16.463	4.109	4.01	0	8.339	24.586	***
x12	-11.766	3.027	-3.89	0	-17.75	-5.782	***
x13	-.589	3.768	-0.16	.876	-8.038	6.86	
Constant	42.915	21.017	2.04	.043	1.366	84.463	**
Mean dependent var		73.385	SD dependent var			44.958	
R-squared		0.222	Number of obs			168.000	
F-test		6.712	Prob > F			0.000	
Akaike crit. (AIC)		1129.210	Bayesian crit. (BIC)			1151.078	

*** p<.01, ** p<.05, * p<.1

4.1 Evaluation of Findings.

By simply comparing their rank in GCI and IDI as shown in Table 4.11 and 4.12 below which one of these sub-pillars is more influencing can be easily checked.

Table 4.11:Comparing top 10 high ranked countries in the Uni-Industry collaboration in R&D with their IDI Ranks

Country	The University-industry collaboration in R&D Rank	IDI Ranks
Switzerland	1	3
United States	2	16
Israel	3	23
Finland	4	22
Netherlands	5	7
United Kingdom	6	5
Germany	7	12
Singapore	8	18
Belgium	9	25
Sweden	10	11

Source: WEF (2017) & ITU (2017a).

Table 4.12: Comparing top 10 high ranked countries in Availability of scientists and engineers with their IDI Ranks

Country	Availability of scientists and engineers	IDI Ranks
Finland	1	22
United States	2	16
United Arab Emirates	3	40
Canada	4	29
Qatar	5	39
Israel	6	23
Malaysia	7	63
Japan	8	10
Singapore	9	18
Greece	10	38

Source: WEF (2017) & ITU (2017a).

As we can see in Table 4.11 countries with high ranking in University-industry collaboration in R&D also has a high rank in IDI it means University-Industry collaboration in R&D is one of the influencing factor and pillar but as it's shown in Table 4.12 Countries with high-rank Availability of scientists and engineers has a low rank in IDI in means Availability of scientists and engineers is a lower influencing pillar.

5. CONCLUSION AND DISCUSSION

The main purpose of this study is to investigate the effect of ICT on the Trades to GDP ratio and the possible reasons for these effects. To understand this, GCI data for the past ten years were examined. In the end, it can be seen that apart from other pillars, a country's Trade/GDP ratio also depends on the country's health and primary education, Macroeconomy environment, Financial market development, technological readiness, and innovation capability, which is highly related to it.

To go deeper, a new analysis was applied to the ICT-related sub-pillars which are Technology readiness and innovation and it is observed that among the ICT-related sub-pillars, the following are very influential in the Trade/GDP ratio, if not Intended a time lag:

Availability of latest technologies

FDI and technology transfer

Individuals Using internet

Government procurement of advanced tech products

Availability of scientists and engineers

The FDI and technology transfer and Government procurement of advanced technological products are the negatively related sub-pillars with the Trade/GDP ratio of a country. Especially the FDI and technology transfer triggers an increase in the imports as most of the firms in all the countries import the technology from major high-tech exporter countries.

According to the United Nations data of 2019 high-tech export, China is the world's largest high-tech exporter with $ 322038.79 million, exporting more than 25% of the overall high-tech products in the world. The first four countries, which are China, Germany, the US, and South Korea, have a total share of more than 50%, and with the next three countries, Japan, UK, and Mexico, this share reaches 75% in the total 2019 high-tech exports (The United Nations, 2019). Except for the UK, the other six countries were also included in the analysis.

It is obvious that investing in advanced technology and absorbing the technology of companies in many countries reduces the country's Trade surplus, because it increases imports, especially in the short term. Similarly, government purchases of high-tech products increase a country's imports and, consequently, reduce its Trade surplus. In fact, both sub-pillars can be considered as the main factors for a country's technology imports.

On the other hand, it can be seen that three sub-pillars significantly affect a country's export positively, which are Individuals using the internet, the University-industry collaboration in R&D (as well as Quality of scientific research institutions pillar, which is highly correlated with it) and the availability of scientists and engineers. These three sub-pillars represent the quality of ICT usage in a country. the University-industry collaboration in R&D and the quality of the scientific research institutions may be considered as one of the drivers of the ICT usage efficiency as the increased quality in these institutions probably represents an increase in Research and Development (R&D) activities, which is closely related with the efficiency usage (World Bank, 2012; WEF, 2015). On the other hand, as scientists and engineers are innovators and creators the Availability of scientists and engineers indicates innovation and creativity.

Also, the studies which were conducted by WEF and the World Bank support this idea of an existing relationship between the countries' R&D expenditures and the availability of scientists and engineers.

Apart from these six sub-pillars that affect a country's Trade/GDP ratio, when working with a time lag, the results show that with a one-year and two-year lag, the impact of University-industry collaboration in R&D increases, respectively. It is possible to see that the results support the long-term effectiveness of this sub-pillar when viewed with larger datasets over many years. For this study, we cannot talk about specific effectiveness, but it is clear that with increasing lag, there is increasing effectiveness.

This study is mainly done on the relationship between the use of Information and Communication Technology and the ratio of Trades/GDP of 21 countries including developed and developing and is the most influential sub-sector of the usage of information and communication technology in the internationalization or globalization of a country. Unlike other studies in the literature, the main focus of this study was to identify the main factors related to ICT in internationalization and to present an idea

of the place of investment, and to show the possible bottlenecks and areas for improvement. This study also has limitations. The GCI data retrieved from the WEF was ten years and relatively small, which may be a natural consequence of the short history of ICT use and studies. Obviously, the larger amount of data that will be available in the coming years will lead to more accurate calculations. The time lag was another limitation for the study, as there was a possibility of a time delay effect, but the data were too small to observe correctly. Obviously, to deepen the study, a time lag must be applied to the larger data set, and the Pillars and sub-pillars must be issued for time-lag analysis to see their effects. Especially for the innovation pillar and its sub-pillars, its effects can be clearly seen by observing the effective results of innovation after years.

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APPENDICES

Appendix A: Countries' independent and dependent main pillar variable scores (GCI, 2009-2018)

Appendix B: ICT Related Sub-Pillar

Appendix C. Hausman Test for 2 years lagged all countries

Appendix D. Hausman Test for all countries

Appendix E. Hausman Test for Sub-Pillars

Appendix A: Countries' independent and dependent main pillar variable scores

Country	year	Y	macroecoenv	healthandprimedu	goodsmrkteff	labormrkteff	finmrktdev	techredd	marketsize	innovation
Brazil	2009	10.851	3.926	5.240	3.872	4.272	4.470	4.056	5.628	3.523
Brazil	2010	10.866	3.997	5.453	3.708	4.142	4.441	3.923	5.604	3.549
Brazil	2011	11.583	4.162	5.448	3.811	4.186	4.469	3.976	5.613	3.496
Brazil	2012	11.878	4.727	5.430	3.935	4.385	4.448	4.431	5.634	3.424
Brazil	2013	11.742	4.626	5.425	3.819	4.129	4.401	4.137	5.653	3.415
Brazil	2014	11.012	4.492	5.654	3.846	3.828	4.299	4.210	5.660	3.314
Brazil	2015	12.900	4.009	5.126	3.716	3.680	3.988	4.387	5.782	3.164
Brazil	2016	12.467	3.486	5.296	3.700	3.666	3.635	4.366	5.731	3.096
Brazil	2017	12.523	3.443	5.411	3.791	3.682	3.700	4.568	5.692	3.209
Brazil	2018	14.890	4.858	5.558	3.213	3.745	4.522	4.067	5.691	3.423
Country	year	Y+2	macroecoenv	healthandprimedu	goodsmrkteff	labormrkteff	finmrktdev	techredd	marketsize	innovation
Brazil	2009	11.583	3.926	5.240	4.142	3.872	4.272	4.470	4.056	3.523
Brazil	2010	11.878	3.997	5.453	4.293	3.708	4.142	4.441	3.923	3.549
Brazil	2011	11.742	4.162	5.448	4.350	3.811	4.186	4.469	3.976	3.496
Brazil	2012	11.012	4.727	5.430	4.273	3.935	4.385	4.448	4.431	3.424
Brazil	2013	12.900	4.626	5.425	4.218	3.819	4.129	4.401	4.137	3.415
Brazil	2014	12.467	4.492	5.654	4.920	3.846	3.828	4.299	4.210	3.314
Brazil	2015	12.523	4.009	5.126	3.846	3.716	3.680	3.988	4.387	3.164
Brazil	2016	14.890	3.486	5.296	4.109	3.700	3.666	3.635	4.366	3.096

Source: WEF (2009) – WEF (2019)

Country	year	Y	macroecoenv	healthandprimedu	goodsmrkteff	labormrkteff	finmrktdev	techredd	marketsize	innovation
China	2009	45.18488	5.929	5.7167	4.46568	4.73532	4.05225	3.37655	6.62715	3.92726
China	2010	50.71707	6.10964	6.16248	4.40023	4.70252	4.27836	3.4446	6.70874	3.92124
China	2011	50.7409	6.22024	6.16013	4.42114	4.68233	4.41512	3.57056	6.77407	3.92164
China	2012	48.26752	6.21967	6.10909	4.3146	4.60419	4.3066	3.49973	6.82423	3.84535
China	2013	46.74438	6.29341	6.06237	4.32388	4.62537	4.3241	3.43504	6.85189	3.89289
China	2014	44.90522	6.41089	6.0773	4.41717	4.55046	4.29837	3.52617	6.86176	3.90719
China	2015	39.46417	6.51573	6.09451	4.37097	4.49814	4.07794	3.70035	6.97778	3.89224
China	2016	36.89441	6.19458	6.16667	4.42948	4.52671	4.15838	3.95702	7	4.04034
China	2017	37.63242	5.99861	6.21165	4.54878	4.54839	4.22851	4.18268	7	4.13614
China	2018	37.45624	6.916	6.146	4.032	4.144	5.25	5.495	7	4.536
Country	year	Y+2	macroecoenv	healthandprimedu	goodsmrkteff	labormrkteff	finmrktdev	techredd	marketsize	innovation
China	2011	45.18488	6.22024	6.16013	4.42114	4.68233	4.41512	3.57056	6.77407	3.92164
China	2012	50.71707	6.21967	6.10909	4.3146	4.60419	4.3066	3.49973	6.82423	3.84535
China	2013	50.7409	6.29341	6.06237	4.32388	4.62537	4.3241	3.43504	6.85189	3.89289
China	2014	48.26752	6.41089	6.0773	4.41717	4.55046	4.29837	3.52617	6.86176	3.90719
China	2015	46.74438	6.51573	6.09451	4.37097	4.49814	4.07794	3.70035	6.97778	3.89224
China	2016	44.90522	6.19458	6.16667	4.42948	4.52671	4.15838	3.95702	7	4.04034
China	2017	39.46417	5.99861	6.21165	4.54878	4.54839	4.22851	4.18268	7	4.13614
China	2018	36.89441	6.916	6.146	4.032	4.144	5.25	5.495	7	4.536

Country	year	Y	macroecoenv	healthandprimedu	goodsmrkteff	labormrkteff	finmrktdev	techredd	marketsize	innovation
France	2009	50.46245	4.71691	6.22402	4.85856	4.38692	4.94696	5.23794	5.77548	4.49912
France	2010	54.86779	4.97646	6.42427	4.68913	4.47187	4.95511	5.28221	5.758	4.48453
France	2011	58.79058	4.5995	6.36766	4.56323	4.37763	4.99946	5.63364	5.74228	4.72291
France	2012	59.70206	4.64161	6.30967	4.47267	4.40629	4.73302	5.71709	5.75527	4.91134
France	2013	59.76406	4.64967	6.33013	4.43387	4.31234	4.61379	5.68525	5.76457	4.67556
France	2014	60.4788	4.55032	6.43989	4.57482	4.26705	4.78718	5.7679	5.74233	4.74077
France	2015	61.75169	4.65804	6.42724	4.63802	4.39055	4.53017	5.88012	5.76449	4.88112
France	2016	61.10014	4.7262	6.4341	4.71401	4.41937	4.60235	5.92117	5.73523	4.92492
France	2017	62.96185	4.82	6.3932	4.68036	4.34915	4.52993	5.89852	5.74699	4.8883
France	2018	64.4792	6.986	6.944	4.354	4.403	6.013	5.159	5.712	5.404
Country	year	Y+2	macroecoenv	healthandprimedu	goodsmrkteff	labormrkteff	finmrktdev	techredd	marketsize	innovation
France	2011	50.46245	4.5995	6.36766	4.56323	4.37763	4.99946	5.63364	5.74228	4.72291
France	2012	54.86779	4.64161	6.30967	4.47267	4.40629	4.73302	5.71709	5.75527	4.91134
France	2013	58.79058	4.64967	6.33013	4.43387	4.31234	4.61379	5.68525	5.76457	4.67556
France	2014	59.70206	4.55032	6.43989	4.57482	4.26705	4.78718	5.7679	5.74233	4.74077
France	2015	59.76405	4.65804	6.42724	4.63802	4.39055	4.53017	5.88012	5.76449	4.88112
France	2016	60.4788	4.7262	6.4341	4.71401	4.41937	4.60235	5.92117	5.73523	4.92492
France	2017	61.75169	4.82	6.3932	4.68036	4.34915	4.52993	5.89852	5.74699	4.8883
France	2018	61.10014	6.986	6.944	4.354	4.403	6.013	5.159	5.712	5.404

Country	year	Y	macroecoenv	healthandprimedu	goodsmrkteff	labormrkteff	finmrktdev	techredd	marketsize	innovation
Germany	2009	71.22871	5.27562	6.01364	5.01492	4.33428	4.68339	5.62548	6.0156	5.10881
Germany	2010	79.86862	5.32495	6.31707	4.96696	4.3983	4.62373	5.35953	6.00554	5.18521
Germany	2011	85.20612	5.42837	6.269	4.78649	4.40889	4.53662	5.60734	5.99871	5.38927
Germany	2012	86.51405	5.48173	6.3032	4.91869	4.50537	4.66055	5.70981	6.0208	5.41712
Germany	2013	85.07888	5.68246	6.35681	4.9223	4.57429	4.6948	5.72403	6.01995	5.50233
Germany	2014	84.62009	5.82925	6.47752	4.99394	4.57246	4.75816	5.8088	5.99407	5.46519
Germany	2015	86.13514	5.98378	6.47998	4.92261	4.63766	4.71149	6.01201	6.02037	5.50867
Germany	2016	84.68316	6.03213	6.49656	4.97168	4.79591	4.87508	6.10886	5.99309	5.57607
Germany	2017	87.6934	6.09977	6.51874	5.2674	5.02979	5.0332	6.16914	6.00095	5.64932
Germany	2018	88.67084	7	6.461	4.774	5.096	5.537	4.9	6.02	6.468
Country	year	Y+2	macroecoenv	healthandprimedu	goodsmrkteff	labormrkteff	finmrktdev	techredd	marketsize	innovation
Germany	2011	71.22871	5.42837	6.269	4.78649	4.40889	4.53662	5.60734	5.99871	5.38927
Germany	2012	79.86862	5.48173	6.3032	4.91869	4.50537	4.66055	5.70981	6.0208	5.41712
Germany	2013	85.20612	5.68246	6.35681	4.9223	4.57429	4.6948	5.72403	6.01995	5.50233
Germany	2014	86.51405	5.82925	6.47752	4.99394	4.57246	4.75816	5.8088	5.99407	5.46519
Germany	2015	85.07888	5.98378	6.47998	4.92261	4.63766	4.71149	6.01201	6.02037	5.50867
Germany	2016	84.62009	6.03213	6.49656	4.97168	4.79591	4.87508	6.10886	5.99309	5.57607
Germany	2017	86.13514	6.09977	6.51874	5.2674	5.02979	5.0332	6.16914	6.00095	5.64932
Germany	2018	84.68316	7	6.461	4.774	5.096	5.537	4.9	6.02	6.468

Country	year	Y	macroecoenv	healthandprimedu	goodsmrkteff	labormrkteff	finmrktdev	techredd	marketsize	innovation
Greece	2009	47.74385	4.01903	5.80807	4.09166	3.79579	4.02167	3.86064	4.58701	3.13623
Greece	2010	52.8291	3.60995	6.12772	3.90518	3.71341	3.87561	4.05808	4.5243	2.99862
Greece	2011	57.84462	3.29	6.09028	3.88381	3.63295	3.51658	4.21057	4.42439	2.97879
Greece	2012	61.81777	2.42116	6.0357	3.92049	3.56253	3.12758	4.53854	4.3771	2.99506
Greece	2013	63.51914	2.82186	6.09556	3.93249	3.76547	2.86223	4.61914	4.37484	3.07958
Greece	2014	67.14945	3.31261	6.14799	4.1981	3.74016	2.9736	4.78723	4.34132	3.17599
Greece	2015	63.05516	3.25579	6.13012	4.18388	3.73518	2.8128	4.91858	4.31308	3.23406
Greece	2016	60.84053	2.90122	6.10466	4.17495	3.75105	2.52397	4.97932	4.23166	3.29704
Greece	2017	67.00056	3.70065	6.09585	4.12433	3.72493	2.49395	4.8017	4.27755	3.26646
Greece	2018	72.5197	5.25	6.545	3.766	3.689	3.43	4.529	4.172	3.157
Country	year	Y+2	macroecoenv	healthandprimedu	goodsmrkteff	labormrkteff	finmrktdev	techredd	marketsize	innovation
Greece	2011	47.74385	3.29	6.09028	3.88381	3.63295	3.51658	4.21057	4.42439	2.97879
Greece	2012	52.8291	2.42116	6.0357	3.92049	3.56253	3.12758	4.53854	4.3771	2.99506
Greece	2013	57.84462	2.82186	6.09556	3.93249	3.76547	2.86223	4.61914	4.37484	3.07958
Greece	2014	61.81777	3.31261	6.14799	4.1981	3.74016	2.9736	4.78723	4.34132	3.17599
Greece	2015	63.51914	3.25579	6.13012	4.18388	3.73518	2.8128	4.91858	4.31308	3.23406
Greece	2016	67.14945	2.90122	6.10466	4.17495	3.75105	2.52397	4.97932	4.23166	3.29704
Greece	2017	63.05516	3.70065	6.09585	4.12433	3.72493	2.49395	4.8017	4.27755	3.26646
Greece	2018	60.84053	5.25	6.545	3.766	3.689	3.43	4.529	4.172	3.157

Country	year	Y	macroecoenv	healthandprimedu	goodsmrkteff	labormrkteff	finmrktdev	techredd	marketsize	innovation
Iceland	2009	88.47451	3.56996	6.45438	4.71508	5.43461	3.98719	5.56612	2.49287	4.54686
Iceland	2010	94.09104	2.58996	6.66118	4.70887	5.39313	3.25303	5.98721	2.36886	4.52811
Iceland	2011	101.8191	3.78289	6.59348	4.48681	5.18824	3.57508	6.20805	2.31608	4.64853
Iceland	2012	104.2675	3.73373	6.58467	4.47396	5.09762	3.73775	5.98958	2.36104	4.67632
Iceland	2013	99.3063	3.94099	6.53738	4.43224	4.91019	3.88816	5.91433	2.42816	4.27893
Iceland	2014	96.99387	4.40667	6.5206	4.54344	4.94026	4.03295	6.02449	2.44167	4.1902
Iceland	2015	96.47575	5.19918	6.5492	4.65007	5.07734	3.8934	6.15435	2.38569	4.46896
Iceland	2016	89.03102	5.53331	6.5923	4.74025	5.20773	4.17217	6.16742	2.30874	4.73333
Iceland	2017	88.06945	5.93924	6.58434	4.78471	5.20849	4.21701	6.16625	2.46103	4.66376
Iceland	2018	92.01679	7	6.839	4.13	5.243	4.991	5.971	2.261	4.557
Country	year	Y+2	macroecoenv	healthandprimedu	goodsmrkteff	labormrkteff	finmrktdev	techredd	marketsize	innovation
Iceland	2011	88.4745	3.78289	6.59348	4.48681	5.18824	3.57508	6.20805	2.31608	4.64853
Iceland	2012	94.09104	3.73373	6.58467	4.47396	5.09762	3.73775	5.98958	2.36104	4.67632
Iceland	2013	101.8191	3.94099	6.53738	4.43224	4.91019	3.88816	5.91433	2.42816	4.27893
Iceland	2014	104.2675	4.40667	6.5206	4.54344	4.94026	4.03295	6.02449	2.44167	4.1902
Iceland	2015	99.3063	5.19918	6.5492	4.65007	5.07734	3.8934	6.15435	2.38569	4.46896
Iceland	2016	96.99387	5.53331	6.5923	4.74025	5.20773	4.17217	6.16742	2.30874	4.73333
Iceland	2017	96.47575	5.93924	6.58434	4.78471	5.20849	4.21701	6.16625	2.46103	4.66376
Iceland	2018	89.03101	7	6.839	4.13	5.243	4.991	5.971	2.261	4.557

Country	year	Y	macroecoenv	healthandprimedu	goodsmrkteff	labormrkteff	finmrktdev	techredd	marketsize	innovation
India	2009	46.27287	4.23069	4.82058	4.41582	4.22639	5.10228	3.32529	6.06536	3.72858
India	2010	49.25521	4.52573	5.16337	4.13133	4.18349	4.94923	3.32546	6.09936	3.61699
India	2011	55.62387	4.30035	5.25057	4.21425	4.20056	4.92793	3.35559	6.16365	3.57624
India	2012	55.79372	4.2521	5.26576	4.20556	4.24255	4.89894	3.35686	6.23942	3.55868
India	2013	53.84413	4.09993	5.30258	4.18351	4.08004	4.83068	3.22317	6.24942	3.6249
India	2014	48.92219	4.22057	5.3511	4.13258	3.8053	4.33693	2.74825	6.26147	3.53256
India	2015	41.92291	4.39831	5.48017	4.16748	3.85753	4.07863	2.73274	6.43997	3.64537
India	2016	40.08249	4.54835	5.53893	4.39398	4.09579	4.41139	2.99328	6.4262	4.04928
India	2017	40.72281	4.53784	5.50329	4.47179	4.14604	4.37269	3.11589	6.43117	4.09371
India	2018	43.40497	6.3	4.235	3.528	3.773	4.865	2.247	6.559	3.563
Country	year	Y+2	macroecoenv	healthandprimedu	goodsmrkteff	labormrkteff	finmrktdev	techredd	marketsize	innovation
India	2011	46.27287	4.30035	5.25057	4.21425	4.20056	4.92793	3.35559	6.16365	3.57624
India	2012	49.25521	4.2521	5.26576	4.20556	4.24255	4.89894	3.35686	6.23942	3.55868
India	2013	55.62387	4.09993	5.30258	4.18351	4.08004	4.83068	3.22317	6.24942	3.6249
India	2014	55.79372	4.22057	5.3511	4.13258	3.8053	4.33693	2.74825	6.26147	3.53256
India	2015	53.84413	4.39831	5.48017	4.16748	3.85753	4.07863	2.73274	6.43997	3.64537
India	2016	48.92218	4.54835	5.53893	4.39398	4.09579	4.41139	2.99328	6.4262	4.04928
India	2017	41.92291	4.53784	5.50329	4.47179	4.14604	4.37269	3.11589	6.43117	4.09371
India	2018	40.08249	6.3	4.235	3.528	3.773	4.865	2.247	6.559	3.563

Country	year	Y	macroecoenv	healthandprimedu	goodsmrkteff	labormrkteff	finmrktdev	techredd	marketsize	innovation
Indonesia	2009	45.51212	4.81569	5.20382	4.49126	4.29763	4.30276	3.20202	5.21499	3.57322
Indonesia	2010	46.70127	5.15079	5.77695	4.34908	4.23087	4.22716	3.24901	5.21371	3.71255
Indonesia	2011	50.18001	5.66171	5.73515	4.22793	4.06423	4.05974	3.32756	5.22367	3.59043
Indonesia	2012	49.5829	5.67536	5.6897	4.29377	3.87004	4.06901	3.55614	5.26958	3.61306
Indonesia	2013	48.63737	5.75014	5.71067	4.40074	4.03643	4.17558	3.65836	5.32264	3.82091
Indonesia	2014	48.08018	5.47971	5.66905	4.54489	3.81211	4.45251	3.57531	5.33916	3.93271
Indonesia	2015	41.93764	5.49755	5.5938	4.43201	3.73912	4.19474	3.48802	5.74155	3.93589
Indonesia	2016	37.42134	5.50738	5.27632	4.40269	3.7962	4.33011	3.53673	5.71132	3.98882
Indonesia	2017	39.3555	5.71702	5.42534	4.59117	3.90807	4.50264	3.86321	5.72752	4.01941
Indonesia	2018	43.00194	6.3	4.956	4.074	4.039	4.48	3.878	5.768	2.639
Country	year	Y+2	macroecoenv	healthandprimedu	goodsmrkteff	labormrkteff	finmrktdev	techredd	marketsize	innovation
Indonesia	2011	45.51212	5.66171	5.73515	4.22793	4.06423	4.05974	3.32756	5.22367	3.59043
Indonesia	2012	46.70127	5.67536	5.6897	4.29377	3.87004	4.06901	3.55614	5.26958	3.61306
Indonesia	2013	50.18001	5.75014	5.71067	4.40074	4.03643	4.17558	3.65836	5.32264	3.82091
Indonesia	2014	49.5829	5.47971	5.66905	4.54489	3.81211	4.45251	3.57531	5.33916	3.93271
Indonesia	2015	48.63737	5.49755	5.5938	4.43201	3.73912	4.19474	3.48802	5.74155	3.93589
Indonesia	2016	48.08018	5.50738	5.27632	4.40269	3.7962	4.33011	3.53673	5.71132	3.98882
Indonesia	2017	41.93764	5.71702	5.42534	4.59117	3.90807	4.50264	3.86321	5.72752	4.01941
Indonesia	2018	37.42134	6.3	4.956	4.074	4.039	4.48	3.878	5.768	2.639

Country	**year**	**Y**	**macroecoenv**	**healthandprimedu**	**goodsmrkteff**	**labormrkteff**	**finmrktdev**	**techredd**	**marketsize**	**innovation**
Ireland	2009	172.9987	4.63169	6.22616	5.0921	4.86281	4.59819	5.26623	4.26439	4.28866
Ireland	2010	189.4217	4.26089	6.51314	5.09259	4.87015	3.78653	4.99176	4.19543	4.2492
Ireland	2011	188.7558	4.01228	6.48821	5.10227	4.89523	3.43543	5.34294	4.11804	4.366
Ireland	2012	191.537	3.43592	6.4565	5.24198	4.99621	3.59927	5.81996	4.12914	4.65878
Ireland	2013	188.5216	3.56915	6.60013	5.21428	4.92564	3.85507	5.74568	4.15149	4.57698
Ireland	2014	201.9903	3.48773	6.5353	5.28634	4.82181	4.15111	5.89387	4.14587	4.67956
Ireland	2015	215.1366	4.4508	6.51312	5.4086	5.0518	3.97605	6.07951	4.23461	4.81239
Ireland	2016	226.0414	5.20098	6.5002	5.42903	5.12547	3.9926	6.05015	4.27097	4.81337
Ireland	2017	219.9983	5.77004	6.47803	5.34736	4.87204	3.99012	5.96919	4.49709	4.70499
Ireland	2018	211.5111	7	6.643	4.263	5.32	4.816	4.662	4.522	4.585
Country	year	Y+2	macroecoenv	healthandprimedu	goodsmrkteff	labormrkteff	finmrktdev	techredd	marketsize	innovation
Ireland	2011	172.9987	4.01228	6.48821	5.10227	4.89523	3.43543	5.34294	4.11804	4.366
Ireland	2012	189.4217	3.43592	6.4565	5.24198	4.99621	3.59927	5.81996	4.12914	4.65878
Ireland	2013	188.7558	3.56915	6.60013	5.21428	4.92564	3.85507	5.74568	4.15149	4.57698
Ireland	2014	191.537	3.48773	6.5353	5.28634	4.82181	4.15111	5.89387	4.14587	4.67956
Ireland	2015	188.5216	4.4508	6.51312	5.4086	5.0518	3.97605	6.07951	4.23461	4.81239
Ireland	2016	201.9903	5.20098	6.5002	5.42903	5.12547	3.9926	6.05015	4.27097	4.81337
Ireland	2017	215.1366	5.77004	6.47803	5.34736	4.87204	3.99012	5.96919	4.49709	4.70499
Ireland	2018	226.0414	7	6.643	4.263	5.32	4.816	4.662	4.522	4.585

Country	**year**	**Y**	**macroecoenv**	**healthandprimedu**	**goodsmrkteff**	**labormrkteff**	**finmrktdev**	**techredd**	**marketsize**	**innovation**
Japan	2009	24.4909	4.21512	6.12954	5.06231	5.09731	4.65198	5.22991	6.1721	5.50896
Japan	2010	28.61301	4.12019	6.51621	5.058	5.07514	4.60877	4.87464	6.10681	5.51834
Japan	2011	30.393	4.19681	6.51725	4.97619	5.03833	4.64275	5.05934	6.12383	5.58661
Japan	2012	30.63612	3.66519	6.49595	4.98312	4.88909	4.63131	5.70493	6.12766	5.54055
Japan	2013	34.14752	3.68243	6.50267	5.0102	4.8222	4.79943	5.59001	6.14336	5.49134
Japan	2014	37.54577	3.63807	6.62272	5.19966	4.72536	4.98464	5.61449	6.14223	5.53645
Japan	2015	35.64102	3.67465	6.68361	5.23799	4.80393	4.7051	5.72222	6.10229	5.53807
Japan	2016	31.54181	4.0992	6.63723	5.20034	4.84691	4.91339	5.80941	6.06416	5.42734
Japan	2017	34.57344	4.30296	6.60385	5.23602	4.78316	4.88654	6.00554	6.06835	5.3687
Japan	2018	36.81651	6.643	7	4.928	5.005	6.013	6.034	6.083	5.481
Country	year	Y+2	macroecoenv	healthandprimedu	goodsmrkteff	labormrkteff	finmrktdev	techredd	marketsize	innovation
Japan	2011	24.4909	4.19681	6.51725	4.97619	5.03833	4.64275	5.05934	6.12383	5.58661
Japan	2012	28.61301	3.66519	6.49595	4.98312	4.88909	4.63131	5.70493	6.12766	5.54055
Japan	2013	30.393	3.68243	6.50267	5.0102	4.8222	4.79943	5.59001	6.14336	5.49134
Japan	2014	30.63612	3.63807	6.62272	5.19966	4.72536	4.98464	5.61449	6.14223	5.53645
Japan	2015	34.14752	3.67465	6.68361	5.23799	4.80393	4.7051	5.72222	6.10229	5.53807
Japan	2016	37.54577	4.0992	6.63723	5.20034	4.84691	4.91339	5.80941	6.06416	5.42734
Japan	2017	35.64102	4.30296	6.60385	5.23602	4.78316	4.88654	6.00554	6.06835	5.3687
Japan	2018	31.54181	6.643	7	4.928	5.005	6.013	6.034	6.083	5.481

Country	**year**	**Y**	**macroecoenv**	**healthandprimedu**	**goodsmrkteff**	**labormrkteff**	**finmrktdev**	**techredd**	**marketsize**	**innovation**
KoreaRep.	2009	86.13362	5.79627	5.98544	4.64462	4.22481	4.35602	5.50351	5.56408	4.83804
KoreaRep	2010	91.3996	5.76431	6.34409	4.54951	4.27417	3.99039	5.04923	5.55735	4.80798
KoreaRep	2011	105.5663	6.37429	6.38443	4.56634	4.30129	3.95396	5.32566	5.57028	4.8893
KoreaRep	2012	105.4583	6.24703	6.49261	4.7501	4.35074	4.06005	5.70196	5.60432	4.93706
KoreaRep	2013	97.9521	6.3244	6.37073	4.67503	4.21255	3.88536	5.56853	5.60992	4.77626
KoreaRep	2014	90.61444	6.43573	6.31253	4.7038	4.06656	3.81466	5.42253	5.59536	4.82704
KoreaRep	2015	79.13249	6.58227	6.33978	4.81464	4.08176	3.60265	5.50061	5.55772	4.82945
KoreaRep	2016	73.60381	6.57554	6.28287	4.93079	4.14023	3.86109	5.54473	5.50677	4.75063
KoreaRep	2017	77.12092	6.62838	6.34367	4.97377	4.18077	3.9014	5.64793	5.52737	4.78327
KoreaRep	2018	78.66026	7	6.93	3.927	4.403	5.908	6.496	5.523	5.537
Country	year	Y+2	macroecoenv	healthandprimedu	goodsmrkteff	labormrkteff	finmrktdev	techredd	marketsize	innovation
KoreaRep	2011	86.13362	6.37429	6.38443	4.56634	4.30129	3.95396	5.32566	5.57028	4.8893
KoreaRep	2012	91.3996	6.24703	6.49261	4.7501	4.35074	4.06005	5.70196	5.60432	4.93706
KoreaRep	2013	105.5663	6.3244	6.37073	4.67503	4.21255	3.88536	5.56853	5.60992	4.77626
KoreaRep	2014	105.4583	6.43573	6.31253	4.7038	4.06656	3.81466	5.42253	5.59536	4.82704
KoreaRep	2015	97.9521	6.58227	6.33978	4.81464	4.08176	3.60265	5.50061	5.55772	4.82945
KoreaRep	2016	90.61444	6.57554	6.28287	4.93079	4.14023	3.86109	5.54473	5.50677	4.75063
KoreaRep	2017	79.13249	6.62838	6.34367	4.97377	4.18077	3.9014	5.64793	5.52737	4.78327
KoreaRep	2018	73.60381	7	6.93	3.927	4.403	5.908	6.496	5.523	5.537

Country	**year**	**Y**	**macroecoenv**	**healthandprimedu**	**goodsmrkteff**	**labormrkteff**	**finmrktdev**	**techredd**	**marketsize**	**innovation**
Mexico	2009	55.96777	5.293	5.4839	3.96538	3.81986	4.12218	3.52697	5.57425	2.98708
Mexico	2010	60.76032	5.23773	5.6628	3.86256	3.80045	3.81857	3.55194	5.54104	3.01222
Mexico	2011	63.46968	5.24721	5.68622	4.08148	3.91799	3.92314	3.74536	5.55322	3.19299
Mexico	2012	65.76725	5.21464	5.7057	4.19743	4.01376	4.15396	3.80259	5.5767	3.32606
Mexico	2013	63.76488	5.11441	5.68889	4.19177	3.94155	4.18716	3.66191	5.61045	3.34963
Mexico	2014	64.96358	5.04228	5.7256	4.19108	3.71197	4.14304	3.55276	5.611	3.31465
Mexico	2015	71.16631	4.85139	5.7108	4.22683	3.75249	4.23606	3.77346	5.65014	3.37895
Mexico	2016	76.10028	4.98142	5.68248	4.33076	3.84789	4.54395	3.96977	5.64073	3.40773
Mexico	2017	77.19414	5.16666	5.68885	4.31689	3.77081	4.50758	4.20911	5.67229	3.40899
Mexico	2018	80.44832	6.846	5.74	4.039	3.906	4.326	3.85	5.656	3.052
Country	year	Y+2	macroecoenv	healthandprimedu	goodsmrkteff	labormrkteff	finmrktdev	techredd	marketsize	innovation
Mexico	2011	55.96777	5.24721	5.68622	4.08148	3.91799	3.92314	3.74536	5.55322	3.19299
Mexico	2012	60.76032	5.21464	5.7057	4.19743	4.01376	4.15396	3.80259	5.5767	3.32606
Mexico	2013	63.46968	5.11441	5.68889	4.19177	3.94155	4.18716	3.66191	5.61045	3.34963
Mexico	2014	65.76724	5.04228	5.7256	4.19108	3.71197	4.14304	3.55276	5.611	3.31465
Mexico	2015	63.76488	4.85139	5.7108	4.22683	3.75249	4.23606	3.77346	5.65014	3.37895
Mexico	2016	64.96358	4.98142	5.68248	4.33076	3.84789	4.54395	3.96977	5.64073	3.40773
Mexico	2017	71.16631	5.16666	5.68885	4.31689	3.77081	4.50758	4.20911	5.67229	3.40899
Mexico	2018	76.10027	6.846	5.74	4.039	3.906	4.326	3.85	5.656	3.052

Country	year	Y	macroecoenv	healthandprimedu	goodsmrkteff	labormrkteff	finmrktdev	techredd	marketsize	innovation
Netherlands	2009	116.8895	5.20766	6.21886	5.23935	4.80574	4.90387	6.01592	5.11713	4.79226
Netherlands	2010	131.5221	5.29125	6.53228	5.17432	4.83079	4.71436	5.99188	5.10156	4.76675
Netherlands	2011	142.4718	5.34062	6.5442	5.17086	4.84073	4.85941	6.12995	5.10405	5.0252
Netherlands	2012	149.2684	5.19967	6.59507	5.2921	4.98535	4.96129	5.97855	5.11477	5.30862
Netherlands	2013	149.5493	5.2157	6.60676	5.25469	4.84152	4.68157	5.97483	5.11065	5.16382
Netherlands	2014	150.0538	5.383	6.63732	5.34489	4.73095	4.54997	5.99888	5.07474	5.25155
Netherlands	2015	157.8166	5.7027	6.59628	5.34116	4.90395	4.43258	6.10036	5.07324	5.36533
Netherlands	2016	148.8587	5.74336	6.66537	5.40808	5.06792	4.47997	6.17705	5.05067	5.44215
Netherlands	2017	156.0282	6.07727	6.69192	5.50012	5.06714	4.62823	6.34435	5.10177	5.55168
Netherlands	2018	157.6533	7	6.594	4.893	5.243	5.922	5.341	5.201	5.341
Country	year	Y+2	macroecoenv	healthandprimedu	goodsmrkteff	labormrkteff	finmrktdev	techredd	marketsize	innovation
Netherlands	2011	116.8895	5.34062	6.5442	5.17086	4.84073	4.85941	6.12995	5.10405	5.0252
Netherlands	2012	131.5221	5.19967	6.59507	5.2921	4.98535	4.96129	5.97855	5.11477	5.30862
Netherlands	2013	142.4718	5.2157	6.60676	5.25469	4.84152	4.68157	5.97483	5.11065	5.16382
Netherlands	2014	149.2684	5.383	6.63732	5.34489	4.73095	4.54997	5.99888	5.07474	5.25155
Netherlands	2015	149.5493	5.7027	6.59628	5.34116	4.90395	4.43258	6.10036	5.07324	5.36533
Netherlands	2016	150.0538	5.74336	6.66537	5.40808	5.06792	4.47997	6.17705	5.05067	5.44215
Netherlands	2017	157.8166	6.07727	6.69192	5.50012	5.06714	4.62823	6.34435	5.10177	5.55168
Netherlands	2018	148.8587	7	6.594	4.893	5.243	5.922	5.341	5.201	5.341

Country	**year**	**Y**	**macroecoenv**	**healthandprimedu**	**goodsmrkteff**	**labormrkteff**	**finmrktdev**	**techredd**	**marketsize**	**innovation**
Nigeria	2009	36.05871	5.4318	2.96406	4.23934	4.44185	4.36907	2.91281	4.48774	3.05883
Nigeria	2010	43.32076	4.25467	3.00075	3.96893	4.34691	3.98861	3.03799	4.64626	2.8685
Nigeria	2011	53.27796	3.9563	3.27925	4.17964	4.35835	3.88539	3.07712	4.58663	3.01451
Nigeria	2012	44.53237	5.24908	3.20458	4.1554	4.49926	4.07287	3.07569	4.62793	3.09836
Nigeria	2013	31.04886	5.16873	3.04482	4.08693	4.47971	4.03872	3.07878	4.6621	3.00037
Nigeria	2014	30.88519	4.62356	2.96511	4.18876	4.52735	4.05564	3.02108	4.69673	2.82112
Nigeria	2015	21.33265	4.61246	2.86107	4.07064	4.54524	3.7537	3.03419	5.06592	2.77627
Nigeria	2016	20.72252	4.01358	2.84508	4.0718	4.53641	3.69084	3.14703	4.99449	2.89857
Nigeria	2017	26.3476	3.51175	2.99811	4.06882	4.59882	3.70085	2.97842	4.98391	2.8491
Nigeria	2018	33.00783	4.221	3.304	3.612	4.214	3.094	2.338	4.977	2.254
Country	year	Y+2	macroecoenv	healthandprimedu	goodsmrkteff	labormrkteff	finmrktdev	techredd	marketsize	innovation
Nigeria	2011	36.05871	3.9563	3.27925	4.17964	4.35835	3.88539	3.07712	4.58663	3.01451
Nigeria	2012	43.32076	5.24908	3.20458	4.1554	4.49926	4.07287	3.07569	4.62793	3.09836
Nigeria	2013	53.27796	5.16873	3.04482	4.08693	4.47971	4.03872	3.07878	4.6621	3.00037
Nigeria	2014	44.53237	4.62356	2.96511	4.18876	4.52735	4.05564	3.02108	4.69673	2.82112
Nigeria	2015	31.04886	4.61246	2.86107	4.07064	4.54524	3.7537	3.03419	5.06592	2.77627
Nigeria	2016	30.88519	4.01358	2.84508	4.0718	4.53641	3.69084	3.14703	4.99449	2.89857
Nigeria	2017	21.33265	3.51175	2.99811	4.06882	4.59882	3.70085	2.97842	4.98391	2.8491
Nigeria	2018	20.72252	4.221	3.304	3.612	4.214	3.094	2.338	4.977	2.254

Country	year	Y	macroecoenv	healthandprimedu	goodsmrkteff	labormrkteff	finmrktdev	techredd	marketsize	innovation
Poland	2009	75.2263	4.56469	5.87802	4.33861	4.54103	4.60814	3.96938	5.07447	3.33084
Poland	2010	82.10833	4.70199	6.12773	4.37787	4.57649	4.66263	4.01742	5.07924	3.31236
Poland	2011	87.08272	4.70874	6.06035	4.35864	4.48006	4.60457	4.17848	5.08131	3.22988
Poland	2012	89.32746	4.59958	6.03398	4.3943	4.48139	4.59426	4.65791	5.11797	3.2518
Poland	2013	90.69187	4.87589	6.03488	4.34064	4.20313	4.54284	4.46767	5.13775	3.24473
Poland	2014	93.69692	4.76532	6.17158	4.49358	4.13812	4.6012	4.46606	5.12454	3.2627
Poland	2015	95.902	5.10737	6.14758	4.51056	4.10708	4.26032	4.77689	5.1551	3.32175
Poland	2016	100.3508	5.14496	6.18539	4.56663	4.12723	4.23523	4.76498	5.1253	3.38521
Poland	2017	104.4922	5.19536	6.21524	4.55496	4.13869	4.17089	4.89493	5.17324	3.39517
Poland	2018	107.4782	7	5.866	4.067	4.193	4.487	4.578	5.187	3.479
Country	year	Y+2	macroecoenv	healthandprimedu	goodsmrkteff	labormrkteff	finmrktdev	techredd	marketsize	innovation
Poland	2011	75.2263	4.70874	6.06035	4.35864	4.48006	4.60457	4.17848	5.08131	3.22988
Poland	2012	82.10833	4.59958	6.03398	4.3943	4.48139	4.59426	4.65791	5.11797	3.2518
Poland	2013	87.08273	4.87589	6.03488	4.34064	4.20313	4.54284	4.46767	5.13775	3.24473
Poland	2014	89.32746	4.76532	6.17158	4.49358	4.13812	4.6012	4.46606	5.12454	3.2627
Poland	2015	90.69186	5.10737	6.14758	4.51056	4.10708	4.26032	4.77689	5.1551	3.32175
Poland	2016	93.69692	5.14496	6.18539	4.56663	4.12723	4.23523	4.76498	5.1253	3.38521
Poland	2017	95.902	5.19536	6.21524	4.55496	4.13869	4.17089	4.89493	5.17324	3.39517
Poland	2018	100.3508	7	5.866	4.067	4.193	4.487	4.578	5.187	3.479

Country	**year**	**Y**	**macroecoenv**	**healthandprimedu**	**goodsmrkteff**	**labormrkteff**	**finmrktdev**	**techredd**	**marketsize**	**innovation**
Romania	2009	58.47283	4.55157	5.50259	4.23988	4.28829	4.40052	3.78829	4.49306	3.10163
Romania	2010	71.23556	4.49526	5.77121	4.08142	4.31592	4.0084	3.81816	4.40651	2.94155
Romania	2011	79.87144	4.51865	5.72495	3.95753	4.09797	3.91448	3.76194	4.39139	2.91469
Romania	2012	79.94243	4.82755	5.51219	3.85925	4.01099	3.98022	4.09328	4.41369	2.9188
Romania	2013	80.5244	5.14189	5.4724	3.88852	3.96366	3.95497	4.13952	4.43844	3.00908
Romania	2014	82.76816	5.19642	5.50768	4.18028	4.04257	4.11828	4.48557	4.43778	3.28385
Romania	2015	82.65751	5.44108	5.49193	4.27858	4.1308	4.04697	4.63272	4.56882	3.23971
Romania	2016	83.29795	5.53346	5.47826	4.22042	4.03976	3.72887	4.7116	4.53489	3.13612
Romania	2017	85.06415	5.24957	5.48602	4.14307	3.97226	3.73996	4.77975	4.61153	3.085
Romania	2018	86.17344	6.279	5.404	3.878	4.312	3.99	5.04	4.564	2.961
Country	year	Y+2	macroecoenv	healthandprimedu	goodsmrkteff	labormrkteff	finmrktdev	techredd	marketsize	innovation
Romania	2011	58.47284	4.51865	5.72495	3.95753	4.09797	3.91448	3.76194	4.39139	2.91469
Romania	2012	71.23556	4.82755	5.51219	3.85925	4.01099	3.98022	4.09328	4.41369	2.9188
Romania	2013	79.87144	5.14189	5.4724	3.88852	3.96366	3.95497	4.13952	4.43844	3.00908
Romania	2014	79.94243	5.19642	5.50768	4.18028	4.04257	4.11828	4.48557	4.43778	3.28385
Romania	2015	80.52441	5.44108	5.49193	4.27858	4.1308	4.04697	4.63272	4.56882	3.23971
Romania	2016	82.76816	5.53346	5.47826	4.22042	4.03976	3.72887	4.7116	4.53489	3.13612
Romania	2017	82.65751	5.24957	5.48602	4.14307	3.97226	3.73996	4.77975	4.61153	3.085
Romania	2018	83.29795	6.279	5.404	3.878	4.312	3.99	5.04	4.564	2.961

Country	year	Y	macroecoenv	healthandprimedu	goodsmrkteff	labormrkteff	finmrktdev	techredd	marketsize	innovation
RussianFederation	2009	48.43506	5.23574	5.6488	3.74801	4.67236	3.26644	3.44943	5.77568	3.35117
RussianFederation	2010	50.35551	4.48813	5.9182	3.57513	4.51097	3.17652	3.55937	5.73943	3.24926
RussianFederation	2011	48.0354	5.16225	5.69644	3.59912	4.39928	3.21075	3.65529	5.73171	3.14134
RussianFederation	2012	47.15139	5.80267	5.7495	3.62492	4.23169	3.19186	4.1338	5.75848	3.00747
RussianFederation	2013	46.28715	5.93301	5.71362	3.80256	4.31027	3.38752	3.97164	5.77984	3.13153
RussianFederation	2014	47.80134	5.53676	5.96519	4.08551	4.41698	3.49567	4.18887	5.76776	3.28623
RussianFederation	2015	49.35935	5.28619	5.93707	4.16238	4.40444	3.52901	4.21934	5.92628	3.28848
RussianFederation	2016	46.51812	4.2986	5.91764	4.18635	4.42541	3.42554	4.30432	5.89915	3.40199
RussianFederation	2017	46.87652	5.02719	5.99526	4.20936	4.33299	3.44722	4.5482	5.89839	3.54663
RussianFederation	2018	51.13314	6.3	4.844	3.703	4.27	3.899	5.39	5.894	3.703
Country	year	Y+2	macroecoenv	healthandprimedu	goodsmrkteff	labormrkteff	finmrktdev	techredd	marketsize	innovation
RussianFederation	2011	48.43506	5.16225	5.69644	3.59912	4.39928	3.21075	3.65529	5.73171	3.14134
RussianFederation	2012	50.35551	5.80267	5.7495	3.62492	4.23169	3.19186	4.1338	5.75848	3.00747
RussianFederation	2013	48.0354	5.93301	5.71362	3.80256	4.31027	3.38752	3.97164	5.77984	3.13153
RussianFederation	2014	47.15139	5.53676	5.96519	4.08551	4.41698	3.49567	4.18887	5.76776	3.28623
RussianFederation	2015	46.28715	5.28619	5.93707	4.16238	4.40444	3.52901	4.21934	5.92628	3.28848
RussianFederation	2016	47.80134	4.2986	5.91764	4.18635	4.42541	3.42554	4.30432	5.89915	3.40199
RussianFederation	2017	49.35935	5.02719	5.99526	4.20936	4.33299	3.44722	4.5482	5.89839	3.54663
RussianFederation	2018	46.51812	6.3	4.844	3.703	4.27	3.899	5.39	5.894	3.703

Country	year	Y	macroecoenv	healthandprimedu	goodsmrkteff	labormrkteff	finmrktdev	techredd	marketsize	innovation
SouthAfrica	2009	55.41826	4.6198	3.6014	4.65369	4.15222	5.43366	3.68746	4.86005	3.54244
SouthAfrica	2010	55.98899	4.98666	4.06147	4.47801	4.13088	5.29871	3.48042	4.81793	3.48996
SouthAfrica	2011	60.11263	4.96052	3.95878	4.6577	4.05626	5.48334	3.59678	4.814	3.52728
SouthAfrica	2012	60.8997	4.63038	3.92626	4.68137	3.93967	5.71681	4.01173	4.84983	3.54647
SouthAfrica	2013	64.24176	4.38981	3.89036	4.75333	3.93226	5.80199	3.92143	4.89257	3.63864
SouthAfrica	2014	64.4345	4.45446	3.95827	4.71305	3.79729	5.36569	3.85518	4.91191	3.63743
SouthAfrica	2015	61.61707	4.50244	4.21945	4.62993	3.81725	5.02869	4.55915	4.94405	3.6895
SouthAfrica	2016	60.63819	4.52031	4.30036	4.76878	3.94105	5.19192	4.70482	4.89142	3.84583
SouthAfrica	2017	57.97389	4.52275	4.46565	4.48282	3.9631	4.35481	4.5817	4.9139	3.79569
SouthAfrica	2018	59.47033	6.188	3.731	3.836	4.263	5.824	3.479	4.802	3.164
Country	year	Y+2	macroecoenv	healthandprimedu	goodsmrkteff	labormrkteff	finmrktdev	techredd	marketsize	innovation
SouthAfrica	2011	55.41826	4.96052	3.95878	4.6577	4.05626	5.48334	3.59678	4.814	3.52728
SouthAfrica	2012	55.98899	4.63038	3.92626	4.68137	3.93967	5.71681	4.01173	4.84983	3.54647
SouthAfrica	2013	60.11263	4.38981	3.89036	4.75333	3.93226	5.80199	3.92143	4.89257	3.63864
SouthAfrica	2014	60.8997	4.45446	3.95827	4.71305	3.79729	5.36569	3.85518	4.91191	3.63743
SouthAfrica	2015	64.24176	4.50244	4.21945	4.62993	3.81725	5.02869	4.55915	4.94405	3.6895
SouthAfrica	2016	64.4345	4.52031	4.30036	4.76878	3.94105	5.19192	4.70482	4.89142	3.84583
SouthAfrica	2017	61.61707	4.52275	4.46565	4.48282	3.9631	4.35481	4.5817	4.9139	3.79569
SouthAfrica	2018	60.63819	6.188	3.731	3.836	4.263	5.824	3.479	4.802	3.164

Country	year	Y	macroecoenv	healthandprimedu	goodsmrkteff	labormrkteff	finmrktdev	techredd	marketsize	innovation
Turkey	2009	45.93247	4.656	5.31509	4.29795	3.65145	4.06253	3.82569	5.21823	3.11349
Turkey	2010	45.89922	4.47289	5.6489	4.21323	3.57179	4.23041	3.85491	5.1677	3.10403
Turkey	2011	52.66294	4.75768	5.62219	4.37602	3.50669	4.26046	3.94824	5.18859	3.149
Turkey	2012	52.24531	4.86216	5.77586	4.55462	3.79431	4.4567	4.28601	5.27621	3.33145
Turkey	2013	50.35032	4.62495	5.85958	4.51751	3.73617	4.39738	4.05111	5.30288	3.46944
Turkey	2014	51.4141	4.83442	5.75418	4.60094	3.47692	4.20753	4.26565	5.31353	3.41548
Turkey	2015	49.29987	4.74745	5.68692	4.52969	3.45606	3.9326	4.08265	5.41218	3.35332
Turkey	2016	46.81565	4.94927	5.59269	4.47475	3.38925	3.81941	4.15886	5.38347	3.30806
Turkey	2017	54.05831	5.09701	5.59967	4.4837	3.38909	3.81941	4.42267	5.49857	3.31487
Turkey	2018	60.15737	4.291	6.097	3.787	3.703	4.284	4.046	5.53	3.115
Country	year	Y+2	macroecoenv	healthandprimedu	goodsmrkteff	labormrkteff	finmrktdev	techredd	marketsize	innovation
Turkey	2011	45.93248	4.75768	5.62219	4.37602	3.50669	4.26046	3.94824	5.18859	3.149
Turkey	2012	45.89922	4.86216	5.77586	4.55462	3.79431	4.4567	4.28601	5.27621	3.33145
Turkey	2013	52.66294	4.62495	5.85958	4.51751	3.73617	4.39738	4.05111	5.30288	3.46944
Turkey	2014	52.24531	4.83442	5.75418	4.60094	3.47692	4.20753	4.26565	5.31353	3.41548
Turkey	2015	50.35032	4.74745	5.68692	4.52969	3.45606	3.9326	4.08265	5.41218	3.35332
Turkey	2016	51.4141	4.94927	5.59269	4.47475	3.38925	3.81941	4.15886	5.38347	3.30806
Turkey	2017	49.29987	5.09701	5.59967	4.4837	3.38909	3.81941	4.42267	5.49857	3.31487
Turkey	2018	46.81565	4.291	6.097	3.787	3.703	4.284	4.046	5.53	3.115

Country	year	Y	macroecoenv	healthandprimedu	goodsmrkteff	labormrkteff	finmrktdev	techredd	marketsize	innovation
UnitedStates	2009	24.64156	4.30694	5.87541	5.13142	5.76488	4.96347	5.60939	6.93302	5.77105
UnitedStates	2010	28.05795	4.39299	6.11658	4.80918	5.63327	4.67276	5.09609	6.9292	5.65342
UnitedStates	2011	30.78929	4.48886	6.05158	4.79754	5.56984	4.86607	5.23319	6.92112	5.56904
UnitedStates	2012	30.56818	3.96858	6.11127	4.8812	5.36762	5.06917	5.83667	6.93102	5.50172
UnitedStates	2013	30.01301	3.95279	6.10135	4.93338	5.3697	5.26344	5.71746	6.93586	5.36619
UnitedStates	2014	29.96885	4.01486	6.05699	5.05018	5.3049	5.34731	5.77592	6.93511	5.49366
UnitedStates	2015	27.73677	4.34877	6.0541	5.10197	5.39885	5.4544	5.8484	6.91044	5.58174
UnitedStates	2016	26.514	4.61613	6.17956	5.20914	5.47807	5.56399	6.02377	6.89506	5.63806
UnitedStates	2017	27.14232	4.50905	6.32817	5.47218	5.64375	5.72681	6.23478	6.86014	5.81989
UnitedStates	2018	27.56442	6.986	5.81	4.802	5.46	6.37	5.201	6.965	5.887
Country	year	Y+2	macroecoenv	healthandprimedu	goodsmrkteff	labormrkteff	finmrktdev	techredd	marketsize	innovation
UnitedStates	2011	24.64156	4.48886	6.05158	4.79754	5.56984	4.86607	5.23319	6.92112	5.56904
UnitedStates	2012	28.05795	3.96858	6.11127	4.8812	5.36762	5.06917	5.83667	6.93102	5.50172
UnitedStates	2013	30.78929	3.95279	6.10135	4.93338	5.3697	5.26344	5.71746	6.93586	5.36619
UnitedStates	2014	30.56818	4.01486	6.05699	5.05018	5.3049	5.34731	5.77592	6.93511	5.49366
UnitedStates	2015	30.01301	4.34877	6.0541	5.10197	5.39885	5.4544	5.8484	6.91044	5.58174
UnitedStates	2016	29.96885	4.61613	6.17956	5.20914	5.47807	5.56399	6.02377	6.89506	5.63806
UnitedStates	2017	27.73677	4.50905	6.32817	5.47218	5.64375	5.72681	6.23478	6.86014	5.81989
UnitedStates	2018	26.514	6.986	5.81	4.802	5.46	6.37	5.201	6.965	5.887

Country	**year**	**Y**	**macroecoenv**	**healthandprimedu**	**goodsmrkteff**	**labormrkteff**	**finmrktdev**	**techredd**	**marketsize**	**innovation**
VietNam	2009	134.7063	3.86414	5.28239	4.19824	4.69604	4.05062	3.45445	4.55365	3.45294
VietNam	2010	152.2174	4.46771	5.73967	4.21222	4.76238	4.21037	3.58213	4.55535	3.40486
VietNam	2011	162.9146	4.77633	5.65798	4.15801	4.59768	4.00359	3.50588	4.58784	3.16318
VietNam	2012	156.5539	4.16381	5.77478	4.12556	4.51456	3.85203	3.3336	4.62963	3.06528
VietNam	2013	165.0942	4.43888	5.78279	4.25109	4.40488	3.76259	3.13579	4.63505	3.14083
VietNam	2014	169.5345	4.6582	5.86006	4.24052	4.37473	3.7654	3.12479	4.68516	3.11767
VietNam	2015	178.7674	4.74052	5.89225	4.22677	4.38425	3.65232	3.31699	4.84005	3.24654
VietNam	2016	184.6863	4.54538	5.78873	4.21254	4.32922	3.87539	3.51098	4.84511	3.29135
VietNam	2017	200.3846	4.58677	5.80915	4.1472	4.34903	3.97902	3.98314	4.91225	3.3062
VietNam	2018	208.3067	5.25	5.635	3.78	4.074	4.473	4.83	5.026	2.576
Country	year	Y+2	macroecoenv	healthandprimedu	goodsmrkteff	labormrkteff	finmrktdev	techredd	marketsize	innovation
VietNam	2011	134.7063	4.77633	5.65798	4.15801	4.59768	4.00359	3.50588	4.58784	3.16318
VietNam	2012	152.2174	4.16381	5.77478	4.12556	4.51456	3.85203	3.3336	4.62963	3.06528
VietNam	2013	162.9146	4.43888	5.78279	4.25109	4.40488	3.76259	3.13579	4.63505	3.14083
VietNam	2014	156.5539	4.6582	5.86006	4.24052	4.37473	3.7654	3.12479	4.68516	3.11767
VietNam	2015	165.0942	4.74052	5.89225	4.22677	4.38425	3.65232	3.31699	4.84005	3.24654
VietNam	2016	169.5345	4.54538	5.78873	4.21254	4.32922	3.87539	3.51098	4.84511	3.29135
VietNam	2017	178.7674	4.58677	5.80915	4.1472	4.34903	3.97902	3.98314	4.91225	3.3062
VietNam	2018	184.6863	5.25	5.635	3.78	4.074	4.473	4.83	5.026	2.576

Appendix B. ICT Related Sub-Pillars

Country	year	Y	FDI&TechTra	IndUsiInt	UniColinR&D	Gov'tPrAdTechProd	AvaofSci&Eng
Brazil	2009	22.10598	5.156	22.554	3.866	3.555	3.394
Brazil	2010	22.77218	5.302	35.200	4.056	3.684	4.235
Brazil	2011	23.93441	5.189	38.713	4.295	3.927	4.046
Brazil	2012	25.11429	5.083	40.650	4.205	3.883	3.757
Brazil	2013	25.78598	5.158	45.000	4.101	3.761	3.481
Brazil	2014	24.68541	5.146	49.848	3.978	3.489	3.411
Brazil	2015	26.95364	4.939	51.600	3.799	3.368	3.309
Brazil	2016	24.5337	4.595	57.600	3.799	3.050	3.254
Brazil	2017	24.32771	4.460	59.079	3.246	2.726	3.442
Brazil	2018	29.39778	4.594	59.683	3.416	2.695	3.622
China	2009	45.18488	4.729	10.350	4.209	4.505	4.220
China	2010	50.71707	4.698	22.300	4.568	4.433	4.613
China	2011	50.7409	4.571	28.534	4.587	4.537	4.622
China	2012	48.26752	4.569	34.300	4.529	4.439	4.631
China	2013	46.74438	4.574	38.300	4.373	4.430	4.438
China	2014	44.90522	4.541	42.300	4.415	4.381	4.459
China	2015	39.46417	4.469	45.800	4.401	4.295	4.410
China	2016	36.89441	4.417	49.300	4.401	4.281	4.474
China	2017	37.63242	4.545	50.300	4.316	4.429	4.677
China	2018	37.45624	4.660	53.200	4.390	4.527	4.679
France	2009	50.46245	5.062	49.569	5.008	3.926	4.254
France	2010	54.86779	4.974	51.212	3.91	4.002	5.269
France	2011	58.79058	4.936	71.581	4.035	3.961	5.261
France	2012	59.70206	4.944	80.096	4.239	3.974	5.309
France	2013	59.76406	4.767	79.58	4.442	3.823	4.908
France	2014	60.4788	4.6	83	4.458	3.597	4.787
France	2015	61.75169	4.815	81.92	4.583	3.755	4.834
France	2016	61.10014	4.94	83.75	4.583	3.966	4.908
France	2017	62.96185	4.956	84.695	4.287	3.803	4.723
France	2018	64.4792	5.002	85.622	4.221	3.621	4.648

Source: WEF (2009) - WEF(2019)

Country	year	Y	FDI&TechTra	IndUsiInt	UniColinR&D	Gov'tPrAdTechProd	AvaofSci&Eng
Germany	2009	71.22871	4.966	46.666	5.796	5.365	4.038
Germany	2010	79.86862	4.656	75.726	5.247	3.934	4.628
Germany	2011	85.20612	4.499	79.258	5.237	4.207	4.82
Germany	2012	86.51405	4.321	81.85	5.157	4.18	4.472
Germany	2013	85.07888	4.551	83	5.249	4.296	4.533
Germany	2014	84.62009	4.757	84	5.391	4.258	4.918
Germany	2015	86.13514	4.85	83.961	5.335	4.192	4.916
Germany	2016	84.68316	4.966	86.19	5.335	4.277	4.984
Germany	2017	87.6934	5.154	87.59	5.351	4.497	5.028
Germany	2018	88.67084	5.423	89.647	5.374	4.892	5.154
Greece	2009	47.74385	4.422	18.384	2.849	2.918	3.179
Greece	2010	52.8291	4.266	32.5	3.166	3.292	5.079
Greece	2011	57.84462	4.05	44.535	3.026	3.162	5.013
Greece	2012	61.81777	4.037	44.4	2.87	3.009	5.006
Greece	2013	63.51914	3.919	53	2.858	2.663	5.204
Greece	2014	67.14945	4.006	56	3.013	2.437	5.378
Greece	2015	63.05516	4.132	59.866	3.061	2.564	5.379
Greece	2016	60.84053	4.056	63.21	3.061	2.579	5.316
Greece	2017	67.00056	3.882	66.835	2.654	2.635	5.242
Greece	2018	72.5197	3.7	69.088	2.548	2.486	5.158
Iceland	2009	88.47451	4.508	65.298	4.645	4.957	4.414
Iceland	2010	94.09104	4.37	67.199	4.845	4.288	5.395
Iceland	2011	101.8191	4.532	93.457	4.974	4.32	5.658
Iceland	2012	104.2675	4.574	95	5.032	4.361	5.442
Iceland	2013	99.3063	4.263	95.02	4.919	4.034	5.032
Iceland	2014	96.99387	3.775	96	4.767	3.664	4.669
Iceland	2015	96.47575	3.744	96.547	4.619	3.554	4.567
Iceland	2016	89.03102	3.973	98.16	4.619	3.63	4.793
Iceland	2017	88.06945	4.223	98.2	4.783	3.683	5.043
Iceland	2018	92.01679	4.34	98.24	4.746	3.62	4.859

Country	year	Y	FDI&TechTra	IndUsiInt	UniColinR&D	Gov'tPrAdTechProd	AvaofSci&Eng
India	2009	46.27287	5.355	10.719	3.913	3.598	3.363
India	2010	49.25521	5.355	6.929	3.8	3.57	5.621
India	2011	55.62387	5.123	5.117	3.738	3.532	5.152
India	2012	55.79372	4.985	7.5	3.818	3.5	4.934
India	2013	53.84413	4.899	10.07	3.849	3.433	5.039
India	2014	48.92219	5.042	12.58	3.995	3.28	5.033
India	2015	41.92291	4.223	15.1	3.871	3.547	4.36
India	2016	40.08249	4.06	18	3.871	3.879	4.223
India	2017	40.72281	4.573	26	4.536	4.464	4.567
India	2018	43.40497	4.484	29.547	4.435	4.676	4.628
Indonesia	2009	45.51212	5.318	4.691	3.798	3.452	3.377
Indonesia	2010	46.70127	5.03	10.793	3.835	4.054	4.726
Indonesia	2011	50.18001	4.917	8.697	4.162	4.211	4.697
Indonesia	2012	49.5829	4.725	9.1	4.129	4.113	4.429
Indonesia	2013	48.63737	4.756	18	4.182	4.044	4.321
Indonesia	2014	48.08018	4.959	15.36	4.489	4.119	4.479
Indonesia	2015	41.93764	4.911	15.82	4.547	4.221	4.621
Indonesia	2016	37.42134	4.644	17.14	4.547	4.153	4.563
Indonesia	2017	39.3555	4.618	21.976	4.422	4.325	4.52
Indonesia	2018	43.00194	4.701	25.366	4.316	4.367	4.544
Ireland	2009	172.9987	6.338	34.229	4.587	4.94	3.921
Ireland	2010	189.4217	6.258	64.614	4.956	3.739	5.254
Ireland	2011	188.7558	6.256	67.383	4.973	3.564	5.134
Ireland	2012	191.537	6.38	69.853	4.956	3.433	4.938
Ireland	2013	188.5216	6.434	76.82	5.096	3.461	4.908
Ireland	2014	201.9903	6.322	79	5.195	3.483	4.864
Ireland	2015	215.1366	6.37	78.248	5.243	3.527	4.954
Ireland	2016	226.0414	6.315	79.69	5.243	3.577	5.191
Ireland	2017	219.9983	6.307	80.122	5.111	3.555	5.172
Ireland	2018	211.5111	6.085	82.17	5.043	3.399	4.805

Country	year	Y	FDI&TechTra	IndUsiInt	UniColinR&D	Gov'tPrAdTechProd	AvaofSci&Eng
Japan	2009	24.4909	5.208	68.274	5.843	4.61	3.943
Japan	2010	28.61301	4.954	68.854	4.651	3.884	5.885
Japan	2011	30.393	4.713	73.988	4.859	4.102	5.801
Japan	2012	30.63612	4.7	80	5.056	4.125	5.812
Japan	2013	34.14752	4.689	79.53	5.027	3.83	5.744
Japan	2014	37.54577	4.782	79.05	4.957	3.913	5.487
Japan	2015	35.64102	4.733	86.25	5.004	4.091	5.44
Japan	2016	31.54181	4.792	90.58	5.004	4.145	5.568
Japan	2017	34.57344	4.875	93.329	4.752	4.021	5.508
Japan	2018	36.81651	5.092	92	4.738	3.972	5.32
Korea, Rep.	2009	86.13362	5.302	71.109	5.375	5.066	5.077
Korea, Rep.	2010	91.3996	4.814	77.449	4.563	4.382	4.884
Korea, Rep.	2011	105.5663	4.459	81.601	4.681	4.103	4.942
Korea, Rep.	2012	105.4583	4.475	83.7	4.66	4.129	4.893
Korea, Rep.	2013	97.9521	4.502	83.8	4.705	3.999	4.874
Korea, Rep.	2014	90.61444	4.494	84.1	4.677	3.971	4.612
Korea, Rep.	2015	79.13249	4.581	84.77	4.616	4.139	4.419
Korea, Rep.	2016	73.60381	4.496	84.33	4.616	3.885	4.403
Korea, Rep.	2017	77.12092	4.56	89.896	4.36	3.682	4.434
Korea, Rep.	2018	78.66026	4.544	92.717	4.42	3.796	4.509
Mexico	2009	55.96777	4.975	18.984	2.983	3.019	3.177
Mexico	2010	60.76032	5.039	21.577	3.479	3.278	3.641
Mexico	2011	63.46968	5.04	25.946	3.724	3.276	3.777
Mexico	2012	65.76725	5.162	31	4.04	3.548	3.858
Mexico	2013	63.76488	5.3	36.15	4.128	3.626	4.01
Mexico	2014	64.96358	5.253	38.42	4.084	3.562	3.997
Mexico	2015	71.16631	5.108	43.46	3.971	3.398	3.945
Mexico	2016	76.10028	5.077	44.39	3.971	3.104	4.07
Mexico	2017	77.19414	5.07	57.431	3.625	3.022	4.141
Mexico	2018	80.44832	5.042	59.54	3.614	3.069	4.178

Country	year	Y	FDI&TechTra	IndUsiInt	UniColinR&D	Gov'tPrAdTechProd	AvaofSci&Eng
Netherlands	2009	116.8895	5.205	85.711	5.028	5.121	4.029
Netherlands	2010	131.5221	4.952	86.764	5.152	4.096	5.001
Netherlands	2011	142.4718	5.035	89.634	5.186	4.322	4.972
Netherlands	2012	149.2684	5.025	90.719	5.325	4.283	4.985
Netherlands	2013	149.5493	5.008	92.3	5.296	4.216	4.819
Netherlands	2014	150.0538	4.969	93	5.25	4.108	4.477
Netherlands	2015	157.8166	4.968	93.956	5.38	4.002	4.623
Netherlands	2016	148.8587	5.174	93.17	5.38	3.934	4.847
Netherlands	2017	156.0282	5.289	93.097	5.5	3.867	4.806
Netherlands	2018	157.6533	5.457	90.411	5.567	4.099	4.855
Nigeria	2009	36.05871	4.854	5.953	3.83	3.038	2.667
Nigeria	2010	43.32076	4.484	7.262	3.188	2.966	4.506
Nigeria	2011	53.27796	4.393	28.425	3.093	3.163	3.941
Nigeria	2012	44.53237	4.327	28.43	3.141	3.246	4.058
Nigeria	2013	31.04886	4.315	28.43	3.506	3.647	4.073
Nigeria	2014	30.88519	4.536	32.876	3.295	3.444	3.964
Nigeria	2015	21.33265	4.547	38	2.752	2.976	3.777
Nigeria	2016	20.72252	4.408	42.68	2.752	2.783	3.577
Nigeria	2017	26.3476	4.315	47.443	2.667	2.922	3.76
Nigeria	2018	33.00783	4.178	25.67	2.516	2.929	3.796
Poland	2009	75.2263	4.929	36.585	3.117	3.035	3.662
Poland	2010	82.10833	5.085	44	3.324	4.159	4.28
Poland	2011	87.08272	5.011	58.966	3.625	3.719	4.213
Poland	2012	89.32746	4.99	62.316	3.636	3.294	4.082
Poland	2013	90.69187	4.791	64.88	3.591	3.186	4.195
Poland	2014	93.69692	4.579	65	3.541	3.15	4.209
Poland	2015	95.902	4.628	62.849	3.504	3.242	4.17
Poland	2016	100.3508	4.513	66.6	3.504	3.076	4.169
Poland	2017	104.4922	4.639	67.997	3.293	2.927	4.253
Poland	2018	107.4782	4.855	73.301	3.224	3.074	4.189

Country	year	Y	FDI&TechTra	IndUsiInt	UniColinR&D	Gov't PrAdTechProd	AvaofSci&Eng
Romania	2009	58.47283	4.961	52.244	2.967	3.091	3.492
Romania	2010	71.23556	4.976	24	3.332	3.441	4.296
Romania	2011	79.87144	4.696	36.601	3.093	3.208	4.309
Romania	2012	79.94243	4.497	39.925	2.996	3.085	4.214
Romania	2013	80.5244	4.258	44.02	3.082	3.081	3.826
Romania	2014	82.76816	4.408	50	3.328	3.206	3.636
Romania	2015	82.65751	4.78	49.765	3.59	3.41	4.026
Romania	2016	83.29795	4.747	54.08	3.59	2.895	4.134
Romania	2017	85.06415	4.408	55.763	3.33	2.344	4.08
Romania	2018	86.17344	4.147	59.504	3.142	2.311	3.784
RussianFederation	2009	48.43506	4.407	18.022	3.449	3.562	3.59
RussianFederation	2010	50.35551	4.207	21.053	3.762	3.566	4.435
RussianFederation	2011	48.0354	3.851	42.378	3.669	3.45	4.266
RussianFederation	2012	47.15139	3.703	43	3.486	3.298	4.049
RussianFederation	2013	46.28715	3.579	49	3.418	2.943	3.773
RussianFederation	2014	47.80134	3.732	53.275	3.642	3.067	3.797
RussianFederation	2015	49.35935	3.771	61.4	3.632	3.342	4.064
RussianFederation	2016	46.51812	3.771	70.52	3.632	3.342	4.064
RussianFederation	2017	46.87652	3.67	73.41	3.678	3.255	4.13
RussianFederation	2018	51.13314	3.733	76.409	3.855	3.379	4.253
South Africa	2009	55.41826	5.203	7.774	3.973	4.157	3.644
South Africa	2010	55.98899	5.051	8.574	4.481	3.43	3.089
South Africa	2011	60.11263	5.004	8.821	4.605	3.211	3.272
South Africa	2012	60.8997	4.959	12.3	4.618	3.256	3.403
South Africa	2013	64.24176	4.981	21	4.51	3.139	3.363
South Africa	2014	64.4345	4.951	41	4.537	2.946	3.481
South Africa	2015	61.61707	4.777	48.9	4.487	2.956	3.54
South Africa	2016	60.63819	4.503	49	4.487	2.768	3.399
South Africa	2017	57.97389	4.588	51.919	4.442	2.907	3.397
South Africa	2018	59.47033	4.47	54	4.375	3.432	3.538

Country	year	Y	FDI&TechTra	IndUsiInt	UniColinR&D	Gov'tPrAdTechProd	AvaofSci&Eng
Turkey	2009	45.93247	4.668	17.728	2.97	3.379	3.064
Turkey	2010	45.89922	4.924	32.286	3.406	3.328	4.364
Turkey	2011	52.66294	4.803	35.3	3.371	3.717	4.479
Turkey	2012	52.24531	4.661	39.822	3.489	3.81	4.544
Turkey	2013	50.35032	4.721	42.1	3.566	4.006	4.49
Turkey	2014	51.4141	4.87	45.13	3.861	4.121	4.394
Turkey	2015	49.29987	5.065	46.25	3.687	4.16	4.215
Turkey	2016	46.81565	4.672	51.04	3.687	3.705	4.214
Turkey	2017	54.05831	4.458	53.745	3.469	3.352	4.258
Turkey	2018	60.15737	4.458	58.348	3.469	3.352	4.258
USA	2009	24.64156	5.33	69.827	5.839	5.847	4.931
USA	2010	28.05795	5.125	71.244	5.903	4.767	5.603
USA	2011	30.78929	4.902	76.239	5.789	4.717	5.67
USA	2012	30.56818	4.905	79	5.711	4.663	5.529
USA	2013	30.01301	4.899	77.863	5.631	4.442	5.415
USA	2014	29.96885	4.871	81.025	5.743	4.338	5.346
USA	2015	27.73677	4.867	84.2	5.85	4.353	5.317
USA	2016	26.514	4.858	87.36	5.85	4.275	5.417
USA	2017	27.14232	5.051	74.55	5.573	4.372	5.528
USA	2018	27.56442	5.571	76.177	5.706	5.088	5.748
Viet Nam	2009	134.7063	5.037	17.205	3.618	3.132	4.193
Viet Nam	2010	152.2174	5.031	20.454	3.497	4.475	4.205
Viet Nam	2011	162.9146	5.059	27.251	3.659	4.391	4.1
Viet Nam	2012	156.5539	4.781	27.56	3.403	4.035	4.092
Viet Nam	2013	165.0942	4.267	35.07	3.235	3.923	4.016
Viet Nam	2014	169.5345	4.122	39.49	3.337	3.977	3.828
Viet Nam	2015	178.7674	4.235	43.9	3.27	3.866	3.81
Viet Nam	2016	184.6863	4.24	48.31	3.27	3.852	3.92
Viet Nam	2017	200.3846	4.196	52.72	3.333	3.79	3.77
Viet Nam	2018	208.3067	4.132	46.5	3.5	3.637	3.8

Appendix C. Hausman Test for 2 years lagged all countries

```
. hausman Fe Re

                 ---- Coefficients ----
                 (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
                  Fe           Re       Difference          S.E.
-------------------------------------------------------------------------------
x3macroeco~v     1.33324     1.648671       -.3154308                .
x4healthan~u     17.52203     16.50104        1.020985        1.356599
x6goodsmrk~f    -7.848612    -4.27613       -3.572483                .
x7labormrk~f    -7.823829    -8.222221        .3983926        1.011419
x8finmrktdev    -.5946048    -1.377869        .7832644                .
  x9techredd     6.017241     5.194789        .8224521                .
xl0markets~e     -14.1088    -18.63142        4.522613        4.102861
xl2innovat~n     13.42496     11.36267        2.062294        .9066292
-------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(8) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =       27.97
                Prob>chi2 =      0.0005
                (V_b-V_B is not positive definite)
```

Appendix D. Hausman Test for all countries

```
. hausman Fe Re
```

	Coefficients (b) Fe	(B) Re	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
x3macroeco~v	3.613526	3.941035	-.3275095	.
x4healthan~u	10.32048	10.26866	.0518146	.6399822
x6goodsmrk~f	-4.211174	-3.791105	-.4200688	.
x7labormrk~f	-1.336184	-1.444575	.1083909	.6042347
x8finmrktdev	-4.354445	-4.564528	.2100828	.
x9techredd	6.10699	6.501329	-.3943397	.
x10markets~e	1.897552	-5.364698	7.262251	3.167163
x12innovat~n	.4469942	-.1511161	.5981103	.

```
                b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(8) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =         2.35
                Prob>chi2 =       0.9684
                (V_b-V_B is not positive definite)

.
```

Appendix E. Hausman Test for Sub-Pillars

```
. hausman Re Fe
```

	Coefficients (b) Re	(B) Fe	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
x1	5.912396	6.601397	-.6890018	.
x3	-5.235946	-6.45898	1.223035	.159024
x4	.131299	.1188801	.0124189	.0031485
x11	4.796971	4.836387	-.0394156	.1919977
x12	-4.676992	-4.511517	-.1654744	.2312705
x13	3.972104	4.000189	-.0280846	.2110537

```
                b = consistent under Ho and Ha; obtained from xtreg
     B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test:  Ho:  difference in coefficients not systematic

           chi2(6) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                   =      103.78
         Prob>chi2 =      0.0000
         (V_b-V_B is not positive definite)
```

RESUME

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Education

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2013-2017**:** Jawzjan University / Bachelor of Economics
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Urdu: Advanced
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German**:** Intermediate

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