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

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

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A Panel Data Analysis

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ABSTRACT

Effects of Information and Communication Technologies on International Trade:

A Panel Data Analysis

Information and communication technologies (ICT) are considered as one of the key factors increasing the efficiency, productivity and the overall performance of the systems. This thesis aims to explore the increasing importance of ICT usage in international trade. Different indexes in measuring ICT usage are reviewed with their pillars and the top country rankings. Taking the Global Competitiveness Index 2014 as the source, the study investigates the effects of ICT usage on the integration of countries to the world trade by taking the countries' export/GDP ratio as their integration indicator. The panel data is generated by taking 21 countries and nine years into account without time lag and seven years with two years of time lag. The results show that there is a significant positive relationship between ICT usage and a country's export/GDP ratio. Especially, the number of fixed broadband connection subscriptions and quality of scientific research institutions are seen to be two of the most influential factors to affect the export/GDP ratio positively, while on the other hand, firms' technology absorption and governments' advanced technology procurement are the most negatively sub-pillars of ICT usage. Additionally, the FDI and the technology transfer seem to be candidates for being influential factors for the export/GDP ratio in the long run.

ÖZET

"Bilgi ve İletişim Teknolojileri Kullanım Oranının Uluslararası Ticaret Üzerindeki Etkileri: Panel Data Analizi"

Bilgi iletişim teknolojileri (BİT), son 20 yılda üstlendikleri rol ile artık yalnızca insanların daha kolay ve etkili iletişim kurmasına yarayan bir araç olmaktan çıkmış; günlük hayatta, iş hayatında, siyasette ve özel hayatta karar alma süreçlerini etkileyen önemli unsurlar haline gelmişlerdir. Öte yandan bu teknolojiler kullanıldıkları sistemlerde verimlilik ve üretkenliği artıran, süreçleri geliştiren ve otomatize eden etkenler olmaya başlanmışlardır ve bu nedenle yine kişiler, şirketler ve devletler tarafından yatırım odağı haline gelmişlerdir. Bu çalışmada BİT'in, uluslararası ticaret üzerindeki etkileri araştırılmış, bunu yaparken de gösterge olarak ülkelerin toplam ihracat/GYSH oranları dikkate alınmıştır. Çalışmanın giriş kısmında BİT'in zamanla artan önemine değinilmiş, önemleri arttıkça bilgi iletişim araçlarının nelerin yerini almaya başladığına değinilmiştir. 2. bölümde, BİT kullanımının ülkeler bazındaki ölçüm endeksleri, bu endekslerin dikkate aldıkları kriterlere değinilmiş, analiz kısmında ise bu endekslerden "Global Rekabet Endeksi" veri ve kriterleri seçilerek BİT'in ülkelerin ihracat/GSYH oranlarını etkileyip etkilemediği araştırılmıştır. Sonuç olarak ülkelerin ihracat/GSYH oranlarının BİT kullanımıyla yakından alakalı olduğu, buna ek olarak da BİT kullanımının hangi alt faktörleri ile yakından ilgili olduğu saptanmış, son bölümde de çalışmanın detaylı sonuçları, limitleri ve çalışmayı daha ileri götürebilecek faktörler üzerinde durulmuştur.

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I dedicate this thesis to my beloved grandmother, who passed away on April 18th, while I was continuing my studies.

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LIST OF ABBREVIATIONS

BRICS	Brazil-Russia-India-China-South Africa
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

CHAPTER 1

INTRODUCTION

After the 1990s, with the rise of the use of ICT and especially with the increase in the Internet usage, a new type of definition of a sustainable economy gained importance, which relies on know-how, innovation, and technology. Governments became interested in the transformative effects of ICT and started to plan ICT usage in their projects. In the *National Performance Review* of the U.S. federal government in 1993, it was claimed that re-engineering the government through ICT would help government organisations to work better and more comfortable (Bellamy, 2002).

In comparison with the classical economic functions depending on capital and labor, after the rise of ICT and the regional and global economic crisis, the sustainability of the economic welfare started to depend on the sustainability of knowledge diffusion, knowledge access, and increase in the knowledge skills of a society, which in a period of time lead to innovations in economic units of the society.

With the diffusion of ICT and the changes in the drivers of the sustainable economic growth and welfare, the endogenous growth theories advocating that investment in human capital, innovation, and knowledge are significant contributors to economic growth increased their weight in the economic thought.

The increasing order of the externalities and the spillover effects of the technology also caused a shift from Fordist production lines, which aim for mass production with an automation process of workers, to post-Fordism in the late 20th century, aiming for small batch production, flexible specialization and the advantages of information technologies together with the increased importance of

flexibility, skills, and tacit knowledge of the workers. Also, with the New Trade Theory of Paul Krugman, a new perspective was brought to the mass production, returns to scale, and specialization terms as the theory was the first to enable specialization and large-scale production with lower costs and with a greater diversity of commodities (Neary, 2009).

Additionally, the diffusion of ICT accelerated the shift in the industry, which had already begun during the Industrial Revolution. The traditional production lines yielded to the new modern and high technology production methods with post-Fordism, and the idea that the adoption of the information, know-how, and high technology is one of the major needs for competitiveness has gained recognition. Furthermore, it also started to be discussed that to be successful in the market, it is not enough to adopt new technologies but it is also critical to create and lead the innovation.

It can be considered that innovation and technology had an increased importance with the rise of post-Fordism. Instead of the automated production lines and the repetitive routine for mass production, post-Fordism is based on the idea of flexible specialization, labor's individual skills, and the advantages of information technologies (Thompson, 1998). It is in this new era where the flexibility in production and the skill in labor gained importance simultaneously.

This study mainly explores the effects of ICT usage on countries' integration to the world trade and investigates a model which derives a relation between ICT usage of countries and their export/GDP ratio. At this point, it is important to define ICT usage of countries. The indices measuring the ICT ability of countries are examined in detail in the third chapter. The main pillars of the indices contain

various sub-pillars. In the fourth chapter, we choose an index, the Global Competitiveness Index (GCI), which is widely used in the literature, and run an econometric analysis in order to assess the effects of each sub-pillar of the GCI index on the export/GDP ratio. In the fifth chapter, we interpret the model that we derived and discuss the reasons and the results of the revealed relation between ICT usage and integration to the world trade.

CHAPTER 2

LITERATURE REVIEW

The first studies about the ICT usage effect on export and international trade date back to the late 1990s and early 2000s. Freund and Weinhold (2004) mainly investigate the effect of the Internet on international trade. The study claims that companies and individuals from different parts of the world started to transform their business models from local operations to international ones. In the study, the researchers find out that Internet usage and development help to explain the growth in international trade.

Colecchia and Schreyer (2001) emphasize that economic growth can be achieved through increased use of capital and labor by an improvement of multi-factor productivity. With the rise of ICT usage, a new factor of productivity is composed. In their study, the researchers compare the impact of ICT capital accumulation on output growth in Australia, Canada, Finland, France, Germany, Italy, Japan, the United Kingdom, and the United States. The results show that over the past two decades, ICT has contributed between 0.2 and 0.5 percentage points per year to economic growth, depending on the country. During the second half of the 1990s, this contribution rose to 0.3 to 0.9 percentage points per year.

A study by Mathews and Bianchi (2010) reveals that websites and e-sales are significantly related to the export growth in a group of Australian firms. Moreover, Mathews and Bianchi (2010) argue that the Internet has indirect effects on a group of Chilean firms through improved information flow and business relationships. New Zealand's Statistics Office defines ICT as any electronic technology for collecting, processing, storing, or transmitting information in the form of voice, images, or details including computers, software, the Internet, and global positioning systems

(GPS) and argue that exports rates are higher for those using ICT, across all business sizes. As a result, they emphasize that a business's ICT use and its participation in growth-related activities are strongly linked in New Zealand, although some of the differences between businesses' growth activities can be explained by the nature of their industry or their size.

Bascavusoglu and Colakoglu (2011) emphasize in their study that once a firm becomes an innovator, its propensity to innovate does not depend anymore on the use of technology or ICT. This point is extremely important in the regard of the transition process of Turkey from being an efficiency-driven country to innovation-driven country, according to the Global Innovation Index. On the other hand, the export shares of medium technology and high technology products in the total exports can be considered whether our firms are already innovators or not. They also argue in their research that innovative efforts are highly associated with R&D investments, exporting, and utility models; educational level of the employees, outsourcing, use of technology-intensive production processes, and ICT also arise as important determinants of innovative efforts.

In their study, Brynjolfsson and Hitt (2000) discuss the economic impact of information technology and its productivity effect on firms since the late 1980s, when the positive impact of computers and information technology on the economy used to be questioned. The firm-level studies in particular suggest that, rather than being paradoxically unproductive, computers have had an impact on economic growth that is disproportionately large compared to their share of capital stock or investment, and this impact is likely to grow further in coming years. In that sense, Brynjolfsson and Hitt support the literature. As new business processes, new skills, and new organizational and industry structures were created by the use of

information technologies, these intangible assets became the major drivers of the contribution of information technology, and a new constantly improving cycle has started.

Banomyong (2010) argues that the development of logistics services and communication technologies has revolutionized supply chain management and has created a "global" market. Supply chain management integrates suppliers, manufacturers, and distribution centers to get the right products to the right place at the right time and in the proper condition (Christopher & Towill, 2001). As the management of supply chains improves, the potential of integrated global supply chains is starting to be realized and this improvement in the management of the supply chain depends on the firm's capability of using ICT efficiently and effectively.

The Boston Consultancy Group's research (2013) with Microsoft surveys more than 4,000 SMEs in five countries (the U.S., Germany, China, India, and Brazil) and reveals that technology leaders of the SMEs far outperform their peers in the marketplace. In the research, a "technology leader" is defined as a company that not only uses various combinations of technologies such as cloud services, online customer relationship management software, and big data analytics, but also have the willingness to always reach the latest technology and have the capability to create custom software. According to the research, the leader SMEs in technological adoption from 2010 to 2012 created jobs twice as fast as other SMEs and also grew faster than the economy as a whole. In addition, the research also puts forward that the technology adopters also increased the revenues 15% faster than the companies with low levels of technology adoption.

Altomonte, Aquilante, Békés and Ottaviano (2013) also show that innovation leads to productivity growth, and their study emphasizes that there exists a strong correlation between the internationalization and innovation of a firm. Since the literature shows that the usage of ICT has a high correlation with innovation capabilities, we can conclude that the usage of ICT also has a positive correlation with internationalization and growth.

Lecerf (2012) examines 335 French SMEs and their ability of internationalization with the indicators affecting their abilities. The results confirm a strong interdependence between technological appropriation in internationalized SMEs and their business growth and also indicate that technological resources are a common driver of both innovation and internationalization activities.

In recent studies, lower technology levels of firms are considered as the indicators of export barriers. Dhanaraj and Beamish (2003), in their study of the resource-based approach to the export performance of U.S. and Canadian small and medium-sized exporters, find out that technological intensity is a good predictor of the export strategy, which is also influenced positively by the company's performance.

According to Özkanli, Benek and Akdeve (2006), while companies benefiting from high technology tend to lean towards internationalization, this great impact of ICT usage on export also drives companies with lower levels of technology to the domestic markets or less demanding foreign markets. Additionally, Dhanaraj and Beamish (2003) also confirm that technology is a key resource for a firm that can be used by a company to exploit its advantage in foreign markets.

Kotnik and Hagsten (2013), in their study of ICT and export capability of countries, show that in a number of European countries there exists a positive

relationship between ICT use and firms' exports – where ICT use is measured by online presence, use of online transactions, ICT-intensive human capital, and the proportion of employees with access to fast Internet capacity. In addition to that, previous studies also show that exports were found to be a significant determinant of ICT adoption as they create a know-how for the home country (Giunta & Trivieri, 2007; Haller & Siedschlag, 2011).

In addition, Scupola (2003) emphasizes the positive impact of the use of Internet-based technologies on increasing the market power and competitiveness of SMEs. Scupola (2009), after the studies of Italian SMEs, further studied SMEs in Denmark and Australia and their e-commerce adoption. As a result, both studies showed that access and quality of ICT consulting services have a significant effect on the SMEs' adoption of e-commerce.

According to Didonet and Diaz (2012), the central challenge for the supply chain management (SCM) practices is the integration of the firms with clients and suppliers. Thus, the use of ICT in SCM is a basic condition for ensuring interaction between suppliers and clients in order to coordinate activities and transactions by maintaining the information flow within and among the departments and enterprises involved (Didonet & Diaz, 2012; Bayraktar et al., 2009; Kauremaa, Kärkkäinen & Ala-Risku, 2009). The important question here is if only big multinational companies have the ability and the resources to reach and implement ICT or if smaller and local ones also do so. According to Eagan, Clancy, and O'Toole (2003), there is a lack of management commitment to SMEs, low perceived need for technology, and poor ability to maintain skills, while Damaskopoulos and Evgeniou (2003) emphasize a lack of financial resources as a barrier to the adoption of ICT. Eliminating these barriers and investing in the long run by adopting IT in the internal and external

processes can benefit companies through reduced operative costs and greater agility in the transmission of information to their suppliers, in addition to providing unique products and services to their clients, generating sustainable competitive advantages over time (Didonet & Diaz, 2012).

Tektaş, Günay, Karataş and Helvacıoğlu (2008) emphasize that large-scale companies have the ability to cope with the dynamics of the fierce global competition, while on the other hand, smaller ones face challenges in the process of adopting and utilizing innovation. Arguing that information and communication technologies (ICT) adoption capacity provides an initial step towards innovation utilization among small and medium enterprises, their study results show that SMEs with higher ICT adoption capabilities have higher innovation utilization rates in the Organized Industrial Zone in Istanbul. The survey results given also prove the importance of ICT usage in SMEs such that the reasons for using the Internet by the SMEs are classified as improvement in competitiveness and productivity (42%), supply chain relations (33%), e-commerce (27%), and increasing production (21%).

CHAPTER 3

INDICES MEASURING COUNTRIES' ICT ABILITY

This chapter contains different indices and their indicators which are used to measure ICT usage and capability, innovation capability, and knowledge of countries:

1. ICT Development Index (IDI)
2. Measuring Information Society (MIS)
3. Network Readiness Index (NRI)
4. IT Industry Competitiveness Index (IT-CI)
5. Global Competitiveness Index (GCI)

3.1. ICT Development Index (IDI)

The IDI is an index that is published by the United Nations International Telecommunication Union (ITU). Based on 11 indicators, the IDI covers 166 economies and ranks countries according to their performance in two consecutive years. It is an important tool that allows governments, companies, researchers, 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 1.

The IDI divides the transformation to being an ICT country into three substantial stages, which are as follows:

1. ICT readiness
2. ICT intensity
3. ICT impact

First of all, by building necessary infrastructure and network systems, access to technologies is maintained. Then, the level of use of ICT is augmented and the skills to use those technologies are developed. Finally, in the third stage, successful implications of ICT readiness and intensity create positive externalities and the country successfully manages the ICT impact stage by reflecting the short-term and long-term monetary and non-monetary outcomes.

Table 1. ICT Development Index indicators (MIS, 2014)

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

The IDI is divided into the following three sub-indices, as shown in Table 1 above. The Access sub-index captures the first stage, which is ICT readiness. The Use sub-index includes ICT intensity measures, and finally the Skills sub-index captures the third stage, which is ICT impact on society. According to the study's results shown in Table 2, the top 10 countries consist of Northern European and Asian countries.

Table 2. ICT Development Index 2013 (MIS, 2014)

ICT Development Index 2013			
Top Ten Countries	Rank	Developing Countries	Rank
Denmark	1	Turkey	68
South Korea	2	Brazil	65
Sweden	3	Russia	42
Iceland	4	India	129
United Kingdom	5	Indonesia	106
Norway	6	China	86
Netherlands	7	South Africa	90
Finland	8	Mexico	95
Hong Kong	9		
Luxembourg	10		

Developing countries achieve relatively low rankings, while the Russian Federation has the highest ranking. Although China and India together constitute 45% of the world's Internet users and 66% of Asia-Pacific Internet users, they achieve relatively low rankings, particularly India. Due to the income differences between the countries, the penetration rate differs, while the Internet users in China make up 46% and in India 18%, as mentioned in Table 4 (ICT Use) (MIS, 2014).

Table 3, Table 4, and Table 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 in the Skills sub-index, while Brazil has the lowest ranking in the Skills sub-index. Russia ranks 18th 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 3. ICT Access Sub-Index 2013 (MIS, 2014)

ICT Access Sub-Index 2013			
Top Ten Countries	Rank	Developing Countries	Rank
Luxembourg	1	Turkey	77
Switzerland	2	Brazil	71
Iceland	3	Russia	44
Hong Kong	4	India	132
Germany	5	Indonesia	109
United Kingdom	6	China	89
Malta	7	South Africa	92
South Korea	8	Mexico	93
Sweden	9		
Netherlands	10		

Table 4. ICT Use Sub-Index (MIS, 2014)

ICT Use Sub-Index 2013			
Top Ten Countries	Rank	Developing Countries	Rank
Denmark	1	Turkey	69
Sweden	2	Brazil	60
South Korea	3	Russia	42
Finland	4	India	133
Norway	5	Indonesia	106
United Kingdom	6	China	77
Japan	7	South Africa	82
Luxembourg	8	Mexico	95
Iceland	9		
United States	10		

Table 5. ICT Skills Sub-Index (MIS, 2014)

ICT Skills Sub-Index 2013			
Top Ten Countries	Rank	Developing Countries	Rank
Greece	1	Turkey	48
South Korea	2	Brazil	80
Finland	3	Russia	18
Belarus	4	India	121
United States	5	Indonesia	95
Australia	6	China	84
Slovenia	7	South Africa	86
Andorra	8	Mexico	88
Spain	9		
Iceland	10		

Table 6 gives the global averages of the sub-indices and the standard deviations. In all sub-indices, Turkey has a higher value than the average and it is approximately two points away from the average of the developed countries' IDI score, while it is approximately one point in front of the mean of the developing countries.

Table 6. Average Value and Standard Deviation of Sub-Indices and Turkey

	Average Value	St.dev.	Turkey's Value
IDI	4.77	2.22	5.29
Access Sub-Index	5.41	2.24	5.83
Use Sub-Index	3.19	2.44	3.24
Skills Sub-Index	6.66	2.15	8.34
Developed IDI	7.03	1.08	5.29
Developing IDI	3.67	1.75	5.29

Unfortunately, the Internet usage and IDI ranks of Turkey are really low in regional comparisons. Europe's IDI average was 7.14 in 2013, while Turkey's score remained lower by 5.29 (Figure 1).

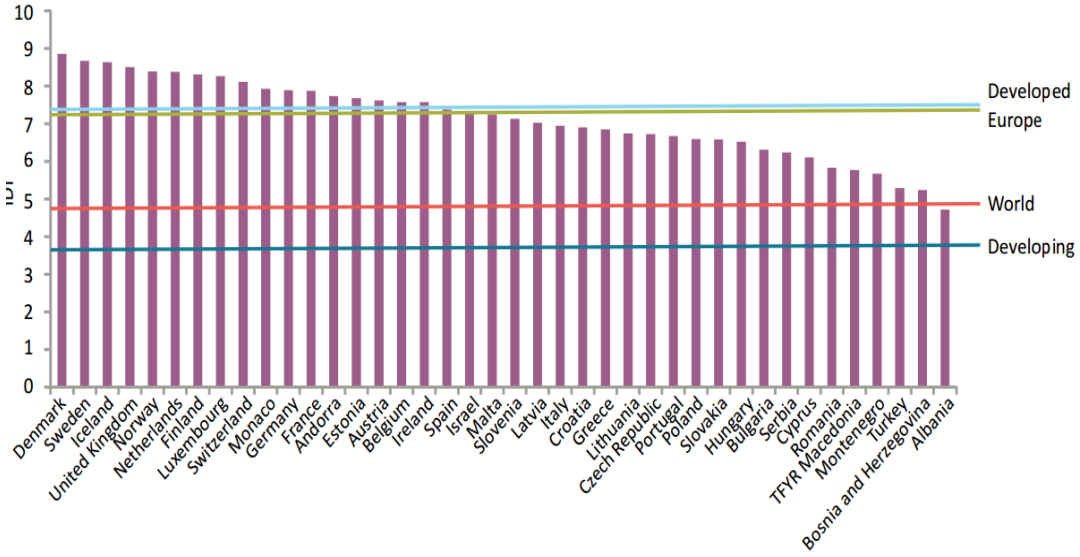

Figure 1. IDI values compared with the global, regional and developing/developed-country averages for Europe in 2013 (MIS, 2014).

Close to half a billion Europeans were online in 2013, which corresponds to 73% of the population. It can be seen in Figure 2 that Turkey has the lowest proportion of Internet users, at below 50% (MIS, 2014). According to the report's findings, in the European region, the most populous country, Germany, ranks 11th in the IDI 2013, with a very high IDI value of 7.90. Turkey, the country with the second highest population in Europe, ranks 68th in the IDI 2013 (MIS, 2014).

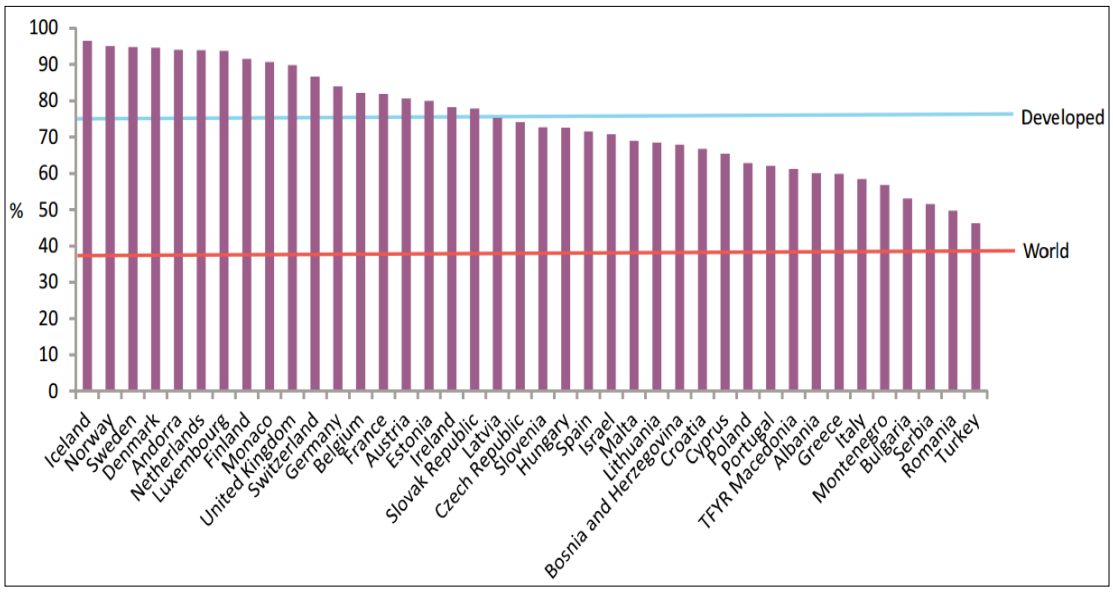

Figure 2. Percentage of individuals using the Internet, Europe, compared to global and developed country average, 2013 (MIS, 2014)

3.2. Measuring the Information Society (MIS)

Measuring the Information Society (MIS) has been published annually since 2009, and in addition to the IDI facts and data, the 2014 edition also presents the latest results of the ICT Price Basket (IPB), along with the first complete price data set for mobile and fixed prepaid and after-paid broadband services (MIS, 2014). The price indices in percentages of GNI are important because these indices show the affordability and the competition in the communication sector favoring the consumer. In addition, the higher percentage of GNI gives a brief understanding of

the low penetration rates of Internet and mobile services, since sustaining basic necessities are more important for households and individuals.

Table 7. Fixed broadband prices as % of GNI in 2013 (MIS, 2014).

Fixed Broadband Prices 2013 as % of GNI (Lowest to Highest)			
Top Ten Countries	Rank	Developing Countries	Rank
Macao	1	Turkey	39
Kuwait	2	Brazil	46
Singapore	3	India	87
United Kingdom	4	Indonesia	113
Switzerland	5	China	89
Russian Federation	6	South Africa	75
Japan	7	Mexico	49
Norway	8		
Ireland	9		
Austria	10		

Table 8. Prepaid mobile broadband prices as % of GNI (MIS, 2014)

Prepaid Mobile Broadband Prices 2013 as % of GNI (Lowest to Highest)			
Top Ten Countries	Rank	Developing Countries	Rank
Norway	1	Turkey	44
Austria	2	Brazil	75
Iceland	3	Russia	13
Sweden	4	India	81
Lithuania	5	Indonesia	28
Finland	6	China	72
Singapore	7	South Africa	82
Qatar	8	Mexico	85
Switzerland	9		
Poland	10		

3.3. Network Readiness Index (NRI)

The World Economic Forum's (WEF) *Global Information Technology Report*, published annually, is based on the Network Readiness Index (NRI) published by WEF and INSEAD Business School together. The NRI offers a comprehensive assessment of the present 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 2014 covers 148 economies accounting for more than 98% of the world's GDP with a record high and analyzes those countries relying on four sub-indices with 10 different pillars, listed in Table 9, along with 53 particular indicators. One of the key findings of the report is that countries cannot only rely on ICT infrastructure development to become competitive (NRI, 2014). Rather, the benefits of ICT can only be fully derived when a country implements a holistic strategy aimed at creating conditions for skills, innovation and entrepreneurship to flourish alongside modern infrastructure (NRI, 2014).

Table 9. NRI Sub-indices and pillars (NRI, 2014)

NRI Sub-index	Pillars
Environmental Sub-index	1. Political and Regulatory Environment 2. Business and Innovation Environment
Readiness Sub-index	1. Infrastructure and Digital Content 2. Affordability 3. Skills
Usage Sub-index	1. Individual Usage 2. Business Usage 3. Government Usage
Impact Sub-index	1. Economic Impacts 2. Social Impacts

Table 10 below shows that Northern European countries and Asian countries constitute the top 10 in NRI 2014.

Table 10. Network Readiness Index (NRI, 2014).

Network Readiness Index			
Top Ten Countries	Rank	Developing Countries	Rank
Finland	1	Turkey	51
Singapore	2	Brazil	69
Sweden	3	Russia	50
Netherlands	4	India	83
Norway	5	Indonesia	64
Switzerland	6	China	62
US	7	South Africa	70
Hong Kong	8	Mexico	79
United Kingdom	9		
South Korea	10		

In NRI 2013, Turkey ranked 45th among 144 countries with a score of 4.2, while in 2014, although Turkey achieved a higher score of 4.3 overall, it ranked 51st. This shows that Turkey remains relatively slow in terms of applying necessary regulations, investing in infrastructure and developing human capital, and acknowledging the new technologies in government and business.

The rankings in Figure 3 below reveal that, also in comparison with upper-middle income countries Turkey have an affordability advantage. According to the sub-pillars of the Affordability pillar, Turkey ranks as the top country in the Internet and telephony competition. This high competition in the market is 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 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. The Skills pillar has relatively lower score and rankings due to the

quality of the education system (ranks 91st out of 144 countries), quality of math and science education (101st out of 144 countries).

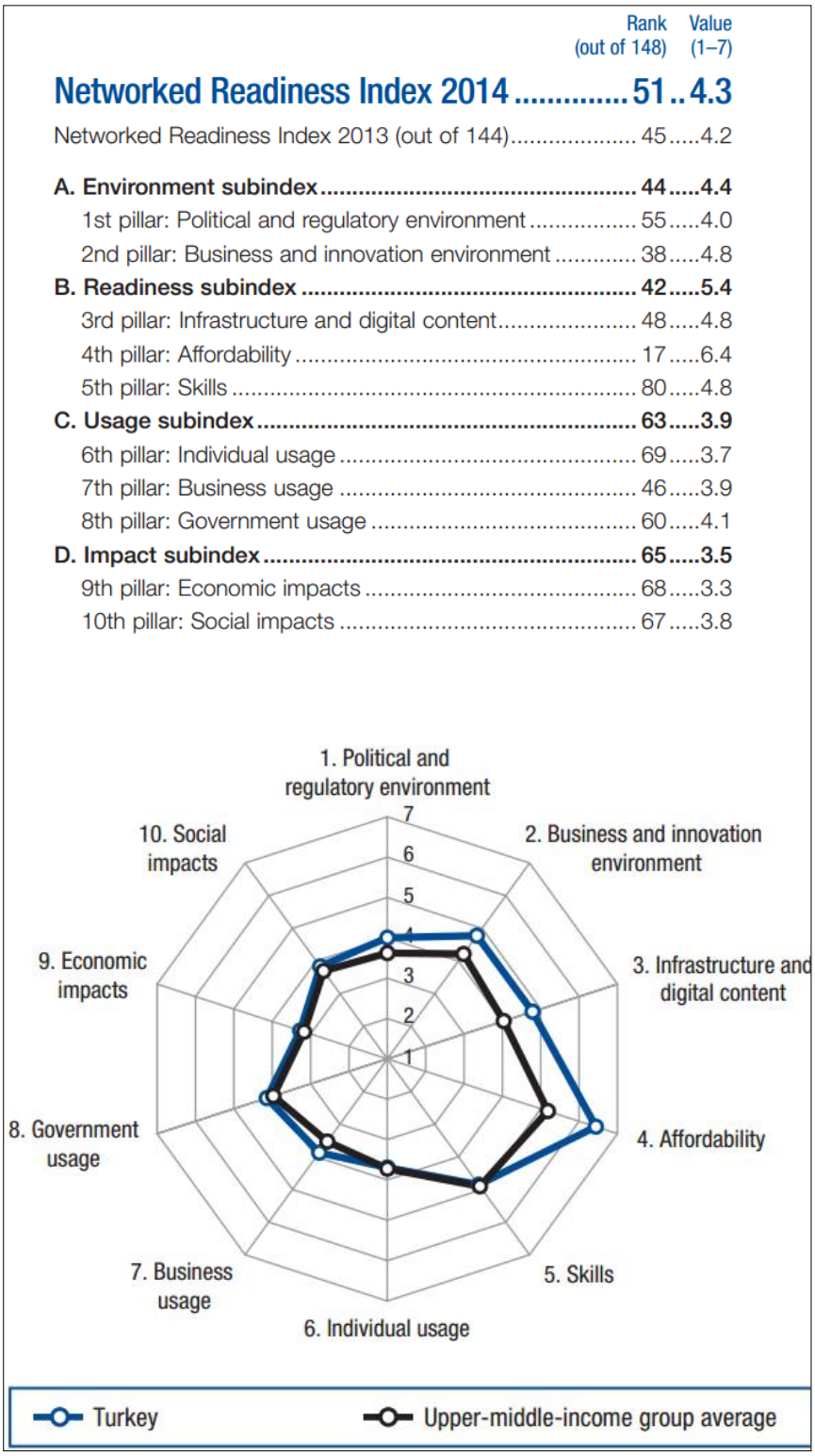

Figure 3. Turkey's Sub Index Scores in NRI 2014 (NRI, 2014)

The rankings in Table 11 show the reasons of achieving lower scores in Individual Use, Business Use, Government Use and Social Impact. For example, although the affordability is high and the mobile coverage is 100%, in mobile phone subscriptions Turkey ranks 102nd and mobile broadband subscriptions are low with a rank of 77. 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 an 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 business-to-business Internet use and business-to-consumer Internet use still needs to be developed in Turkey. Especially the extent of staff training has a high importance in the era of internationalization of businesses, particularly SMEs.

Table 11. Lower Ranked Pillars of Turkey (NRI, 2014)

Individual Use	**Rank**	**Business Use**	**Rank**
Mobile phone subscriptions/100 pop	102	Firm-level technology absorption	37
Individuals using Internet, %	73	Capacity for innovation	45
Households w/ personal computer, %	64	PCT patents, applications/million pop	44
Households w/ Internet access, %	60	Business-to-business Internet use	55
Fixed broadband Internet subs./100 pop	57	Business-to-consumer Internet use	48
Mobile broadband subscriptions/100 pop	77	Extent of staff training	65
Use of virtual social networks	61		
Government Use	**Rank**	**Social Impact**	**Rank**
Importance of ICTs to gov't vision	55	Impact of ICTs on access to basic services	40
Government Online Service Index	77	Internet access in schools	63
Gov't success in ICT promotion	69	ICT use and gov't efficiency	44
		E-Participation Index	107

3.4. IT Industry Competitiveness Index (IT-CI)

First published in 2007 by the Economic Intelligence Unit for Business Software Association, the *IT Industry Competitiveness Index* consists of 26 sub-indicators in six main categories and is published biennially. Covering 66 countries, the IT-CI compares countries in relation to the extent they have the required conditions and infrastructure to support and develop a strong IT industry (IT-CI, 2011).

Table 12. IT-CI indicators and sub-indicators (IT-CI, 2011)

Indicator	Sub-Indicators
Overall business environment (Weight 10%)	Foreign investment policy Private property protection Government regulation Freedom to compete
IT infrastructure (Weight 20%)	IT investment PC ownership Broadband penetration Internet security Mobile penetration
Human capital (Weight 20%)	Enrolment in higher education Enrolment in science Employment in IT Quality of technology skills
Legal environment (Weight 10%)	Intellectual property protection Enforcement of IP rights Electronic signature Data privacy and spam Cybercrime
R&D environment (Weight 25%)	Public sector R&D Private sector R&D Patents Royalty and license fees
Support for IT industry development (Weight 15%)	Access to investment capital E-government strategy Public procurement of IT Government technology neutrality

Table 13 below compares the 2009 and 2011 ranks and scores of the specific countries. According to this table, Turkey is well below the OECD countries as a member of OECD. Fortunately, the pillars indicated in Table 11 above are developing and Turkey climbed five places in the 2011 Index, with improvement in several categories. In overall business environment, Turkey has fallen four places to the 33rd in this category from 2009. This decrease in the ranking is not because of the lack of improvement for Turkey but due to the fact that other countries achieved relatively higher scores in this category.

In IT infrastructure, Turkey has slipped two places and ranked 46th in 2011 since only marginal improvements were achieved. Broadband penetration has increased only marginally since 2009 and remains at a relatively low level (under 10%) in the region (IT-CI Turkey Report, 2011). Market spending on IT, technology and penetration of mobile services decreased due to the economic recession. Since this report was published in 2011, unfortunately we do not have a chance to observe the 2011-2015 trend.

Table 13. Overall Rankings and Scores for Countries 2009-2011 (IT-CI Turkey Report, 2011)

Country	2011 Rank	2011 Score	2009 Rank	2009 Score
United States	1	80.5	1	78.9
United Kingdom	5	68.1	6	70.2
Germany	15	64.1	20	58.1
France	21	59.3	17	59.2
Italy	23	50.7	24	48.5
Czech Republic	27	46.1	26	47.0
Poland	30	44.6	35	40.8
India	34	41.6	44	34.1
China	38	39.8	39	36.7
Brazil	39	39.5	40	36.6
Turkey	41	38.7	46	33.8
Bulgaria	43	38.1	47	33.6
Russia	46	35.2	38	36.8
OECD Average	-	57.3	-	57.1

The statistics in Table 14 reveal that in addition to the developed European countries, USA, Singapore, Australia, and Canada are the top 10 countries in IT-CI. Although developed countries are the ones that were significantly affected by the global crisis, they still maintained their rankings. On the other side, in developing countries, India, China, and Brazil have better rankings in comparison to Turkey. Unfortunately, these countries, including Turkey, have really low IT infrastructure scores in comparison to the top 10 countries, which are 5.8, 18.1, 25.9 and 20.8, respectively.

Table14. IT-CI rankings (IT-CI 2011)

IT Industry Competitiveness Index			
Top Ten Countries	Rank	Developing Countries	Rank
USA	1	Turkey	41
Finland	2	Brazil	39
Singapore	3	Russia	46
Sweden	4	India	34
UK	5	Indonesia	57
Denmark	6	China	38
Canada	7	South Africa	47
Ireland	8	Mexico	44
Australia	9		
Netherlands	10		

3.5. Global Competitiveness Index (GCI)

As the world's most comprehensive competitiveness report, the *Global Competitiveness Report* 2014-2015 assesses the competitiveness landscape of 144 economies, providing insight into the drivers of their productivity and prosperity and providing a platform for dialogue between governments, business, and civil society about the actions required to improve economic prosperity (GCI, 2014).

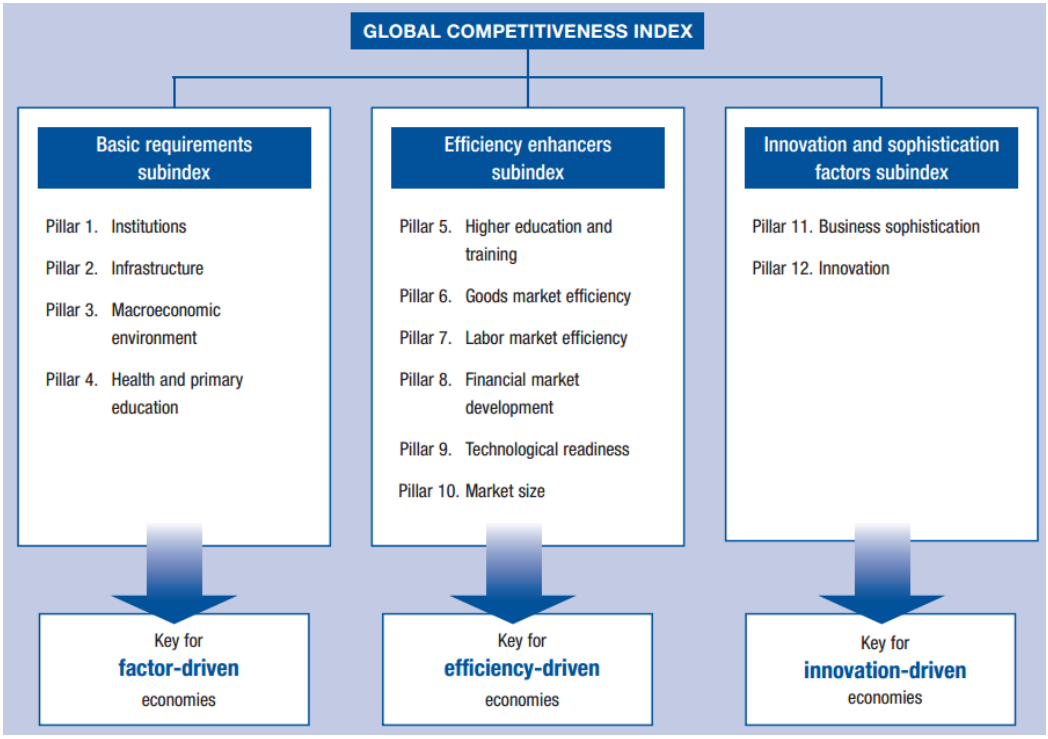

Figure 4. Global Competitiveness Index indicators (GCI, 2014).

Defining competitiveness as the set of institutions, policies, and factors that determine the level of productivity of a country, the GCI presents data and insights under 12 main pillars that determine the productivity and thus the competitiveness of the country and then classifies these pillars according to the nature of the driver of their economies (Figure 4) (GCI, 2014).

Table 15. Global Competitiveness Index (GCI, 2014)

Global Competitiveness Index			
Top Ten Countries	Rank	Developing Countries	Rank
Switzerland	1	Turkey	45
Singapore	2	Brazil	57
United States	3	Russia	53
Finland	4	India	71
Germany	5	Indonesia	34
Japan	6	China	28
Hong Kong SAR	7	South Africa	56
Netherlands	8	Mexico	61
United Kingdom	9		
Sweden	10		

To generate the index, the GCI uses statistical data obtained from internationally recognized agencies such as the United Nations Educational, Scientific and Cultural Organization (UNESCO), the International Monetary Fund (IMF), and the World Health Organization (WHO). It also obtains a comparable data from WEF's Executive Opinion Survey for the part that requires a cross-country comparison. (GCI, 2014).

According to the data in Table 15, the most competitive countries in 2014-2015 are Switzerland, Singapore, United States, Finland, Germany, Japan, Hong Kong, the Netherlands, United Kingdom, and Sweden. BRICS countries, as expected, have relatively low rankings, while Turkey has a better ranking than most BRICS countries, except China and India, with a rank of 45. In addition, while Turkey maintained its ranking in the GCI 2013 Report, Russia increased its ranking from 64th to 53rd, while India faced a decrease from 60th to 71st.

Since the GCI Report covers 12 pillars with 114 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 2014 Report, Turkey ranks 56th in basic requirements, 45th in efficiency enhancers, and 51st in innovation and sophistication factors. Figure 5 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 market size (due to the high population), business sophistication, innovation, infrastructure, goods market efficiency, and financial market

development, while it achieved lower scores in health and primary education, labor market efficiency, and technological readiness.

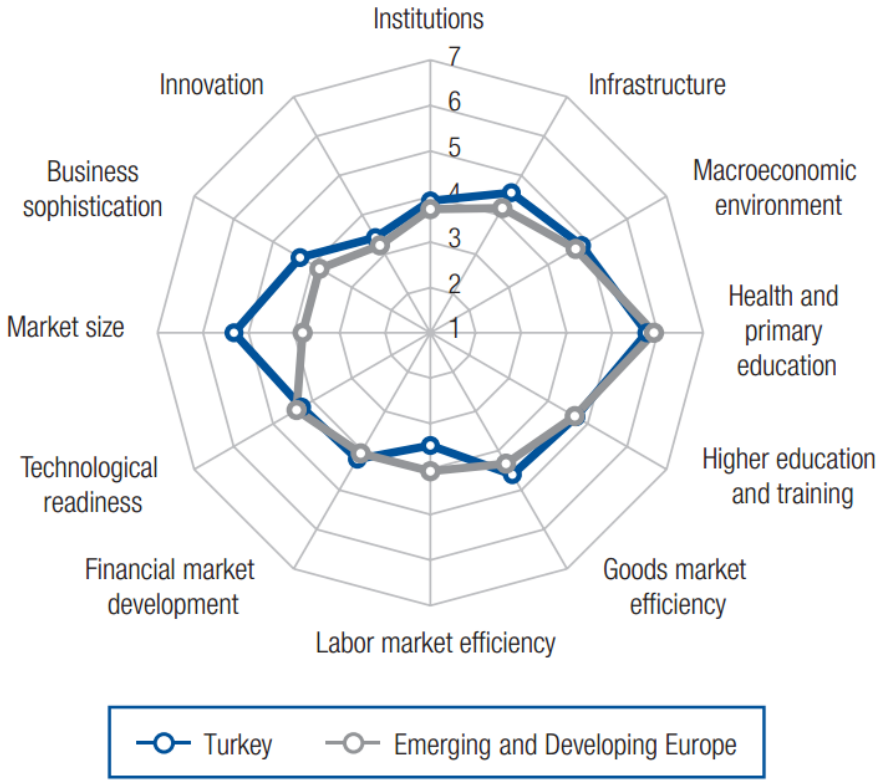

Figure 5. Comparison of Turkey and Emerging and Developing Countries in Europe (GCI, 2014)

The rankings in the Table 16 indicate the changes in Turkey in specific pillars between 2012 and 2014 (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 smart phones and the shift from fixed broadband Internet subscriptions to mobile Internet subscriptions. Since the consumer habits change as the technology changes, the technological pillars reflect those changes.

Table 16. Turkey's Ranks in Selected Indicators between 2012 and 2015 (GCI, 2012-2013-2014)

Turkey			
Series	2012-2013	2013-2014	2014-2015
2.07 Quality of electricity supply, 1-7 (best)	77	77	72
2.09 Fixed telephone lines/100 pop.	63	66	65
2.08 Mobile telephone subscriptions/100 pop.	98	105	105
B. Electricity and telephony infrastructure	85	87	80
2nd pillar: Infrastructure	51	49	51
6.01 Intensity of local competition, 1-7 (best)	16	15	11
6.09 Prevalence of trade barriers, 1-7 (best)	98	97	77
6.13 Burden of customs procedures, 1-7 (best)	96	87	83
6.15 Degree of customer orientation, 1-7 (best)	22	24	32
6.16 Buyer sophistication, 1-7 (best)	84	82	67
6th pillar: Goods market efficiency	38	43	43
A. Efficiency	36	37	44
9.01 Availability of latest technologies, 1-7 (best)	45	44	45
9.02 Firm-level technology absorption, 1-7 (best)	39	37	37
9.03 FDI and technology transfer, 1-7 (best)	65	47	28
B. Technological adoption	49	42	40
9.04 Individuals using Internet, %	69	73	72
9.05 Fixed broadband Internet subscriptions/100 pop.	57	60	59
9.06 Int'l Internet bandwidth, kb/s per user	41	44	40
9.07 Mobile broadband subscriptions/100 pop.	73	73	62
C. ICT use	60	68	63
9th pillar: Technological readiness	53	58	55

Table 17 and Table 18 below show the 2006-2014 Global Competitiveness Index rankings for BRICS countries, as well as Indonesia, Poland, and Turkey to make a comparison for 12 different main pillars, and Table 18 shows the change in the rankings from 2006 to 2014. Positive numbers in Table 18 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 17. BRICS and Poland and Turkey Pillar Rankings 2006-2014 (GCI, 2007 and GCI, 2014)

	2006-2007								**2014-2015**							
Main Pillars and Rankings	Brazil	Russia	India	Indon.	China	S.Africa	Poland	Turkey	Brazil	Russia	India	Indon.	China	S.Africa	Poland	Turkey
1st pillar: Institutions	82	112	37	60	75	35	69	54	94	97	70	53	47	36	56	64
2nd pillar: Infrastructure	68	66	62	78	52	32	65	61	76	39	87	56	46	60	63	51
3rd pillar: Macroeconomic environment	114	35	86	73	3	46	51	101	85	31	101	34	10	89	63	58
4th pillar: Health and primary education	59	77	92	93	85	100	21	74	77	56	98	74	46	132	39	69
5th pillar: Higher education and training	56	45	47	70	74	49	33	58	41	39	93	61	65	86	34	50
6th pillar: Goods market efficiency	80	79	36	33	60	29	56	43	123	99	95	48	56	32	51	43
7th pillar: Labor market efficiency	95	40	96	51	54	79	41	114	109	45	112	110	37	113	79	131
8th pillar: Financial market development	69	98	38	58	119	24	64	85	53	110	51	42	54	7	35	58
9th pillar: Technological readiness	54	72	57	75	69	47	46	50	58	59	121	77	83	66	48	55
10th pillar: Market size	10	9	3	15	2	20	22	18	9	7	3	15	2	25	19	16
11th pillar: Business sophistication	35	78	24	41	58	32	56	42	47	86	57	34	43	31	63	50
12th pillar: Innovation	37	47	26	39	38	29	43	49	62	65	49	31	32	43	72	56

Table 18. 2006-2014 Change in Rankings

	2006 to 2014 Change							
Main Pillars and Rankings	Brazil	Russia	India	Indon.	China	S.Africa	Poland	Turkey
1st pillar: Institutions	-12	15	-33	7	28	-1	13	-10
2nd pillar: Infrastructure	-8	27	-25	22	6	-28	2	10
3rd pillar: Macroeconomic environment	29	4	-15	39	-7	-43	-12	43
4th pillar: Health and primary education	-18	21	-6	19	39	-32	-18	5
5th pillar: Higher education and training	15	6	-46	9	9	-37	-1	8
6th pillar: Goods market efficiency	-43	-20	-59	-15	4	-3	5	0
7th pillar: Labor market efficiency	-14	-5	-16	-59	17	-34	-38	-17
8th pillar: Financial market development	16	-12	-13	16	65	17	29	27
9th pillar: Technological readiness	-4	13	-64	-2	-14	-19	-2	-5
10th pillar: Market size	1	2	0	0	0	-5	3	2
11th pillar: Business sophistication	-12	-8	-33	7	15	1	-7	-8
12th pillar: Innovation	-25	-18	-23	8	6	-14	-29	-7

According to Table 18, all developing countries show a development in the Financial Market Development except Russia and India, 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 and Labor Market Efficiency, except China, and this underlines that the goods markets move towards monopolistic markets while the labor market is exploited. The important pillars for this study are the Infrastructure, Macroeconomic Environment, Financial Market Development, Technological Readiness, Market Size, Business Sophistication, and Innovation.

CHAPTER 4

METHODOLOGY AND DATA

In this study, the data were derived from the Global Competitiveness Index from 2006 to 2014 in order to maintain the consistency in the data. In addition, as the sample set, for the developing countries BRICS, Greece, Indonesia, Mexico, Nigeria, Poland, Romania, Turkey, and Vietnam are chosen. For the developed countries, France, Germany, Iceland, Ireland, Japan, Netherlands, South Korea, and United States are chosen.

Many scholars studied the relationship of the information and communication technologies usage or technological readiness and export capabilities of countries or the internationalization 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.

The ratio of total exports to a country's GDP was chosen as the dependent variable, while the effects of institutions, infrastructure, macroeconomic environment, health and primary education, higher education and training, goods market efficiency, labor market efficiency, financial market development, technological readiness, market size, business sophistication, and innovation capabilities 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 19.

Table 19. Independent Variables Used in the Model and Sub-Indicators in the Global Competitiveness Index (GCI, 2014)

Main Pillars/Independent Variables	Sub Indicators by GCI 2014
X1 Institutions	1.03 Diversion of public funds, 1-7 (best)
	1.04 Public trust in politicians, 1-7 (best)
	1.05 Irregular payments and bribes, 1-7 (best)
	1.06 Judicial independence, 1-7 (best)
	1.07 Favoritism in decisions of government officials, 1-7 (best)
	1.08 Wastefulness of government spending, 1-7 (best)
	1.09 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 19. continued

Main Pillars/Independent Variables	Sub Indicators by GCI 2014
X2 Infrastructure	2.01 Quality of overall infrastructure, 1-7 (best)
	2.02 Quality of roads, 1-7 (best)
	2.03 Quality of railroad infrastructure, 1-7 (best)
	2.04 Quality of port infrastructure, 1-7 (best)
	2.05 Quality of air transport infrastructure, 1-7 (best)
	2.06 Available airline seat km/week, millions
	2.07 Quality of electricity supply, 1-7 (best)
	2.08 Mobile telephone subscriptions/100 pop.
	2.09 Fixed telephone lines/100 pop.
X3 Macroeco. Env.	3.01 Government budget balance, % GDP
	3.02 Gross national savings, % GDP
	3.03 Inflation, annual % change
	3.04 General government debt, % GDP
	3.05 Country credit rating, 0–100 (best)

Table 19. continued

Main Pillars/Independent Variables	Sub Indicators by GCI 2014
X4 Health and Primary Education	4.02 Business impact of malaria, 1-7 (best)
	4.01 Malaria cases/100,000 pop.
	4.04 Business impact of tuberculosis, 1-7 (best)
	4.03 Tuberculosis cases/100,000 pop.
	4.06 Business impact of HIV/AIDS, 1-7 (best)
	4.05 HIV prevalence, % adult pop.
	4.07 Infant mortality, deaths/1,000 live births
	4.08 Life expectancy, years
	4.09 Quality of primary education, 1-7 (best)
	4.10 Primary education enrollment, net %
X5 Higher education and training	5.01 Secondary education enrollment, gross %
	5.02 Tertiary education enrollment, gross %
	5.03 Quality of the education system, 1-7 (best)
	5.04 Quality of math and science education, 1-7 (best)
	5.05 Quality of management schools, 1-7 (best)
	5.06 Internet access in schools, 1-7 (best)
	5.07 Availability of research and training services, 1-7 (best)
	5.08 Extent of staff training, 1-7 (best)

Table 19. continued

Main Pillars/Independent Variables	Sub Indicators by GCI 2014
X6 Goods Market Eff.	6.01 Intensity of local competition, 1-7 (best)
	6.02 Extent of market dominance, 1-7 (best)
	6.03 Effectiveness of anti-monopoly policy, 1-7 (best)
	6.04 Effect of taxation on incentives to invest, 1-7 (best)
	6.06 No. procedures to start a business
	6.07 No. days to start a business
	6.08 Agricultural policy costs, 1-7 (best)
	6.05 Total tax rate, % profits
	6.09 Prevalence of trade barriers, 1-7 (best)
	6.11 Prevalence of foreign ownership, 1-7 (best)
	6.12 Business impact of rules on FDI, 1-7 (best)
	6.13 Burden of customs procedures, 1-7 (best)
	6.14 Imports as a percentage of GDP
	6.10 Trade tariffs, % duty
	6.15 Degree of customer orientation, 1-7 (best)
	6.16 Buyer sophistication, 1-7 (best)

Table 19. continued

Main Pillars/Independent Variables	Sub Indicators by GCI 2014
X7 Labor Mar. Eff.	7.01 Cooperation in labor-employer relations, 1-7 (best)
	7.03 Hiring and firing practices, 1-7 (best)
	7.02 Flexibility of wage determination, 1-7 (best)
	7.05 Effect of taxation on incentives to work, 1-7 (best)
	7.04 Redundancy costs, weeks of salary
	7.06 Pay and productivity, 1-7 (best)
	7.07 Reliance on professional management, 1-7 (best)
	7.08 Country capacity to retain talent, 1-7 (best)
	7.09 Country capacity to attract talent, 1-7 (best)
	7.10 Women in labor force, ratio to men
X8 Fin. Mar. Dev.	8.02 Affordability of financial services, 1-7 (best)
	8.01 Availability of financial services, 1-7 (best)
	8.03 Financing through local equity market, 1-7 (best)
	8.04 Ease of access to loans, 1-7 (best)
	8.05 Venture capital availability, 1-7 (best)
	8.06 Soundness of banks, 1-7 (best)
	8.07 Regulation of securities exchanges, 1-7 (best)
	8.08 Legal rights index, 0–10 (best)

Table 19. continued

Main Pillars/Independent Variables	Sub Indicators by GCI 2014
X9 Tech. Red.	9.01 Availability of latest technologies, 1-7 (best)
	9.02 Firm-level technology absorption, 1-7 (best)
	9.03 FDI and technology transfer, 1-7 (best)
	9.04 Individuals using Internet, %
	9.05 Fixed broadband Internet subscriptions/100 pop.
	9.06 Int'l Internet bandwidth, kb/s per user
	9.07 Mobile broadband subscriptions/100 pop.
X10 Market size	10.03 GDP (PPP$ billions)
	10.04 Exports as a percentage of GDP
	10.01 Domestic market size index, 1–7 (best)
	10.02 Foreign market size index, 1–7 (best)

Table 19. continued

Main Pillars/Independent Variables	Sub Indicators by GCI 2014
X11 Bus. Soph.	11.01 Local supplier quantity, 1-7 (best)
	11.02 Local supplier quality, 1-7 (best)
	11.03 State of cluster development, 1-7 (best)
	11.04 Nature of competitive advantage, 1-7 (best)
	11.07 Production process sophistication, 1-7 (best)
	11.09 Willingness to delegate authority, 1-7 (best)
	11.06 Control of international distribution, 1-7 (best)
	11.08 Extent of marketing, 1-7 (best)
	11.05 Value chain breadth, 1-7 (best)
X12 Innovation	12.01 Capacity for innovation, 1-7 (best)
	12.02 Quality of scientific research institutions, 1-7 (best)
	12.03 Company spending on R&D, 1-7 (best)
	12.04 University-industry collaboration in R&D, 1-7 (best)
	12.05 Gov't procurement of advanced tech products, 1-7 (best)
	12.06 Availability of scientists and engineers, 1-7 (best)
	12.07 PCT patents, applications/million pop.

Table 20. Correlation between the Main Pillars

	Y	X1 Institutions	X2 Infrastructure	X3 Macroeco. Env.	X4 Health and Prim. Edu.	X5 Higher Edu.	X6 Goods Mar. Eff.	X7 Labor Mar. Eff.	X8 Fin. Mar. Dev.	X9 Tech. Red.	X10 Market size	X11 Bus. Soph.	X12 Innovation
Y	1												
X1 Institutions	0,2904	1											
X2 Infrastructure	0,0581	0,7787	1										
X3 Macroeco. Env.	0,1455	-0,0252	0,0321	1									
X4 Health and Prim. Edu.	0,1692	0,509	0,6639	-0,0077	1								
X5 Higher Edu.	0,1387	0,7598	0,8726	-0,0217	0,7721	1							
X6 Goods Mar. Eff.	0,3105	0,8835	0,6767	0,0925	0,3732	0,6694	1						
X7 Labor Mar. Eff.	0,2242	0,5653	0,4227	-0,0262	0,3318	0,5374	0,557	1					
X8 Fin. Mar. Dev.	-0,0996	0,611	0,3384	0,1065	-0,03	0,3252	0,6629	0,2963	1				
X9 Tech. Red.	0,2446	0,7833	0,8758	-0,089	0,6463	0,923	0,6885	0,5426	0,3279	1			
X10 Market size	-0,4455	-0,0631	0,2021	0,3053	0,052	0,0309	0,0757	0,0099	0,1868	-0,0697	1		
X11 Bus. Soph.	0,0491	0,8625	0,7907	0,0203	0,4377	0,7286	0,8708	0,53	0,6411	0,7489	0,2821	1	
X12 Innovation	0,0885	0,8189	0,8515	0,0659	0,5239	0,805	0,8252	0,6643	0,5097	0,8099	0,2973	0,9368	1

Firstly, the correlation between the pillars (Table 20) 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. Five pillars were excluded out of 12 and the following seven 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

The Hadri LM unit root test was applied to the panel data (Figure 6), to see if the panel data is stationary. The result gives a *P*-Value equal to 0.0003, which confirms that the "H0: All panels are stationary" is true.

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 developed and 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 the statistical calculations.

```
. xtset CountryRank Year
       panel variable:  CountryRank (strongly balanced)
        time variable:  Year, 2006 to 2014
                delta:  1 unit

.
. xtunitroot hadri Y, trend

Hadri LM test for Y
-------------------

Ho: All panels are stationary                Number of panels  =     21
Ha: Some panels contain unit roots           Number of periods =      9

Time trend:         Included                 Asymptotics: T, N -> Infinity
Heteroskedasticity: Not robust                                  sequentially
LR variance:        (not used)
```

	Statistic	p-value
z	3.4317	0.0003

Figure 6. Unit root test for the main pillars panel data

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

CHAPTER 5

EMPIRICAL ANALYSIS

The results obtained from this study can be grouped as:

- Multiple linear regression analysis for all countries
- Multiple linear regression analysis for developed 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

Firstly, by conducting the multiple linear regression analysis for all countries, we have the following results (Figure 7):

F test value, which is equal to 0.00, shows that the model works properly. In addition to this, we can see that *R-sq* is equal to 95.87% (>95%), which indicates that the pillars used in the model have a great influence to explain the dependent variable Y. Figure 6 also shows that four of the dependent variables are the main influencing factors of the model, which have *t* values > 1.96 or < (-1.96) and at the same time *P* values < 0.05.

For the developed and 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* value in Figure 8 is even higher for the developed countries and 2% lower for the developing countries, but still even for the developing countries, the dependent variable is well explained, as can be seen in Figure 9.

```
. areg Y X3MacroecoEnv X4HealthandPrimEdu X6GoodsMarEff X7LaborMarEff X8FinMarDev X9TechRed X10Marketsize, absorb(Country)

Linear regression, absorbing indicators          Number of obs   =        189
                                                 F(   7,    161) =      15.98
                                                 Prob > F        =     0.0000
                                                 R-squared       =     0.9587
                                                 Adj R-squared   =     0.9518
                                                 Root MSE        =     5.0041
```

Y	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
X3MacroecoEnv	.5008749	1.089377	0.46	0.646	-1.650436	2.652186
X4HealthandPrimEdu	1.019584	2.004626	0.51	0.612	-2.939169	4.978336
X6GoodsMarEff	10.5493	3.007786	3.51	0.001	4.609502	16.4891
X7LaborMarEff	-5.014758	2.629064	-1.91	0.058	-10.20666	.1771393
X8FinMarDev	-9.49858	1.35588	-7.01	0.000	-12.17618	-6.820977
X9TechRed	2.711481	1.230049	2.20	0.029	.2823695	5.140593
X10Marketsize	-20.09045	4.075502	-4.93	0.000	-28.13878	-12.04211
_cons	140.6134	27.4144	5.13	0.000	86.47525	194.7516
Country	F(20, 161) =	88.258	0.000	(21 categories)		

Figure 7. Multiple linear regression analysis for all countries

```
. areg Y X3MacroecoEnv X4HealthandPrimEdu X6GoodsMarEff X7LaborMarEff X8FinMarDev X9TechRed X10Marketsize, absorb(Country)

Linear regression, absorbing indicators          Number of obs   =       117
                                                 F(   7,     97) =      5.86
                                                 Prob > F        =    0.0000
                                                 R-squared       =    0.9387
                                                 Adj R-squared   =    0.9266
                                                 Root MSE        =    4.3590
```

Y	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
X3MacroecoEnv	.8328316	1.226925	0.68	0.499	-1.602274	3.267938
X4HealthandPrimEdu	-.2146478	1.953533	-0.11	0.913	-4.091869	3.662574
X6GoodsMarEff	12.10352	3.465576	3.49	0.001	5.225309	18.98173
X7LaborMarEff	-6.091846	3.157181	-1.93	0.057	-12.35798	.1742837
X8FinMarDev	-4.660837	1.904487	-2.45	0.016	-8.440717	-.8809569
X9TechRed	.1377401	1.259568	0.11	0.913	-2.362154	2.637635
X10Marketsize	-18.92937	4.035425	-4.69	0.000	-26.93857	-10.92017
_cons	123.2739	28.18025	4.37	0.000	67.34387	179.2039
Country	F(12, 97) =		50.152	0.000	(13 categories)	

Figure 8. Multiple linear regression analysis for developing countries

```
. areg Y X3MacroecoEnv X4HealthandPrimEdu X6GoodsMarEff X7LaborMarEff X8FinMarDev X9TechRed X10Marketsize, absorb(Country)

Linear regression, absorbing indicators          Number of obs   =         72
                                                 F(   7,     57) =      13.24
                                                 Prob > F        =     0.0000
                                                 R-squared       =     0.9730
                                                 Adj R-squared   =     0.9664
                                                 Root MSE        =     5.3034
```

Y	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
X3MacroecoEnv	1.326756	2.025567	0.66	0.515	-2.729371	5.382884
X4HealthandPrimEdu	1.495566	5.158278	0.29	0.773	-8.833707	11.82484
X6GoodsMarEff	12.24782	5.10406	2.40	0.020	2.027112	22.46852
X7LaborMarEff	-9.281571	4.401412	-2.11	0.039	-18.09525	-.4678957
X8FinMarDev	-10.87792	2.133241	-5.10	0.000	-15.14966	-6.606178
X9TechRed	8.282265	2.820327	2.94	0.005	2.634657	13.92987
X10Marketsize	-11.87185	9.983179	-1.19	0.239	-31.86282	8.119121
_cons	83.17634	61.41651	1.35	0.181	-39.8081	206.1608
Country	F(7, 57) =		63.771	0.000	(8 categories)	

Figure 9. Multiple linear regression analysis for developed countries

Apart from the current year analysis, the results show that the dependent variable is better explained when we apply a time lag of two years to the model (Figure 10). The overall *R-sq* increases, 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:

- X6 Goods Mar. Eff.
- X7 Labor Mar. Eff.
- X8 Fin. Mar. Dev.
- X9 Tech. Red.
- X10 Market size

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

- X4 Health and Prim. Edu.
- X8 Fin. Mar. Dev.
- X10 Market size

It can be seen from this analysis that the size and the financial development of the market are key factors for the export ratio of a country, and additionally these two factors also affect the export ratio of the country years from now. It is also an expected result that the health and primary education pillar is an influencing factor only with the time lag effect, as they are the kind of variables that show their effects after a few years.

We can now have several equations for the following analysis, where Y_t represents the export/GDP ratio:

- Multiple linear regression analysis for all countries
- Multiple linear regression analysis for developed countries
- Multiple linear regression analysis for developing countries
- Multiple linear regression analysis with two years lag for all countries

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

$$Y_t = 140.61 + 10.55X6_t - 5.01X7_t - 9.50X8_t + 2.71X9_t - 20.09X10_t \quad (1)$$

For developing countries, we have:

$$Y_t = 123.27 - 12.1X6_t - 6.09X7_t - 4.66X8_t - 18.93X10_t \quad (2)$$

It is seen that for the developing countries, the importance of the Goods Market Efficiency increases, while the negative effect of the Financial Market Development and the Market Size decreases, compared to all.

Also, for the developed countries, the equation is:

$$Y_t = 83.18 - 12.25X6_t - 9.28X7_t - 10.88X8_t + 8.28X9_t \quad (3)$$

We see that the Market Size pillar is substituted by the Labor Market Efficiency pillar for the developed countries.

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

$$Y_t = 93.07 - 4.18X4_{t-2} - 7.04X8_{t-2} - 12.83X10_{t-2} \quad (4)$$

As mentioned, the new influencing variable Health and Primary Education, is added into the equation as a new explanatory factor. The Goods Market Efficiency, Labor Market Efficiency and Technological Readiness are no longer as effective as they are in the no-lag model.

```
. areg Y2 X3MacroecoEnv X4HealthandPrimEdu X6GoodsMarEff X7LaborMarEff X8FinMarDev X9TechRed X10Marketsize, absorb(Country)

Linear regression, absorbing indicators          Number of obs   =        147
                                                 F(   7,    119) =      14.83
                                                 Prob > F        =     0.0000
                                                 R-squared       =     0.9720
                                                 Adj R-squared   =     0.9656
                                                 Root MSE        =     4.3998
```

Y2	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
X3MacroecoEnv	-1.858232	1.18302	-1.57	0.119	-4.200729	.4842664
X4HealthandPrimEdu	4.183791	1.926813	2.17	0.032	.3685092	7.999073
X6GoodsMarEff	-.1682787	3.212821	-0.05	0.958	-6.529986	6.193428
X7LaborMarEff	5.152292	3.233287	1.59	0.114	-1.24994	11.55452
X8FinMarDev	-7.041564	1.420804	-4.96	0.000	-9.854898	-4.22823
X9TechRed	1.764989	1.41598	1.25	0.215	-1.038794	4.568772
X10Marketsize	-12.82713	3.981993	-3.22	0.002	-20.71187	-4.942388
_cons	93.07272	26.74959	3.48	0.001	40.10587	146.0396
Country	F(20, 119) =	103.439		0.000	(21 categories)	

Figure 10. Multiple linear regression analysis with two years lag for all countries

We see that, as the most related pillar with ICT usage, Technological Readiness is also an extremely influencing positive factor on the country's export/GDP ratio with its *t* value of 2.20 and a *P* value of 0.029, which can be seen in Figure 7. This also brings with itself that the other highly correlated pillars also have similar positive effects on the dependent variable; we can therefore say that Innovation and Higher Education also have effects on the export/GDP ratio.

In terms of having an idea of ICT usage, after seeing that Technological Readiness and Innovation have a positive influence on export/GDP, we can say that the sub-pillars that constitute the main pillar also have an effect on a country's export/GDP ratio. That is also the case for the Higher Education pillar, as higher education, different from primary education, can more instantly influence a country's statistics.

Table 21. Sub-pillars about direct ICT usage

X9 Tech. Red.	9.01 Availability of latest technologies, 1-7 (best)
	9.02 Firm-level technology absorption, 1-7 (best)
	9.03 FDI and technology transfer, 1-7 (best)
	9.04 Individuals using Internet, %*
	9.05 Fixed broadband Internet subscriptions/100 pop.*
	9.06 Int'l Internet bandwidth, kb/s per user*
	9.07 Mobile broadband subscriptions/100 pop.*
X12 Innovation	12.01 Capacity for innovation, 1-7 (best)
	12.02 Quality of scientific research institutions, 1-7 (best)
	12.03 Company spending on R&D, 1-7 (best)
	12.04 University-industry collaboration in R&D, 1-7 (best)
	12.05 Gov't procurement of advanced tech products, 1-7 (best)
	12.06 Availability of scientists and engineers, 1-7 (best)
	12.07 PCT patents, applications/million pop.*

Table 22. Correlation between the ICT usage sub-pillars

	Y	Availability of latest technologies, 1-7 (best)	Availability of scientists and engineers, 1-7 (best)	Capacity for innovation, 1-7 (best)	Company spending on R&D, 1-7 (best)	FDI and technology transfer, 1-7 (best)	Firm-level technology absorption, 1-7 (best)	Fixed broadband Internet subscriptions/100 pop.	Gov't procurement of advanced tech products, 1-7 (best)	Individuals using Internet, %	Quality of scientific research institutions, 1-7 (best)	University-industry collaboration in R&D, 1-7 (best)
Y	1											
Availability of latest technologies, 1-7 (best)	0.0167	1										
Availability of scientists and engineers, 1-7 (best)	-0.0518	0.4924	1									
Capacity for innovation, 1-7 (best)	0.0251	0.7147	0.5661	1								
Company spending on R&D, 1-7 (best)	0.0329	0.6988	0.5950	0.9436	1							
FDI and technology transfer, 1-7 (best)	0.2954	0.1476	0.1257	0.1239	0.2289	1						
Firm-level technology absorption, 1-7 (best)	0.0249	0.8612	0.5636	0.7650	0.7961	0.2378	1					
Fixed broadband Internet subscriptions/100 pop.	0.2492	0.7511	0.4182	0.6239	0.5657	-0.1090	0.5921	1				
Gov't procurement of advanced tech products, 1-7 (best)	0.0771	0.3834	0.4468	0.6689	0.7114	0.1717	0.5779	0.3351	1			
Individuals using Internet, %	0.2573	0.7250	0.3354	0.6122	0.5314	-0.1029	0.5558	0.9432	0.2976	1		
Quality of scientific research institutions, 1-7 (best)	0.1137	0.7884	0.5758	0.8688	0.8902	0.3291	0.7907	0.6487	0.5794	0.6061	1	
University-industry collaboration in R&D, 1-7 (best)	0.1559	0.8025	0.3845	0.8195	0.8398	0.2320	0.7950	0.6546	0.6251	0.6603	0.8867	1

The results of the previous analysis lead us to a new one. It is obvious from the analysis results that ICT usage is related to the export/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 influential ones.

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:

- Int'l Internet bandwidth, kb/s per user
- Mobile broadband subscriptions/100 pop.
- PCT patents, applications/million pop.

The following sub-pillars are also excluded as they are highly correlated with other sub-pillars (Table 22):

- Availability of latest technologies
- Capacity for innovation, (1-7 best)
- Company spending on R&D
- Individuals using the Internet
- University-industry collaboration in R&D

In the end, six sub-pillars out of 14 are available to be included into the new regression analysis. These sub-pillars are:

- Availability of scientists and engineers, (1-7 best)
- FDI and technology transfer, (1-7 best)
- Firm-level technology absorption, (1-7 best)

- Fixed broadband Internet subscriptions/100 pop.
- Gov't procurement of advanced tech products, (1-7 best)
- Quality of scientific research institutions, (1-7 best)

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. Figure 11 shows the results, which confirm that "H0: All the panel is stationary" is true.

```
. xtunitroot hadri Y, trend

Hadri LM test for Y
------------------------

Ho: All panels are stationary                Number of panels  =     21
Ha: Some panels contain unit roots           Number of periods =      9

Time trend:          Included                Asymptotics: T, N -> Infinity
Heteroskedasticity: Not robust                                sequentially
LR variance:         (not used)
------------------------------------------------------------------------------
                     Statistic      p-value
------------------------------------------------------------------------------
 z                     3.4317        0.0003
------------------------------------------------------------------------------
```

Figure 11. Unit root test for ICT usage related sub-pillars

After the linear regression results were obtained from these sub-pillars (Figure 12), we see that there are some highly regressed ICT-based sub-pillars related to the export/GDP ratio. Regarding their *t* and *P* values, we can say that the most influential sub-pillar for the export/GDP ratio is the Quality of Scientific Research Institutions. It can be said that this is a sub-pillar that affects our dependent variable directly and positively.

Secondly, the Fixed Broadband Internet Subscription/100 pop sub-pillar is another positively affecting sub-pillar showing the direct proportion of Internet usage to the country's population, which is one of the most critical sub-pillars indicating ICT usage penetration indirectly.

It can also be derived from the results that the Firm-level Technology Absorption, the Government Procurement of Advanced Tech Products, and the Availability of Scientists and Engineers have negative effects on the export/GDP ratio. This may be the reality for many of the times as these three 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.

The Equation (5) for the export/GDP with no time lag can be determined as follows:

$$Y_t = 34.26 - 5.11X3_t + 0.21X4_t - 3.72X5_t + 11.57X6_t \qquad (5)$$

The definition of the unknowns for the Equation (5) can be found in Table 23 below:

Table 23. Definitions of the unknowns in the equations (5), (6) and (7)

Unknown	Definition
Y	Export/GDP
X1	Availability of scientists and engineers
X2	FDI and technology transfer
X3	Firm-level technology absorption
X4	Fixed broadband Internet subscriptions/100 pop.
X5	Gov't procurement of advanced tech products
X6	Quality of scientific research institutions
t	Year of observation

From this first analysis with no time lag, it can be said that the availability of scientists and engineers and the FDI and the technology transfer are not explanatory for the export/GDP values.

```
. areg Y Availabilityofscientistsanden FDIandtechnologytransfer17 Firmleveltechnologyabsorption FixedbroadbandInternetsubscrip Govtprocuremen
> tofadvancedtec Qualityofscientificresearchin, absorb(Country)

Linear regression, absorbing indicators          Number of obs   =       189
                                                 F(   6,    162) =      9.34
                                                 Prob > F        =    0.0000
                                                 R-squared       =    0.9480
                                                 Adj R-squared   =    0.9397
                                                 Root MSE        =    5.5977
```

Y	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Availabilityofscientistsanden	-2.295325	1.970011	-1.17	0.246	-6.185537	1.594887
FDIandtechnologytransfer17	.0939696	2.508311	0.04	0.970	-4.859232	5.047171
Firmleveltechnologyabsorption	-5.116568	2.189902	-2.34	0.021	-9.441003	-.7921343
FixedbroadbandInternetsubscrip	.2120915	.1098079	1.93	0.055	-.004748	.4289309
Govtprocurementofadvancedtec	-3.718288	1.705329	-2.18	0.031	-7.085829	-.3507476
Qualityofscientificresearchin	11.56838	2.427136	4.77	0.000	6.775481	16.36129
_cons	34.25915	13.34042	2.57	0.011	7.915602	60.60269
Country	F(20, 162) =	101.711		0.000	(21 categories)	

Figure 12. Multiple linear regression analysis with ICT-related sub-pillars for all countries

As these sub-pillars' instant effects are already questionable, firstly, a time lag of one year was applied to the model, specifically to these sub-pillars (Figure 13). For the dataset with a one-year lag to the three sub-pillars, another high correlation can be observed between the Firm-level Technology Absorption and the Quality of Scientific Research Institutions; therefore, we excluded the Firm-level Technology Absorption from the dataset as it is also less correlated with the dependent variable, the export/GDP ratio (Appendix C). The results show that with the one-year lag, the effect of the FDI and Technology transfer increases slightly while the availability of scientists and engineers and fixed broadband Internet subscription ratio becomes less effective compared to the analysis with no-lag data. The Equation (6) shows the equation for the one-year lag model.

$$Y_t = 32.27 - 6.67X5_t + 8.82X6_t \quad (6)$$

Secondly, a time lag of two years was applied to the three sub-pillars. Again, the results of the correlation tests show that when a lag of two years is applied to the three sub-pillars, there is a high correlation between the Firm-level Technology Absorption and the Quality of Scientific Research Institutions. The Firm-level Technology Absorption was removed from the dataset because of its low correlation with the dependent variable, the export/GDP ratio (Appendix D). It can be seen that the effect of the FDI and Technology Transfer increases compared to the other models (Figure 14). The others stay close to their previous values in the analysis with one-year lag, which means that these sub-pillars are either ineffective and do not explain well enough the dependent variable, or they have long-term effects that are not seen in the models with short time lags of one or two years.

The equation for the export/GDP ratio obtained from the analysis with two years of time lag is the Equation (7), where the definitions for the unknowns can be found in Table 23:

$$Y_t = 43.92 - 7.69X5_t + 7{,}61X6_t \quad (7)$$

One of the points to mention here is that, even without a lag application to the four explanatory variables, one of them becomes non-explanatory in the final equation. This can be seen as a natural outcome of the dataset. In the event the dataset is changed, it is possible that the variables may become explanatory or non-explanatory in the model. Here, as the dataset is changed with the lags on certain variables, the Fixed Broadband Internet Subscriptions/100 pop sub-pillar becomes non-explanatory. However, it is already seen in the non-lagged study that the variables affect the export/GDP ratio.

Linear regression, absorbing indicators

Number of obs	168
F(5, 142)	8.06
Prob > F	0.0000
R-squared	0.9531
Adj R-squared	0.9448
Root MSE	5.4598

Y	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Availabilityofscientistsanden	-1.637704	2.148123	-0.76	0.447	-5.884138	2.608729
FDIandtechnologytransfer17	-.605909	2.320377	-0.26	0.794	-5.192857	3.981039
FixedbroadbandInternetsubscrip	.17511	.1261458	1.39	0.167	-.0742563	.4244764
Govtprocurementofadvancedtec	-6.673462	1.82985	-3.65	0.000	-10.29073	-3.056195
Qualityofscientificresearchin	8.818871	2.34123	3.77	0.000	4.190702	13.44704
_cons	32.27197	14.54411	2.22	0.028	3.521008	61.02293
Country	F(20, 142) =	102.248		0.000	(21 categories)	

Figure 13. Multiple linear regression analysis with ICT-related sub-pillars (with a one-year time lag for three sub-pillars, one excluded because of the high correlation)

```
. areg Y Availabilityofscientistsanden FDIandtechnologytransfer17 FixedbroadbandInternetsubscrip Govtprocurementofadvancedtec Qualityofscient
> ificresearchin, absorb(Country)

Linear regression, absorbing indicators          Number of obs   =        147
                                                 F(   5,    121) =       7.04
                                                 Prob > F        =     0.0000
                                                 R-squared       =     0.9594
                                                 Adj R-squared   =     0.9510
                                                 Root MSE        =     5.2549
```

Y	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Availabilityofscientistsanden	-3.657813	2.376678	-1.54	0.126	-8.363074	1.047448
FDIandtechnologytransfer17	.936292	2.302484	0.41	0.685	-3.622082	5.494666
FixedbroadbandInternetsubscrip	.1577898	.1714653	0.92	0.359	-.181671	.4972506
Govtprocurementofadvancedtec	-7.688609	1.96201	-3.92	0.000	-11.57293	-3.804293
Qualityofscientificresearchin	7.608915	2.555684	2.98	0.004	2.549264	12.66857
_cons	43.91576	18.75684	2.34	0.021	6.781644	81.04988
Country	F(20, 121) =	99.389	0.000	(21 categories)		

Figure 14. Multiple linear regression analysis with ICT-related sub-pillars (with a two-year time lag for three sub-pillars, one excluded because of the high correlation)

CHAPTER 6

DISCUSSION AND CONCLUSION

The main objective of this study was to explore the effects of ICT usage on countries' export/GDP ratio and the possible reasons behind these effects. To understand that, the GCI data for the last nine years was examined. It is seen in the end that apart from the other pillars, a country's export/GDP ratio is also related to the country's technological readiness and innovation, which is highly correlated with it.

To go deeper, a new analysis was also applied to the ICT-related sub-pillars and it is seen that among the ICT-related sub-pillars, the following ones are extremely influential on the export/GDP ratio, if no time lag is taken into account:

- Firm level technology absorption
- Fixed broadband Internet subscriptions / population
- Government procurement of advanced tech. products
- Quality of scientific research institutions

The firm-level technology absorption and government procurement of advanced technological products are the negatively related sub-pillars with the export/GDP ratio of a country. Especially the firm-level technology absorption 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 World Bank data of 2012 high-tech export, China is the world largest high-tech exporter with $506 billion, exporting more than 25% of the overall high-tech products in the world. The first four countries, which are China, Germany, US, and Singapore, have a total share of more than 50%, and with the next three countries, Japan, Korea Republic,

and France, this share reaches 75% in the total 2012 high-tech exports (The World Bank, 2012). Except for Singapore, the other six countries were also included in the analysis. It is obvious that the high-tech investment and technology absorption of the firms in many countries decrease that country's export/GDP, as they increase the imports, especially in the short term. Similarly, government procurement of advanced technological products also increases a country's import and, therefore, reduces the export/GDP ratio. In fact, both sub-pillars can be considered as main factors for a country's technology imports.

On the other hand, it can be seen that two sub-pillars significantly affect a country's export positively, which are the percentage of fixed broadband Internet subscribed users to the population (as well as the Individuals Using Internet % pillar, which is highly correlated with it) and the quality of scientific research institutions. These two sub-pillars represent both the quality and the quantity of ICT usage in a country. The fixed broadband Internet subscribed users indicates the number of Internet users, 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 R&D activities, which is closely related with the usage efficiency (World Bank, 2012; WEF, 2015). The studies conducted by WEF and the World Bank also support this idea of an existing relation between the countries' R&D expenditures and quality of their scientific research institutions, as the six countries out of 10—Israel, the United States, Belgium, Japan, Germany, and Finland—are in both lists (Tables 24 and 25).

On the other hand, the quality of scientific research institutions is also highly correlated with the capacity for innovation and the companies' spending on R&D,

which means that we have two other sub-pillars that are also influential on the export/GDP ratio.

Table 24. Top 10 Countries with the Highest Quality of Scientific Research Institutions (GCI, 2014)

Ranking	Country
1	Switzerland
2	United Kingdom
3	Israel
4	United States
5	Belgium
6	Netherlands
7	Japan
8	Germany
9	Australia
10	Finland

Table 25. Top 10 Countries' R&D Expenditure % to GDP for 2012 (World Bank, 2012)

Ranking	Country Name	R&D Expenditure % to GDP
1	Israel	3.93
2	Finland	3.55
3	Sweden	3.41
4	Denmark	2.98
5	Germany	2.92
6	Austria	2.84
7	Slovenia	2.80
8	United States	2.79
9	France	2.26
10	Belgium	2.24

Apart from these four sub-pillars that are influential on the export/GDP ratio of a country, when working with a time lag, the results also show that with one year and two years of lag respectively, the effect of the FDI and Technology Transfer sub-

pillar increases. It is possible that when the study is done with a larger data set with more years observed, it can be found out that the results support the effectiveness of this sub-pillar in a longer term. For this study, it is not possible to speak about a certain effectiveness, but it is clear that there is an increasing effectiveness with the increasing lag.

This study mainly worked on the relationship between ICT usage and the export/GDP ratio of countries and determined the most influential sub-pillars of ICT usage in a country's internationalization. Different from other studies in the literature, the primary focus of the study was locating the main ICT-related factors of internationalization and providing an idea of where to invest and to show the possible bottlenecks and improvement areas. The study also has limitations. The GCI data retrieved from WEF comprised nine years and were relatively small, which may be the natural result of the short history of ICT usage and studies in this area. It is obvious that the larger body of data that will be obtained in the coming years will yield more precise calculations. The data were also affected by the global crisis that occurred in 2008, which probably affected the countries' export statistics as well as most of the others, so data that are purged from the effects of the global crisis would show more accurate results. Time lag was another limitation for the study, as there is a possibility of an existing time lag effect, but the data were very small to observe it properly. It is evident that to go deeper with the study, a time lag should be applied to a larger data set and the pillars and sub-pillars also should be issued to the time-lagged analysis in order to see their effects. Especially for the Innovation pillar and its sub-pillars, the effects can be seen more clearly as the effective results of innovation become visible after certain years.

APPENDIX A

COUNTRIES' INDEPENDENT AND DEPENDENT MAIN PILLAR VARIABLE SCORES (GCI, 2006-2014)

Country	Year	Y	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
Brazil	2006	16,773	3,704	6,038	3,819	3,909	3,990	3,206	5,573
Brazil	2007	14,655	3,657	5,226	3,803	3,957	4,144	3,347	5,444
Brazil	2008	13,871	3,887	5,309	3,896	4,154	4,363	3,593	5,539
Brazil	2009	14,336	3,926	5,240	3,872	4,272	4,470	4,056	5,628
Brazil	2010	11,271	3,997	5,453	3,708	4,142	4,441	3,923	5,604
Brazil	2011	11,109	4,162	5,448	3,811	4,186	4,469	3,976	5,613
Brazil	2012	11,741	4,727	5,430	3,935	4,385	4,448	4,431	5,634
Brazil	2013	11,716	4,626	5,425	3,819	4,129	4,401	4,137	5,653
Brazil	2014	12,468	4,492	5,654	3,846	3,828	4,299	4,210	5,660
Country	Year	Y + 2	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
Brazil	2006	13,871	3,704	6,038	3,819	3,909	3,030	2,906	6,804
Brazil	2007	14,336	3,657	5,226	3,803	3,957	3,347	3,002	6,800
Brazil	2008	11,271	3,887	5,309	3,896	4,154	3,644	3,189	6,576
Brazil	2009	11,109	3,926	5,240	3,872	4,272	4,052	3,377	6,627
Brazil	2010	11,741	3,997	5,453	3,708	4,142	4,278	3,445	6,709
Brazil	2011	11,716	4,162	5,448	3,811	4,186	4,415	3,571	6,774
Brazil	2012	12,468	4,727	5,430	3,935	4,385	4,307	3,500	6,824

Country	Year	Y	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
China	2006	36,800	6,455	5,675	4,167	4,274	4,324	3,435	6,852
China	2007	39,200	6,033	5,490	4,258	4,398	4,298	3,526	6,862
China	2008	41,400	5,947	5,706	4,485	4,492	4,750	4,787	5,798
China	2009	37,800	5,929	5,717	4,466	4,735	5,199	4,878	5,658
China	2010	27,900	6,110	6,162	4,400	4,703	5,186	5,163	5,732
China	2011	29,737	6,220	6,160	4,421	4,682	4,947	5,238	5,775
China	2012	28,509	6,220	6,109	4,315	4,604	4,955	5,282	5,758
China	2013	27,213	6,293	6,062	4,324	4,625	4,999	5,634	5,742
China	2014	26,321	6,411	6,077	4,417	4,550	4,733	5,717	5,755
Country	Year	Y + 2	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
China	2006	41,400	6,455	5,675	4,167	4,274	4,614	5,685	5,765
China	2007	37,800	6,033	5,490	4,258	4,398	4,787	5,768	5,742
China	2008	27,900	5,947	5,706	4,485	4,492	5,443	4,934	6,000
China	2009	29,737	5,929	5,717	4,466	4,735	5,640	5,054	5,898
China	2010	28,509	6,110	6,162	4,400	4,703	5,346	5,223	5,987
China	2011	27,213	6,220	6,160	4,421	4,682	4,683	5,625	6,016
China	2012	26,321	6,220	6,109	4,315	4,604	4,624	5,360	6,006

Country	Year	Y	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
France	2006	26,234	5,065	6,528	5,097	4,064	4,537	5,607	5,999
France	2007	26,901	4,931	6,309	5,032	4,063	4,661	5,710	6,021
France	2008	26,628	5,040	6,354	5,008	4,053	4,695	5,724	6,020
France	2009	26,384	4,717	6,224	4,859	4,387	4,758	5,809	5,994
France	2010	23,049	4,976	6,424	4,689	4,472	4,080	3,254	4,624
France	2011	25,576	4,599	6,368	4,563	4,378	4,412	3,294	4,328
France	2012	27,303	4,642	6,310	4,473	4,406	4,290	3,497	4,517
France	2013	29,794	4,650	6,330	4,434	4,312	4,022	3,861	4,587
France	2014	29,698	4,550	6,440	4,575	4,267	3,876	4,058	4,524
Country	Year	Y + 2	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
France	2006	26,628	5,065	6,528	5,097	4,064	3,517	4,211	4,424
France	2007	26,384	4,931	6,309	5,032	4,063	3,128	4,539	4,377
France	2008	23,049	5,040	6,354	5,008	4,053	2,862	4,619	4,375
France	2009	25,576	4,717	6,224	4,859	4,387	2,974	4,787	4,341
France	2010	27,303	4,976	6,424	4,689	4,472	4,760	3,092	6,196
France	2011	29,794	4,599	6,368	4,563	4,378	4,931	3,172	6,159
France	2012	29,698	4,642	6,310	4,473	4,406	4,981	3,267	5,958

Country	Year	Y	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
Germany	2006	40,155	4,944	6,041	5,309	4,353	5,102	3,325	6,065
Germany	2007	44,900	4,925	5,876	5,291	4,452	4,949	3,325	6,099
Germany	2008	46,700	5,418	6,103	5,192	4,426	4,928	3,356	6,164
Germany	2009	47,248	5,276	6,014	5,015	4,334	4,899	3,357	6,239
Germany	2010	40,651	5,325	6,317	4,967	4,398	4,831	3,223	6,249
Germany	2011	45,201	5,428	6,269	4,786	4,409	4,337	2,748	6,261
Germany	2012	48,275	5,482	6,303	4,919	4,505	4,247	2,788	5,412
Germany	2013	48,863	5,682	6,357	4,922	4,574	4,649	2,993	5,168
Germany	2014	47,845	5,829	6,478	4,994	4,572	4,478	3,023	5,114
Country	Year	Y + 2	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
Germany	2006	46,700	4,944	6,041	5,309	4,353	4,303	3,202	5,215
Germany	2007	47,248	4,925	5,876	5,291	4,452	4,227	3,249	5,214
Germany	2008	40,651	5,418	6,103	5,192	4,426	4,060	3,328	5,224
Germany	2009	45,201	5,276	6,014	5,015	4,334	4,069	3,556	5,270
Germany	2010	48,275	5,325	6,317	4,967	4,398	4,176	3,658	5,323
Germany	2011	48,863	5,428	6,269	4,786	4,409	4,453	3,575	5,339
Germany	2012	47,845	5,482	6,303	4,919	4,505	4,824	5,137	6,130

Country	Year	Y	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
Greece	2006	22,600	4,381	6,243	4,282	3,634	4,938	5,059	6,082
Greece	2007	18,669	4,286	5,831	4,244	3,694	4,750	5,106	6,148
Greece	2008	22,600	4,372	5,894	4,224	3,889	4,652	5,230	6,172
Greece	2009	23,106	4,019	5,808	4,092	3,796	4,609	4,875	6,107
Greece	2010	18,832	3,610	6,128	3,905	3,713	4,643	5,059	6,124
Greece	2011	18,987	3,290	6,090	3,884	3,633	4,631	5,705	6,128
Greece	2012	23,458	2,421	6,036	3,920	3,563	4,799	5,590	6,143
Greece	2013	27,508	2,822	6,096	3,932	3,765	4,985	5,614	6,142
Greece	2014	30,316	3,313	6,148	4,198	3,740	4,442	5,420	5,471
Country	Year	Y + 2	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
Greece	2006	22,600	4,381	6,243	4,282	3,634	5,146	5,461	5,371
Greece	2007	23,106	4,286	5,831	4,244	3,694	4,850	5,507	5,443
Greece	2008	18,832	4,372	5,894	4,224	3,889	4,356	5,504	5,564
Greece	2009	18,987	4,019	5,808	4,092	3,796	3,990	5,049	5,557
Greece	2010	23,458	3,610	6,128	3,905	3,713	3,954	5,326	5,570
Greece	2011	27,508	3,290	6,090	3,884	3,633	4,060	5,702	5,604
Greece	2012	30,316	2,421	6,036	3,920	3,563	3,885	5,569	5,610

Country	Year	Y	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
Iceland	2006	31,521	5,129	6,894	5,101	5,490	3,815	5,423	5,595
Iceland	2007	32,598	4,348	6,522	4,975	5,457	3,650	3,178	5,500
Iceland	2008	35,310	5,170	6,498	4,890	5,412	4,276	3,229	5,341
Iceland	2009	44,711	3,570	6,454	4,715	5,435	4,295	3,248	5,481
Iceland	2010	52,266	2,590	6,661	4,709	5,393	4,122	3,527	5,574
Iceland	2011	56,319	3,783	6,593	4,487	5,188	3,819	3,552	5,541
Iceland	2012	58,209	3,734	6,585	4,474	5,098	3,923	3,745	5,553
Iceland	2013	59,000	3,941	6,537	4,432	4,910	4,154	3,803	5,577
Iceland	2014	57,520	4,407	6,521	4,543	4,940	4,187	3,662	5,610
Country	Year	Y + 2	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
Iceland	2006	35,310	5,129	6,894	5,101	5,490	4,143	3,553	5,611
Iceland	2007	44,711	4,348	6,522	4,975	5,457	4,099	3,392	5,055
Iceland	2008	52,266	5,170	6,498	4,890	5,412	4,323	3,437	4,883
Iceland	2009	56,319	3,570	6,454	4,715	5,435	4,282	3,789	4,996
Iceland	2010	58,209	2,590	6,661	4,709	5,393	4,608	3,969	5,074
Iceland	2011	59,000	3,783	6,593	4,487	5,188	4,663	4,017	5,079
Iceland	2012	57,520	3,734	6,585	4,474	5,098	4,605	4,178	5,081

Country	Year	Y	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
India	2006	21,200	4,567	5,474	4,601	3,902	4,594	4,658	5,118
India	2007	22,000	4,206	4,920	4,655	4,072	4,543	4,468	5,138
India	2008	21,200	4,323	4,994	4,521	4,156	4,601	4,466	5,125
India	2009	24,000	4,231	4,821	4,416	4,226	3,901	3,281	4,584
India	2010	20,588	4,526	5,163	4,131	4,183	4,048	3,291	4,233
India	2011	21,176	4,300	5,251	4,214	4,201	4,424	3,703	4,381
India	2012	26,545	4,252	5,266	4,206	4,243	4,401	3,788	4,493
India	2013	24,157	4,100	5,303	4,184	4,080	4,008	3,818	4,407
India	2014	24,857	4,221	5,351	4,133	3,805	3,914	3,762	4,391
Country	Year	Y + 2	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
India	2006	21,200	4,567	5,474	4,601	3,902	3,980	4,093	4,414
India	2007	24,000	4,206	4,920	4,655	4,072	3,955	4,140	4,438
India	2008	20,588	4,323	4,994	4,521	4,156	4,118	4,486	4,438
India	2009	21,176	4,231	4,821	4,416	4,226	3,472	2,862	5,574
India	2010	26,545	4,526	5,163	4,131	4,183	3,597	3,027	5,540
India	2011	24,157	4,300	5,251	4,214	4,201	3,599	3,360	5,711
India	2012	24,857	4,252	5,266	4,206	4,243	3,266	3,449	5,776

Country	Year	Y	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
Indonesia	2006	33,000	4,795	5,406	4,687	4,336	3,177	3,559	5,739
Indonesia	2007	30,879	4,585	5,310	5,058	4,737	3,211	3,655	5,732
Indonesia	2008	29,362	4,908	5,261	4,666	4,592	3,192	4,134	5,758
Indonesia	2009	29,764	4,816	5,204	4,491	4,298	3,388	3,972	5,780
Indonesia	2010	24,125	5,151	5,777	4,349	4,231	3,496	4,189	5,768
Indonesia	2011	24,726	5,662	5,735	4,228	4,064	5,161	3,371	5,098
Indonesia	2012	26,182	5,675	5,690	4,294	3,870	5,194	3,567	4,891
Indonesia	2013	23,969	5,750	5,711	4,401	4,036	5,225	3,702	4,769
Indonesia	2014	23,613	5,480	5,669	4,545	3,812	5,434	3,687	4,860
Country	Year	Y + 2	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
Indonesia	2006	29,362	4,795	5,406	4,687	4,336	5,299	3,480	4,818
Indonesia	2007	29,764	4,585	5,310	5,058	4,737	5,483	3,597	4,814
Indonesia	2008	24,125	4,908	5,261	4,666	4,592	5,717	4,012	4,850
Indonesia	2009	24,726	4,816	5,204	4,491	4,298	5,802	3,921	4,893
Indonesia	2010	26,182	5,151	5,777	4,349	4,231	5,366	3,855	4,912
Indonesia	2011	23,969	5,662	5,735	4,228	4,064	3,718	3,255	5,160
Indonesia	2012	23,613	5,675	5,690	4,294	3,870	4,403	3,395	4,966

Country	Year	Y	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
Ireland	2006	79,352	5,939	6,376	5,484	4,852	4,112	3,530	5,161
Ireland	2007	84,700	5,690	6,276	5,414	4,868	4,063	3,826	5,218
Ireland	2008	81,000	5,330	6,279	5,298	4,955	4,230	3,855	5,168
Ireland	2009	80,947	4,632	6,226	5,092	4,863	4,260	3,948	5,189
Ireland	2010	90,775	4,261	6,513	5,093	4,870	4,457	4,286	5,276
Ireland	2011	103,941	4,012	6,488	5,102	4,895	4,397	4,051	5,303
Ireland	2012	107,626	3,436	6,456	5,242	4,996	4,208	4,266	5,314
Ireland	2013	109,982	3,569	6,600	5,214	4,926	5,842	5,435	6,846
Ireland	2014	109,137	3,488	6,535	5,286	4,822	5,675	5,427	6,833
Country	Year	Y + 2	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
Ireland	2006	81,000	5,939	6,376	5,484	4,852	5,607	5,570	6,911
Ireland	2007	80,947	5,690	6,276	5,414	4,868	4,963	5,609	6,933
Ireland	2008	90,775	5,330	6,279	5,298	4,955	4,673	5,096	6,929
Ireland	2009	103,941	4,632	6,226	5,092	4,863	4,866	5,233	6,921
Ireland	2010	107,626	4,261	6,513	5,093	4,870	5,069	5,837	6,931
Ireland	2011	109,982	4,012	6,488	5,102	4,895	5,263	5,717	6,936
Ireland	2012	109,137	3,436	6,456	5,242	4,996	5,347	5,776	6,935

Country	Year	Y	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
Japan	2006	14,266	4,596	6,296	5,212	5,196	3,563	2,594	4,795
Japan	2007	16,076	4,454	6,143	5,218	5,111	3,827	2,851	4,513
Japan	2008	17,651	4,533	6,114	5,133	5,094	4,063	3,118	4,413
Japan	2009	17,447	4,215	6,130	5,062	5,097	4,051	3,454	4,554
Japan	2010	12,528	4,120	6,516	5,058	5,075	4,210	3,582	4,555
Japan	2011	16,622	4,197	6,517	4,976	5,038	4,004	3,506	4,588
Japan	2012	16,451	3,665	6,496	4,983	4,889	3,852	3,334	4,630
Japan	2013	15,733	3,682	6,503	5,010	4,822	3,763	3,136	4,635
Japan	2014	17,525	3,638	6,623	5,200	4,725	3,765	3,125	4,685
Country	Year	Y + 2	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
Japan	2006	17,651	4,596	6,296	5,212	5,196	4,250	2,469	4,168
Japan	2007	17,447	4,454	6,143	5,218	5,111	4,485	2,642	4,031
Japan	2008	12,528	4,533	6,114	5,133	5,094	4,525	2,871	4,415
Japan	2009	16,622	4,215	6,130	5,062	5,097	4,369	2,913	4,488
Japan	2010	16,451	4,120	6,516	5,058	5,075	3,989	3,038	4,646
Japan	2011	15,733	4,197	6,517	4,976	5,038	3,885	3,077	4,587
Japan	2012	17,525	3,665	6,496	4,983	4,889	4,073	3,076	4,628

Country	Year	Y	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
Korea, Rep.	2006	42,498	6,236	6,258	4,825	4,400	4,039	3,079	4,662
Korea, Rep.	2007	43,226	5,999	6,078	5,231	4,790	4,056	3,021	4,697
Korea, Rep.	2008	45,600	6,148	6,095	4,996	4,598	5,518	5,533	5,082
Korea, Rep.	2009	52,861	5,796	5,985	4,645	4,225	5,630	5,654	4,946
Korea, Rep.	2010	49,900	5,764	6,344	4,550	4,274	5,566	6,008	5,058
Korea, Rep.	2011	54,410	6,374	6,384	4,566	4,301	4,904	6,016	5,117
Korea, Rep.	2012	58,122	6,247	6,493	4,750	4,351	4,714	5,992	5,102
Korea, Rep.	2013	56,836	6,324	6,371	4,675	4,213	4,859	6,130	5,104
Korea, Rep.	2014	54,953	6,436	6,313	4,704	4,067	4,961	5,979	5,115
Country	Year	Y + 2	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
Korea, Rep.	2006	45,600	6,236	6,258	4,825	4,400	4,682	5,975	5,111
Korea, Rep.	2007	52,861	5,999	6,078	5,231	4,790	4,550	5,999	5,075
Korea, Rep.	2008	49,900	6,148	6,095	4,996	4,598	5,945	4,675	4,374
Korea, Rep.	2009	54,410	5,796	5,985	4,645	4,225	5,913	4,646	4,174
Korea, Rep.	2010	58,122	5,764	6,344	4,550	4,274	5,680	4,982	4,222
Korea, Rep.	2011	56,836	6,374	6,384	4,566	4,301	4,598	5,266	4,264
Korea, Rep.	2012	54,953	6,247	6,493	4,750	4,351	3,787	4,992	4,195

Country	Year	Y	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
Mexico	2006	29,914	5,057	6,343	4,118	3,885	3,435	5,343	4,118
Mexico	2007	31,898	5,364	5,592	4,230	4,094	3,599	5,820	4,129
Mexico	2008	32,532	5,317	5,552	4,139	3,971	3,855	5,746	4,151
Mexico	2009	28,275	5,293	5,484	3,965	3,820	4,151	5,894	4,146
Mexico	2010	27,841	5,238	5,663	3,863	3,800	5,458	5,737	2,813
Mexico	2011	30,270	5,247	5,686	4,081	3,918	5,561	5,769	2,301
Mexico	2012	31,569	5,215	5,706	4,197	4,014	5,309	5,651	2,360
Mexico	2013	32,871	5,114	5,689	4,192	3,942	3,987	5,566	2,493
Mexico	2014	31,765	5,042	5,726	4,191	3,712	3,253	5,987	2,369
Country	Year	Y + 2	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
Mexico	2006	32,532	5,057	6,343	4,118	3,885	3,575	6,208	2,316
Mexico	2007	28,275	5,364	5,592	4,230	4,094	3,738	5,990	2,361
Mexico	2008	27,841	5,317	5,552	4,139	3,971	3,888	5,914	2,428
Mexico	2009	30,270	5,293	5,484	3,965	3,820	4,033	6,024	2,442
Mexico	2010	31,569	5,238	5,663	3,863	3,800	3,990	3,206	5,573
Mexico	2011	32,871	5,247	5,686	4,081	3,918	4,144	3,347	5,444
Mexico	2012	31,765	5,215	5,706	4,197	4,014	4,363	3,593	5,539

Country	Year	Y	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
Netherlands	2006	71,220	5,711	6,476	5,338	4,626	4,470	4,056	5,628
Netherlands	2007	74,178	5,727	6,322	5,368	4,706	4,441	3,923	5,604
Netherlands	2008	75,302	5,452	6,304	5,391	4,720	4,469	3,976	5,613
Netherlands	2009	76,857	5,208	6,219	5,239	4,806	4,448	4,431	5,634
Netherlands	2010	69,298	5,291	6,532	5,174	4,831	3,030	2,906	6,804
Netherlands	2011	87,216	5,341	6,544	5,171	4,841	3,347	3,002	6,800
Netherlands	2012	93,855	5,200	6,595	5,292	4,985	3,644	3,189	6,576
Netherlands	2013	101,190	5,216	6,607	5,255	4,842	4,052	3,377	6,627
Netherlands	2014	100,690	5,383	6,637	5,345	4,731	4,278	3,445	6,709
Country	Year	Y + 2	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
Netherlands	2006	75,302	5,711	6,476	5,338	4,626	4,415	3,571	6,774
Netherlands	2007	76,857	5,727	6,322	5,368	4,706	4,307	3,500	6,824
Netherlands	2008	69,298	5,452	6,304	5,391	4,720	4,750	4,787	5,798
Netherlands	2009	87,216	5,208	6,219	5,239	4,806	5,199	4,878	5,658
Netherlands	2010	93,855	5,291	6,532	5,174	4,831	5,186	5,163	5,732
Netherlands	2011	101,190	5,341	6,544	5,171	4,841	4,947	5,238	5,775
Netherlands	2012	100,690	5,200	6,595	5,292	4,985	4,955	5,282	5,758

Country	Year	Y	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
Nigeria	2006	64,500	4,835	3,572	4,132	4,114	4,999	5,634	5,742
Nigeria	2007	57,900	5,580	3,551	4,189	4,224	4,733	5,717	5,755
Nigeria	2008	56,400	5,704	3,591	4,367	4,426	5,443	4,934	6,000
Nigeria	2009	55,800	5,432	2,964	4,239	4,442	5,640	5,054	5,898
Nigeria	2010	33,300	4,255	3,001	3,969	4,347	5,346	5,223	5,987
Nigeria	2011	32,437	3,956	3,279	4,180	4,358	4,683	5,625	6,016
Nigeria	2012	44,002	5,249	3,205	4,155	4,499	4,624	5,360	6,006
Nigeria	2013	43,249	5,169	3,045	4,087	4,480	4,537	5,607	5,999
Nigeria	2014	35,583	4,624	2,965	4,189	4,527	4,661	5,710	6,021
Country	Year	Y + 2	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
Nigeria	2006	56,400	4,835	3,572	4,132	4,114	4,080	3,254	4,624
Nigeria	2007	55,800	5,580	3,551	4,189	4,224	4,412	3,294	4,328
Nigeria	2008	33,300	5,704	3,591	4,367	4,426	4,290	3,497	4,517
Nigeria	2009	32,437	5,432	2,964	4,239	4,442	4,022	3,861	4,587
Nigeria	2010	44,002	4,255	3,001	3,969	4,347	3,876	4,058	4,524
Nigeria	2011	43,249	3,956	3,279	4,180	4,358	3,517	4,211	4,424
Nigeria	2012	35,583	5,249	3,205	4,155	4,499	3,128	4,539	4,377

Country	Year	Y	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
Poland	2006	37,016	5,102	6,458	4,259	4,437	4,760	3,092	6,196
Poland	2007	40,640	5,008	5,962	4,123	4,440	4,931	3,172	6,159
Poland	2008	41,279	5,253	5,902	4,223	4,400	4,981	3,267	5,958
Poland	2009	39,425	4,565	5,878	4,339	4,541	5,102	3,325	6,065
Poland	2010	38,985	4,702	6,128	4,378	4,576	4,949	3,325	6,099
Poland	2011	40,022	4,709	6,060	4,359	4,480	4,928	3,356	6,164
Poland	2012	43,611	4,600	6,034	4,394	4,481	4,899	3,357	6,239
Poland	2013	45,399	4,876	6,035	4,341	4,203	4,247	2,788	5,412
Poland	2014	46,967	4,765	6,172	4,494	4,138	4,649	2,993	5,168
Country	Year	Y + 2	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
Poland	2006	41,279	5,102	6,458	4,259	4,437	4,478	3,023	5,114
Poland	2007	39,425	5,008	5,962	4,123	4,440	4,303	3,202	5,215
Poland	2008	38,985	5,253	5,902	4,223	4,400	4,227	3,249	5,214
Poland	2009	40,022	4,565	5,878	4,339	4,541	4,060	3,328	5,224
Poland	2010	43,611	4,702	6,128	4,378	4,576	4,069	3,556	5,270
Poland	2011	45,399	4,709	6,060	4,359	4,480	4,824	5,137	6,130
Poland	2012	46,967	4,600	6,034	4,394	4,481	4,938	5,059	6,082

Country	Year	Y	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
Romania	2006	33,954	4,458	5,826	4,036	4,007	4,750	5,106	6,148
Romania	2007	32,387	4,643	5,616	4,039	4,134	4,652	5,230	6,172
Romania	2008	29,300	4,852	5,548	4,184	4,104	4,609	4,875	6,107
Romania	2009	30,900	4,552	5,503	4,240	4,288	4,643	5,059	6,124
Romania	2010	31,216	4,495	5,771	4,081	4,316	4,631	5,705	6,128
Romania	2011	35,691	4,519	5,725	3,958	4,098	4,442	5,420	5,471
Romania	2012	38,456	4,828	5,512	3,859	4,011	5,146	5,461	5,371
Romania	2013	39,803	5,142	5,472	3,889	3,964	4,850	5,507	5,443
Romania	2014	41,900	5,196	5,508	4,180	4,043	4,356	5,504	5,564
Country	Year	Y + 2	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
Romania	2006	29,300	4,458	5,826	4,036	4,007	3,990	5,049	5,557
Romania	2007	30,900	4,643	5,616	4,039	4,134	3,954	5,326	5,570
Romania	2008	31,216	4,852	5,548	4,184	4,104	4,060	5,702	5,604
Romania	2009	35,691	4,552	5,503	4,240	4,288	3,650	3,178	5,500
Romania	2010	38,456	4,495	5,771	4,081	4,316	4,276	3,229	5,341
Romania	2011	39,803	4,519	5,725	3,958	4,098	4,295	3,248	5,481
Romania	2012	41,900	4,828	5,512	3,859	4,011	4,122	3,527	5,574

Country	Year	Y	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
Russian Federation	2006	37,290	5,427	5,786	3,837	4,443	3,819	3,552	5,541
Russian Federation	2007	33,879	5,352	5,514	3,939	4,703	3,923	3,745	5,553
Russian Federation	2008	30,323	5,550	5,591	3,905	4,739	4,154	3,803	5,577
Russian Federation	2009	31,278	5,236	5,649	3,748	4,672	4,099	3,392	5,055
Russian Federation	2010	28,224	4,488	5,918	3,575	4,511	4,323	3,437	4,883
Russian Federation	2011	30,286	5,162	5,696	3,599	4,399	4,282	3,789	4,996
Russian Federation	2012	31,143	5,803	5,749	3,625	4,232	4,608	3,969	5,074
Russian Federation	2013	29,062	5,933	5,714	3,803	4,310	4,663	4,017	5,079
Russian Federation	2014	27,806	5,537	5,965	4,086	4,417	4,605	4,178	5,081
Country	Year	Y + 2	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
Russian Federation	2006	30,323	5,427	5,786	3,837	4,443	4,594	4,658	5,118
Russian Federation	2007	31,278	5,352	5,514	3,939	4,703	3,901	3,281	4,584
Russian Federation	2008	28,224	5,550	5,591	3,905	4,739	4,048	3,291	4,233
Russian Federation	2009	30,286	5,236	5,649	3,748	4,672	4,424	3,703	4,381
Russian Federation	2010	31,143	4,488	5,918	3,575	4,511	4,401	3,788	4,493
Russian Federation	2011	29,062	5,162	5,696	3,599	4,399	4,008	3,818	4,407
Russian Federation	2012	27,806	5,803	5,749	3,625	4,232	3,914	3,762	4,391

Country	Year	Y	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
South Africa	2006	27,095	5,189	4,858	4,743	4,040	3,980	4,093	4,414
South Africa	2007	29,846	5,079	3,957	4,732	4,163	3,472	2,862	5,574
South Africa	2008	31,648	5,059	3,841	4,786	4,175	3,597	3,027	5,540
South Africa	2009	35,367	4,620	3,601	4,654	4,152	3,599	3,360	5,711
South Africa	2010	27,116	4,987	4,061	4,478	4,131	3,266	3,449	5,776
South Africa	2011	26,850	4,961	3,959	4,658	4,056	3,177	3,559	5,739
South Africa	2012	27,351	4,630	3,926	4,681	3,940	3,211	3,655	5,732
South Africa	2013	26,565	4,390	3,890	4,753	3,932	3,192	4,134	5,758
South Africa	2014	31,277	4,454	3,958	4,713	3,797	5,161	3,371	5,098
Country	Year	Y + 2	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
South Africa	2006	31,648	5,189	4,858	4,743	4,040	5,194	3,567	4,891
South Africa	2007	35,367	5,079	3,957	4,732	4,163	5,225	3,702	4,769
South Africa	2008	27,116	5,059	3,841	4,786	4,175	5,434	3,687	4,860
South Africa	2009	26,850	4,620	3,601	4,654	4,152	5,299	3,480	4,818
South Africa	2010	27,351	4,987	4,061	4,478	4,131	5,483	3,597	4,814
South Africa	2011	26,565	4,961	3,959	4,658	4,056	5,717	4,012	4,850
South Africa	2012	31,277	4,630	3,926	4,681	3,940	3,718	3,255	5,160

Country	Year	Y	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
Turkey	2006	28,300	4,293	5,801	4,467	3,529	4,403	3,395	4,966
Turkey	2007	28,941	4,655	5,313	4,538	3,602	4,112	3,530	5,161
Turkey	2008	23,000	4,791	5,326	4,377	3,566	4,063	3,826	5,218
Turkey	2009	23,928	4,656	5,315	4,298	3,651	4,230	3,855	5,168
Turkey	2010	23,169	4,473	5,649	4,213	3,572	4,260	3,948	5,189
Turkey	2011	19,768	4,758	5,622	4,376	3,507	4,457	4,286	5,276
Turkey	2012	22,246	4,862	5,776	4,555	3,794	5,842	5,435	6,846
Turkey	2013	24,500	4,625	5,860	4,518	3,736	5,675	5,427	6,833
Turkey	2014	23,637	4,834	5,754	4,601	3,477	5,607	5,570	6,911
Country	Year	Y + 2	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
Turkey	2006	23,000	4,293	5,801	4,467	3,529	4,963	5,609	6,933
Turkey	2007	23,928	4,655	5,313	4,538	3,602	4,673	5,096	6,929
Turkey	2008	23,169	4,791	5,326	4,377	3,566	4,866	5,233	6,921
Turkey	2009	19,768	4,656	5,315	4,298	3,651	5,069	5,837	6,931
Turkey	2010	22,246	4,473	5,649	4,213	3,572	3,563	2,594	4,795
Turkey	2011	24,500	4,758	5,622	4,376	3,507	3,827	2,851	4,513
Turkey	2012	23,637	4,862	5,776	4,555	3,794	4,063	3,118	4,413

Country	Year	Y	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
United States	2006	10,420	4,855	6,256	5,548	5,803	4,051	3,454	4,554
United States	2007	11,068	4,780	5,996	5,317	5,706	4,210	3,582	4,555
United States	2008	11,870	4,989	5,971	5,324	5,792	4,004	3,506	4,588
United States	2009	13,035	4,307	5,875	5,131	5,765	3,852	3,334	4,630
United States	2010	10,972	4,393	6,117	4,809	5,633	4,250	2,469	4,168
United States	2011	12,233	4,489	6,052	4,798	5,570	4,485	2,642	4,031
United States	2012	13,639	3,969	6,111	4,881	5,368	4,525	2,871	4,415
United States	2013	13,778	3,953	6,101	4,933	5,370	4,369	2,913	4,488
United States	2014	13,340	4,015	6,057	5,050	5,305	3,989	3,038	4,646
Country	Year	Y + 2	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
United States	2006	11,870	4,855	6,256	5,548	5,803	3,885	3,077	4,587
United States	2007	13,035	4,780	5,996	5,317	5,706	4,073	3,076	4,628
United States	2008	10,972	4,989	5,971	5,324	5,792	5,518	5,533	5,082
United States	2009	12,233	4,307	5,875	5,131	5,765	5,630	5,654	4,946
United States	2010	13,639	4,393	6,117	4,809	5,633	5,566	6,008	5,058
United States	2011	13,778	4,489	6,052	4,798	5,570	4,904	6,016	5,117
United States	2012	13,340	3,969	6,111	4,881	5,368	4,714	5,992	5,102

Country	Year	Y	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
Vietnam	2006	70,300	5,304	5,790	3,954	4,434	4,859	6,130	5,104
Vietnam	2007	71,300	5,077	5,144	4,070	4,478	4,961	5,979	5,115
Vietnam	2008	78,200	4,913	5,291	4,174	4,521	5,945	4,675	4,374
Vietnam	2009	79,500	3,864	5,282	4,198	4,696	5,913	4,646	4,174
Vietnam	2010	68,300	4,468	5,740	4,212	4,762	5,680	4,982	4,222
Vietnam	2011	76,945	4,776	5,658	4,158	4,598	4,598	5,266	4,264
Vietnam	2012	86,113	4,164	5,775	4,126	4,515	3,787	4,992	4,195
Vietnam	2013	89,715	4,439	5,783	4,251	4,405	3,435	5,343	4,118
Vietnam	2014	83,555	4,658	5,860	4,241	4,375	3,599	5,820	4,129
Country	Year	Y + 2	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
Vietnam	2006	78,200	5,304	5,790	3,954	4,434	5,458	5,737	2,813
Vietnam	2007	79,500	5,077	5,144	4,070	4,478	5,561	5,769	2,301
Vietnam	2008	68,300	4,913	5,291	4,174	4,521	5,309	5,651	2,360
Vietnam	2009	76,945	3,864	5,282	4,198	4,696	3,987	5,566	2,493
Vietnam	2010	86,113	4,468	5,740	4,212	4,762	3,253	5,987	2,369
Vietnam	2011	89,715	4,776	5,658	4,158	4,598	3,575	6,208	2,316
Vietnam	2012	83,555	4,164	5,775	4,126	4,515	3,738	5,990	2,361

APPENDIX B

ICT-RELATED SUB-PILLARS DATASET

Country	Country Rank	Year	Y	Avlb. of sci. and eng., 1-7 (best)	FDI & tech. TRNS., 1-7 (best)	Firm-lvl tech. absrp., 1-7 (best)	Fixed brdbnd Int. sbscrp./100 pop.*	Gov't proc. of adv. tech prdcts, 1-7 (best)	Qlty. of sci. res. inst., 1-7 (best)
Brazil	1	2006	16,773	4,405272306	5,238710569	4,857165073	1,7725	3,848711907	4,184087644
Brazil	1	2007	14,655	4,422935163	5,114728927	4,894458902	1,7725	3,63261878	4,25939997
Brazil	1	2008	13,871	4,40622564	5,156098473	5,251515663	3,135230303	3,39350243	4,325699351
Brazil	1	2009	14,336	4,235400443	5,301884141	5,4060819	5,199037552	3,684079574	4,222827799
Brazil	1	2010	11,271	4,046240806	5,188665714	5,181972964	7,505627632	3,92686391	4,188443797
Brazil	1	2011	11,109	3,756770521	5,082924636	5,156306431	7,225947205	3,883338283	4,1368731
Brazil	1	2012	11,741	3,480585826	5,15782913	5,154537725	8,558939667	3,760751986	4,115646721
Brazil	1	2013	11,716	3,411287755	5,1458807	4,999347565	9,168616425	3,489463754	4,257830607
Brazil	1	2014	12,468	3,308974568	4,938651445	4,770460479	10,07719955	3,368312847	4,031151079
China	2	2006	36,800	4,184322127	4,527114258	5,030187442	2,8502	4,522868974	3,739879325
China	2	2007	39,200	4,164934959	4,548228043	5,000120614	2,8502	4,257853209	3,976748162
China	2	2008	41,400	4,47224867	4,728748117	5,149103518	3,846677065	4,220002565	4,429279275
China	2	2009	37,800	4,613433175	4,697501821	5,142350608	6,238519192	4,43339945	4,427559002
China	2	2010	27,900	4,6223686	4,570518413	4,949624828	7,701350689	4,537353391	4,321955856
China	2	2011	29,737	4,630617793	4,568914179	4,910625741	9,418749655	4,43867389	4,31204331
China	2	2012	28,509	4,437976129	4,574331838	4,749620978	11,61257248	4,430297812	4,183871507
China	2	2013	27,213	4,459376524	4,541019833	4,689412952	12,9746388	4,381084595	4,303633905
China	2	2014	26,321	4,409803042	4,468837223	4,65800238	13,63406195	4,295115128	4,339201378
France	3	2006	26,234	6,033182212	4,813120059	5,210617791	15,647	4,849093571	5,284120595
France	3	2007	26,901	5,68224228	4,878057734	5,386611295	15,647	4,52668064	5,177741157
France	3	2008	26,628	5,550549846	5,061585282	5,566152456	20,93279457	4,253958118	5,352520462
France	3	2009	26,384	5,269297928	4,973954433	5,512682739	28,55892944	4,002067835	5,22186122
France	3	2010	23,049	5,26112855	4,9355247	5,62014	31,11512566	3,96095115	5,18165075
France	3	2011	25,576	5,309134338	4,943601617	5,617275706	33,92398927	3,974308258	5,348092603
France	3	2012	27,303	4,908420374	4,767403382	5,489869235	36,11830036	3,823442512	5,462352664
France	3	2013	29,794	4,786866371	4,600376381	5,460180865	37,75738945	3,597037522	5,590369219
France	3	2014	29,698	4,834122128	4,814563794	5,450530385	38,79219701	3,754958386	5,560466147

Country	Country Rank	Year	Y	Avlb. of sci. and eng., 1-7 (best)	FDI & tech. TRNS., 1-7 (best)	Firm-lvl tech. absrp., 1-7 (best)	Fixed brdbnd Int. sbscrp./100 pop.*	Gov't proc. of adv. tech prdcts, 1-7 (best)	Qlty. of sci. res. inst., 1-7 (best)
Germany	4	2006	40,155	5,689894419	4,547819987	5,751762601	12,94	4,606418605	5,773811779
Germany	4	2007	44,900	5,435691476	4,920456129	5,97530426	12,94	4,638136836	5,81811021
Germany	4	2008	46,700	4,922892983	4,966264188	6,005715207	18,13442612	4,038291968	5,750066138
Germany	4	2009	47,248	4,627679475	4,656037634	6,001994787	27,38258362	3,933525157	5,773699287
Germany	4	2010	40,651	4,819620275	4,499139036	5,996245299	30,42596245	4,207274782	5,868093175
Germany	4	2011	45,201	4,472082885	4,321015096	5,932377396	31,59079136	4,180340433	5,594990302
Germany	4	2012	48,275	4,532774382	4,551438518	5,876009094	32,47152424	4,29620643	5,613789022
Germany	4	2013	48,863	4,917981928	4,756672007	5,774959143	34,03660338	4,258428963	5,780365857
Germany	4	2014	47,845	4,916253011	4,850197142	5,742040279	34,57588492	4,191609575	5,781352292
Greece	5	2006	22,600	5,502044773	4,400185798	4,329691066	1,4399	3,56072515	3,634758492
Greece	5	2007	18,669	5,405025272	4,404314077	4,37059266	1,4399	3,253340779	3,612381443
Greece	5	2008	22,600	5,221033938	4,422421098	4,370062124	4,382060051	3,178567264	3,756720304
Greece	5	2009	23,106	5,078564074	4,265726067	4,335975178	13,48593426	3,292415785	3,62198803
Greece	5	2010	18,832	5,012807785	4,050376292	4,437762431	17,17205048	3,161981523	3,295826231
Greece	5	2011	18,987	5,00602133	4,037087834	4,556126857	19,83083357	3,008785398	3,29220841
Greece	5	2012	23,458	5,204006933	3,919090139	4,435031738	21,63542838	2,663071538	3,329444884
Greece	5	2013	27,508	5,378378102	4,006442563	4,483509945	23,51679386	2,436500581	3,597886536
Greece	5	2014	30,316	5,37885411	4,132242409	4,533262667	26,15094011	2,564108572	3,738390126
India	6	2006	21,200	6,294070362	5,286329132	5,642630252	0,11782	3,979173153	5,220490974
India	6	2007	22,000	5,916650553	5,280204369	5,58280543	0,11782	3,605370333	5,058263872
India	6	2008	21,200	5,668602497	5,355223041	5,521824616	0,205441803	3,363289195	4,838241659
India	6	2009	24,000	5,620573389	5,35515651	5,466723424	0,445124269	3,57042661	4,886831225
India	6	2010	20,588	5,151688034	5,122748938	5,315501995	0,646551669	3,532268842	4,695717936
India	6	2011	21,176	4,934047662	4,98516034	5,27598521	0,897425398	3,499611002	4,512604737
India	6	2012	26,545	5,038577432	4,898605011	5,238594962	1,033433998	3,433148832	4,445439346
India	6	2013	24,157	5,032914014	5,041993525	5,048564553	1,136884727	3,280235596	4,488521688
India	6	2014	24,857	4,360397674	4,222817639	4,193338995	1,16121238	3,547178841	4,006839648

Country	Country Rank	Year	Y	Avlb. of sci. and eng., 1-7 (best)	FDI & tech. TRNS., 1-7 (best)	Firm-lvl tech. absrp., 1-7 (best)	Fixed brdbnd Int. sbscrp./100 pop.*	Gov't proc. of adv. tech prdcts, 1-7 (best)	Qlty. of sci. res. inst., 1-7 (best)
Indonesia	7	2006	33,000	4,771284667	5,609341153	4,337014636	0,0184	4,230612477	4,358597009
Indonesia	7	2007	30,879	5,052081807	5,923055129	4,700257868	0,0184	3,644690555	4,697195882
Indonesia	7	2008	29,362	4,852512569	5,31827435	4,785550072	0,08620736	3,377172251	4,364469106
Indonesia	7	2009	29,764	4,725609119	5,030004486	4,81452598	0,127128541	4,054496354	4,204305068
Indonesia	7	2010	24,125	4,697344431	4,917403675	4,884576048	0,739243805	4,211262891	4,156438938
Indonesia	7	2011	24,726	4,42868945	4,72494285	4,9833524	0,792217692	4,1126311	3,93564335
Indonesia	7	2012	26,182	4,321424539	4,755805964	4,947889639	1,129215638	4,044074638	3,877224323
Indonesia	7	2013	23,969	4,478834554	4,958809006	5,08139904	1,218699533	4,1190772	4,131708194
Indonesia	7	2014	23,613	4,621474614	4,911354151	5,056921563	1,301419482	4,22134434	4,260181263
Japan	8	2006	14,266	6,218632546	4,667454068	6,282020997	17,461	4,918126441	5,711032506
Japan	8	2007	16,076	5,946450348	5,026995565	6,245513937	17,461	4,494549652	5,555380595
Japan	8	2008	17,651	5,855096281	5,207894845	6,294920145	20,62008476	3,943483842	5,442394444
Japan	8	2009	17,447	5,885174903	4,953709881	6,358788409	23,53274727	3,884279326	5,343193897
Japan	8	2010	12,528	5,801348399	4,713498092	6,254964956	24,93710709	4,101902806	5,321853351
Japan	8	2011	16,622	5,811909387	4,700087228	6,272495927	26,91357758	4,124677141	5,544706992
Japan	8	2012	16,451	5,744257201	4,6893791	6,16433231	27,3649502	3,829900425	5,599741304
Japan	8	2013	15,733	5,487274419	4,781856205	6,06413142	27,91600891	3,913306586	5,692491927
Japan	8	2014	17,525	5,440106076	4,73321413	6,082431621	28,83709257	4,090745132	5,806639849
Korea, Rep.	9	2006	42,498	5,189476267	4,652512886	5,855797594	25,243	4,695215737	5,027947919
Korea, Rep.	9	2007	43,226	5,523839573	5,200465916	5,983636237	25,243	5,289888389	5,562285012
Korea, Rep.	9	2008	45,600	5,120780712	5,302342994	5,848850541	29,26598549	5,077432331	5,536983254
Korea, Rep.	9	2009	52,861	4,88420487	4,813570746	5,963073157	31,98103905	4,381930445	5,026161936
Korea, Rep.	9	2010	49,900	4,942174362	4,458957083	6,070856442	33,82498932	4,10306558	4,82422473
Korea, Rep.	9	2011	54,410	4,893004144	4,474863278	6,035117328	36,62977416	4,128741383	4,817100089
Korea, Rep.	9	2012	58,122	4,873900467	4,5017274	5,997026267	36,90536756	3,999426	4,9360446
Korea, Rep.	9	2013	56,836	4,611582677	4,493560374	5,708560161	37,56499246	3,971164297	4,948307047
Korea, Rep.	9	2014	54,953	4,419457635	4,580795013	5,445571761	38,03511736	4,138757426	4,977447102

Country	Country Rank	Year	Y	Avlb. of sci. and eng., 1-7 (best)	FDI & tech. TRNS., 1-7 (best)	Firm-lvl tech. absrp., 1-7 (best)	Fixed brdbnd Int. sbscrp./100 pop.*	Gov't proc. of adv. tech prdcts, 1-7 (best)	Qlty. of sci. res. inst., 1-7 (best)
Mexico	10	2006	29,914	3,906496239	5,348165216	4,333148086	2,1532	3,540776918	3,792487172
Mexico	10	2007	31,898	3,822884827	5,190928941	4,382570253	2,1532	3,306654453	3,805157351
Mexico	10	2008	32,532	3,522020525	4,975412018	4,35519539	2,849840641	3,176809895	3,672031774
Mexico	10	2009	28,275	3,641130833	5,038724766	4,608086119	7,054317474	3,277996576	3,707956149
Mexico	10	2010	27,841	3,77694664	5,03963926	4,514960731	9,051549911	3,276198776	3,801555111
Mexico	10	2011	30,270	3,858007826	5,161852692	4,647296588	9,984762621	3,547664848	3,952081085
Mexico	10	2012	31,569	4,010246769	5,299890453	4,840577795	10,61813159	3,625711787	4,034777744
Mexico	10	2013	32,871	3,996964362	5,253376408	4,762367325	10,94919748	3,561808004	3,998104131
Mexico	10	2014	31,765	3,945498605	5,108003639	4,602774641	11,13899516	3,398001063	3,93985811
Poland	11	2006	37,016	4,681470315	4,85708695	4,437140331	3,2286	3,492131707	3,802974193
Poland	11	2007	40,640	4,251942194	4,638642692	4,509005848	3,2286	3,374824797	3,824076239
Poland	11	2008	41,279	4,126198266	4,928669751	4,664690438	7,561708927	3,662104423	4,070002187
Poland	11	2009	39,425	4,27980364	5,085440654	4,806874435	9,000527382	4,158510958	4,097433494
Poland	11	2010	38,985	4,212956022	5,010533109	4,587385665	13,5675354	3,718723772	4,087299469
Poland	11	2011	40,022	4,081797667	4,990279508	4,345326353	13,1777433	3,293797068	4,110922663
Poland	11	2012	43,611	4,195491427	4,791287763	4,231043362	14,36070739	3,186032688	4,141793193
Poland	11	2013	45,399	4,209040977	4,57905266	4,148533969	16,63096023	3,149977802	3,996545021
Poland	11	2014	46,967	4,169549336	4,627999345	4,197672708	15,60786291	3,241555756	3,876565494
Romania	12	2006	33,954	4,909874122	5,573072123	4,444101641	3,4594	3,570793971	3,454874853
Romania	12	2007	32,387	4,612860771	5,220864423	4,42056011	3,4594	3,483061845	3,682041085
Romania	12	2008	29,300	4,304120294	4,961098202	4,351750696	5,02989006	3,49202553	3,61036597
Romania	12	2009	30,900	4,295836258	4,976102494	4,427780497	11,76	3,441035811	3,533004891
Romania	12	2010	31,216	4,308971345	4,695889859	4,227053772	13,17995548	3,207987331	3,322533614
Romania	12	2011	35,691	4,213949649	4,496879693	4,050447068	13,9623392	3,085183041	3,24578621
Romania	12	2012	38,456	3,82565985	4,25812986	4,13848568	15,3943077	3,080638259	3,425072327
Romania	12	2013	39,803	3,636239171	4,407502682	4,274430814	15,89712354	3,205804339	3,737709518
Romania	12	2014	41,900	4,025758015	4,78012938	4,438736406	17,32831887	3,409858439	3,975764637

Country	Country Rank	Year	Y	Avlb. of sci. and eng., 1-7 (best)	FDI & tech. TRNS., 1-7 (best)	Firm-lvl tech. absrp., 1-7 (best)	Fixed brdbnd Int. sbscrp./100 pop.*	Gov't proc. of adv. tech prdcts, 1-7 (best)	Qlty. of sci. res. inst., 1-7 (best)
Russian Federation	13	2006	37,290	4,818499541	4,047567248	4,415034216	1,1073	3,561379325	4,408279343
Russian Federation	13	2007	33,879	4,866441595	4,116876149	4,148208501	1,1073	3,434496946	4,239580095
Russian Federation	13	2008	30,323	4,755141407	4,406974316	4,149548604	2,034555197	3,59014444	4,284455752
Russian Federation	13	2009	31,278	4,435054175	4,206783804	4,179998211	2,807046413	3,565500176	4,212889714
Russian Federation	13	2010	28,224	4,266049076	3,851079713	4,03559145	9,157141685	3,450106232	3,936045701
Russian Federation	13	2011	30,286	4,048662179	3,702677697	3,818678532	10,98223394	3,298356385	3,841770925
Russian Federation	13	2012	31,143	3,773159354	3,578914676	3,633594546	12,1980224	2,942520647	3,580227912
Russian Federation	13	2013	29,062	3,796675748	3,732093572	3,93735499	14,4763115	3,067404462	3,704957812
Russian Federation	13	2014	27,806	4,063670682	3,770761293	4,246537026	16,61677589	3,341901961	3,958230025
South Africa	14	2006	27,095	3,816394665	5,200641344	5,242049171	0,34848	4,162307978	4,720503857
South Africa	14	2007	29,846	3,624637604	5,316132739	5,380834999	0,34848	3,786548935	4,700381365
South Africa	14	2008	31,648	3,365537701	5,202501867	5,456160682	0,704108536	3,643686307	4,701884382
South Africa	14	2009	35,367	3,089413761	5,051135431	5,432715829	0,778149843	3,429901101	4,676328919
South Africa	14	2010	27,116	3,272196499	5,004280178	5,409086531	0,959891677	3,211356816	4,69919224
South Africa	14	2011	26,850	3,40317825	4,9587834	5,5361461	1,482063136	3,2559877	4,6671883
South Africa	14	2012	27,351	3,363060291	4,981375844	5,416569991	1,797464121	3,139079438	4,623968615
South Africa	14	2013	26,565	3,480697298	4,950758555	5,38588572	2,182179896	2,946124675	4,774673055
South Africa	14	2014	31,277	3,540224889	4,77665559	5,434675188	3,060493447	2,955596913	4,717356359
Turkey	15	2006	28,300	4,853548471	4,84633221	5,304248127	2,172	3,626253671	3,816820545
Turkey	15	2007	28,941	4,73798165	4,822209074	5,384982637	2,172	3,585935833	4,03620074
Turkey	15	2008	23,000	4,337476512	4,667694662	5,144940997	3,73938489	3,064290928	4,116239582
Turkey	15	2009	23,928	4,363800306	4,92442249	5,068473916	7,582618237	3,328177149	3,648073172
Turkey	15	2010	23,169	4,47862043	4,803140744	5,124750741	8,536034584	3,717324754	3,264951987
Turkey	15	2011	19,768	4,54415633	4,660895437	5,216484225	9,753433997	3,810422908	3,30972229
Turkey	15	2012	22,246	4,490147081	4,720767048	5,29807736	10,28778865	4,006457235	3,402281349
Turkey	15	2013	24,500	4,39365637	4,869985459	5,343249861	10,54663752	4,120614299	3,747604917
Turkey	15	2014	23,637	4,215400799	5,065239098	5,232132121	11,18712872	4,160164793	3,87412468

Country	Country Rank	Year	Y	Avlb. of sci. and eng., 1-7 (best)	FDI & tech. TRNS., 1-7 (best)	Firm-lvl tech. absrp., 1-7 (best)	Fixed brdbnd Int. sbscrp./100 pop.*	Gov't proc. of adv. tech prdcts, 1-7 (best)	Qlty. of sci. res. inst., 1-7 (best)
United States	16	2006	10,420	5,581663935	4,814105876	6,124521394	16,562	4,789038673	6,198869028
United States	16	2007	11,068	5,600429834	5,234707989	6,109470226	16,562	4,942811395	6,126926324
United States	16	2008	11,870	5,548356858	5,329761084	6,262109907	20,10503197	4,930748699	6,300478193
United States	16	2009	13,035	5,603006204	5,124637571	6,229600364	25,58761787	4,76670365	6,18006197
United States	16	2010	10,972	5,670031255	4,901960362	6,018644875	27,10463142	4,716714934	5,951648443
United States	16	2011	12,233	5,529316438	4,904797114	5,901782335	26,33641351	4,663319961	5,82672686
United States	16	2012	13,639	5,41542282	4,899215156	5,89908103	28,74615225	4,442290037	5,757287459
United States	16	2013	13,778	5,345655352	4,87074308	5,993592573	28,03117264	4,337732131	5,954548299
United States	16	2014	13,340	5,316883235	4,866901306	6,065735869	28,53985179	4,353444529	6,112350215
Vietnam	17	2006	70,300	4,735313697	5,048338033	5,210388982	0,24932	4,089188232	3,186698518
Vietnam	17	2007	71,300	4,534769894	5,085154258	5,084754386	0,24932	3,993459671	3,367702048
Vietnam	17	2008	78,200	4,489062398	5,036968366	5,072924127	0,605277956	4,193262113	3,607572266
Vietnam	17	2009	79,500	4,205438021	5,031203328	5,078780738	1,481096506	4,475264084	3,715836653
Vietnam	17	2010	68,300	4,099581994	5,058684219	4,960471348	3,007872343	4,390521626	3,769617394
Vietnam	17	2011	76,945	4,09187108	4,7807367	4,56123506	4,133705497	4,03535164	3,54812594
Vietnam	17	2012	86,113	4,01552035	4,26664855	3,9835433	4,322693681	3,9233495	3,40427915
Vietnam	17	2013	89,715	3,827813171	4,121621171	3,764953463	4,955518134	3,976501151	3,400202146
Vietnam	17	2014	83,555	3,810444668	4,234785073	3,89192354	5,618908162	3,865781488	3,270583627
Nigeria	18	2006	64,500	4,334172234	4,999271115	4,113224785	0,00038014	4,269028995	3,690016256
Nigeria	18	2007	57,900	4,171649924	5,127325758	4,439403016	0,00038014	3,859222495	3,946029293
Nigeria	18	2008	56,400	4,670959252	4,853756706	4,621025392	0,000380144	2,666940228	3,625208104
Nigeria	18	2009	55,800	4,505664814	4,483536471	4,683794043	0,016887587	2,965705279	2,884751043
Nigeria	18	2010	33,300	3,94128478	4,39254788	4,672678116	0,052968778	3,16323528	2,824856695
Nigeria	18	2011	32,437	4,057728429	4,327220665	4,685505376	0,062559026	3,246025223	3,238316935
Nigeria	18	2012	44,002	4,072551388	4,315351745	4,7482244	0,132746982	3,647247688	3,23275087
Nigeria	18	2013	43,249	3,963756525	4,535978695	4,611105803	0,008569317	3,443881863	3,09927539
Nigeria	18	2014	35,583	3,776970727	4,547455879	4,337897734	0,008665709	2,975706356	2,803376804

Country	Country Rank	Year	Y	Avlb. of sci. and eng., 1-7 (best)	FDI & tech. TRNS., 1-7 (best)	Firm-lvl tech. absrp., 1-7 (best)	Fixed brdbnd Int. sbscrp./100 pop.*	Gov't proc. of adv. tech prdcts, 1-7 (best)	Qlty. of sci. res. inst., 1-7 (best)
Netherlands	19	2006	71,220	5,090974064	4,938812636	5,215261107	25,155	4,397999777	5,484306637
Netherlands	19	2007	74,178	4,98747707	5,256418477	5,451701208	25,155	4,420468696	5,573653833
Netherlands	19	2008	75,302	4,938754268	5,204797663	5,493473875	31,78768158	4,029277665	5,689781088
Netherlands	19	2009	76,857	5,00059679	4,952425497	5,516383168	34,9908371	4,096283174	5,703368536
Netherlands	19	2010	69,298	4,971904663	5,034575043	5,607566091	35,57055969	4,322419329	5,630634019
Netherlands	19	2011	87,216	4,984651461	5,025439998	5,722105194	37,97029168	4,282586802	5,680646903
Netherlands	19	2012	93,855	4,819149349	5,007902741	5,757515156	38,74046445	4,216104187	5,739635556
Netherlands	19	2013	101,190	4,477298374	4,969048543	5,682523817	39,43945242	4,107681975	5,756698399
Netherlands	19	2014	100,690	4,623228517	4,967727942	5,630732889	40,07894397	4,002322335	5,866153548
Ireland	20	2006	79,352	5,45926048	6,394269235	5,573768668	6,526	4,198984844	5,158742949
Ireland	20	2007	84,700	5,437922078	6,376883117	5,536233766	6,526	4,167200541	5,391078649
Ireland	20	2008	81,000	5,278236478	6,338048912	5,489895306	14,2972517	3,921032292	5,340618215
Ireland	20	2009	80,947	5,254373104	6,258050387	5,434358252	20,35002518	3,738981796	5,297939872
Ireland	20	2010	90,775	5,133650105	6,256190871	5,451425638	21,62311554	3,563563367	5,287778581
Ireland	20	2011	103,941	4,938260499	6,380465289	5,487990047	22,81849706	3,433447388	5,290608332
Ireland	20	2012	107,626	4,908429947	6,433687106	5,530970686	22,0804622	3,461097532	5,483525131
Ireland	20	2013	109,982	4,864377096	6,322436791	5,617709735	22,70170224	3,483397745	5,579141918
Ireland	20	2014	109,137	4,954112685	6,369658231	5,562296392	24,23836325	3,526819065	5,497522669
Iceland	21	2006	31,521	5,548333333	4,126666667	6,365	26,536	4,038300493	4,622413793
Iceland	21	2007	32,598	5,29143663	4,467357659	6,49106293	26,536	4,044577243	4,654621711
Iceland	21	2008	35,310	5,264552036	4,507689938	6,562285391	29,53147125	4,414399513	4,982992116
Iceland	21	2009	44,711	5,39466945	4,36966535	6,49881205	32,910923	4,2884474	4,9455515
Iceland	21	2010	52,266	5,658320857	4,531932509	6,494471726	33,20948029	4,320472789	4,951158898
Iceland	21	2011	56,319	5,44204134	4,574095048	6,33088638	34,64527576	4,360671095	5,111791328
Iceland	21	2012	58,209	5,031931324	4,2634703	6,262548879	33,91539187	4,034378424	5,015274009
Iceland	21	2013	59,000	4,668656209	3,774717596	6,190864653	34,45124737	3,663751335	4,877043741
Iceland	21	2014	57,520	4,567246502	3,743754757	6,172418016	35,14831505	3,553912708	4,823808489

APPENDIX C

CORRELATION BETWEEN ICT USAGE SUB-PILLARS IN A ONE-YEAR LAG MODEL

```
. correlate Y Availabilityofscientistsanden FDIandtechnologytransfer17 Firmleveltechnologyabsorption FixedbroadbandInternetsubscrip Govtprocu
> rementofadvancedtec Qualityofscientificresearchin
(obs=168)
```

	Y	Availa~n	FDIan~17	Firmle~n	Fixedb~p	Govtpr~c	Qualit~n
Y	1.0000						
Availabili~n	-0.0352	1.0000					
FDIandtec~17	0.3049	0.1126	1.0000				
Firmlevelt~n	0.0420	0.5582	0.2258	1.0000			
Fixedbroad~p	0.2648	0.4393	-0.1074	0.5930	1.0000		
Govtprocur~c	0.0917	0.4147	0.1010	0.5926	0.3725	1.0000	
Qualityofs~n	0.1430	0.5604	0.3122	0.8009	0.6642	0.5806	1.0000

APPENDIX D

CORRELATION BETWEEN ICT USAGE SUB-PILLARS IN A TWO-YEAR LAG MODEL

```
. correlate Y Availabilityofscientistsanden FDIandtechnologytransfer17 Firmleveltechnologyabsorption FixedbroadbandInternetsubscrip Govtprocu
> rementofadvancedtec Qualityofscientificresearchin
(obs=147)
```

	Y	Availa~n	FDIan~17	Firmle~n	Fixedb~p	Govtpr~c	Qualit~n
Y	1.0000						
Availabili~n	-0.0124	1.0000					
FDIandtec~17	0.3243	0.0971	1.0000				
Firmlevelt~n	0.0524	0.5561	0.2098	1.0000			
Fixedbroad~p	0.2822	0.4942	-0.0885	0.6005	1.0000		
Govtprocur~c	0.0897	0.3720	0.0624	0.5743	0.3837	1.0000	
Qualityofs~n	0.1616	0.5562	0.2719	0.8066	0.6923	0.5539	1.0000

REFERENCES

Altomonte, C., Aquilante, T., Békés, G., & Ottaviano, G. I. P. (2013). Internationalization and Innovation of Firms: Evidence and Policy. *European Trade Study Group.* Retrieved from <http://www.etsg.org/ETSG2013/Papers/301.pdf>

Banomyong, Ruth. (2010). Supply Chain Dynamics in Asia. *Asian Development Bank Institute.* 184. January.

Bascavusoglu-Moreau, E., & Colakoglu, M. (2011). Impact of SMEs Policies on Innovation Capabilities: The Turkish Case. *TEKPOL Working Paper Series 11* (05).

Bayraktar, E., Demirbag, M., Koh, S. C. L., Tatoglu, E., & Zaim, H. (2009). A Causal Analysis of the Impact of Information Systems and Supply Chain Management Practices on Operational Performance: Evidence from Manufacturing SMEs in Turkey. *International Journal of Production Economics, 122,* 133-149.

Bellamy, C. (2002). From automation to knowledge management: Modernizing British government with ICTs, *International Review of Administrative Sciences 68(2),* 213-230.

Brynjolfsson, E., & Hitt, L. M. (2000). Beyond Computation: Information Technology, Organizational Transformation and Business Performance. *Journal of Economic Perspectives, 14 (4) 4,* 23–48.

Boston Consultancy Group. (2013). Ahead of the Curve. Retrieved from <http://www.bcg.com.cn/en/files/publications/reports_pdf/BCG_Ahead_of_the_Curve_Oct_2013.pdf>

Christopher, M., & Towill, D. (2001). An Integrated Model for the Design of Agile Supply Chains. *International Journal of Physical Distribution & Logistics Management 31(4):* 235–246.

Colecchia, A., & Schreyer, P. (2001). ICT Investment and Economic Growth in 1990s. *OECD Science, Technology and Industry Working Papers,* (2011) 7.

Damaskopoulos, P., & Evgeniou, T. (2003). Adoption of New Economy Practices in SMEs in Eastern Europe. *European Management Journal, 21(2),* 133-145.

Didone, S., & Diaz, G. (2012). Supply Chain Management Practices as a Support to Innovation in SMEs. *Journal of Technology Management and Innovation, 7(3),* 91-109.

Dhanaraj, C., & Beamish, P.W. (2003). A Resource-Based Approach to the Study of Export Performance. *Journal of Small Business Management, 41 (3),* 242-261.

Eagan, T., Clancy, S., & O'Toole, T. (2003). The Integration of E-commerce Tools into the Business Processes of SMEs. *Irish Journal of Management, 24,* 139-153.

European Commission. (2013). Fact and figures about the EU´s Small and Medium Enterprise (SME). Retrieved from http://ec.europa.eu/enterprise/policies/sme/facts-figures-analysis/index_en.htm

Freund, C., & Weinhold, D. (2004). The Effect of the Internet on International Trade. *Journal of International Economics, 62(1),* 171-189.

Giunta, A., & Trivieri, F. (2007). Understanding the determinants of Information Technology Adoption: Evidence from Italian Manufacturing Firms. *Applied Economics, 39(10),* 1325-1334.

Global Competitiveness Index. (2013). Retrieved from http://www.weforum.org/issues/global-competitiveness

Global Innovation Index. (2043). Retrieved from http://www.globalinnovationindex.org/content.aspx?page=GII-Home

Goto, A. & Suzuki, K. (1989). R&D Capital, Rate of Return on R&D Investment and Spillover of R&D in Japanese Manufacturing Industries. *Review of Economics and Statistics, 71,* 555–564.

Griliches, Z. (1998). Introduction to R&D and Productivity: The Econometric Evidence. ISBN 0-226-30886-3, *University of Chicago Press,* 1-45.

Haller, S. A., & Siedschlag, I. (2011). Determinants of ICT Adoption: Evidence from Firm-level Data. *Applied Economics, 43(26),* 3775-3788.

Hagsten, Eva. (2014). Distributed Access to Linked Microdata: the Example of ICT and Exports. *ETSG 16th Annual Conference in Munich 2014*. Retrieved from http://www.etsg.org/ETSG2014/Papers/424.pdf

ICT Development Index. (2013). Retrieved from http://www.itu.int/en/ITU-D/Statistics/Pages/default.aspx

IT Industry Competitiveness Index. (2011). Retrieved from http://globalindex11.bsa.org/

IT Industry Competitiveness Index Turkey Report (2011). Retrieved from http://globalindex11.bsa.org/upload/summaries/media/#turkey

Kotnik, P., Hagsten, E., & Sweden, S. (2013). *ICT as Enabler of Exports*. Retrieved from https://scholar.googleusercontent.com/scholar?q=cache:cMKbhKiTGGAJ:scholar.google.com/+ICT+as+Enabler+of+Exports+patricia+kotnik&hl=tr&as_sdt=0,5&as_vis=1

Lecerf, M. (2012). Internationalization and Innovation: The Effects of a Strategy Mix on the Economic Performance of French SMEs. *International Business Research Vol.5 No.6*

Mathews, S. & Bianchi, C. (2010). The Role of the Internet on International Market Growth of Australian firms: An Exploratory Study. *In: Proceedings of the Australia and New Zealand International Business Academy (ANZIBA) Conference 2010,* 15-17 April 2010, Sydney, Australia.

Neary, J. P. (2009). Putting "New" into New Trade Theory: Paul Krugman's Nobel Prize in Economics. *Scandinavian Journal of Economics 111 (2),* 217-250, 2009

New Zealand Statistical Office. (2013). Strong Connection Between ICT and Business-Growth Activities. (2013). Retrieved from http://www.stats.govt.nz/browse_for_stats/businesses/business_growth_and_innovation/ict-use-business-characteristics.aspx

OECD Science, Technology and Industry Scoreboard. (2013). Retrieved from http://www.oecd.org/sti/scoreboard.htm

Özkanlı, Ö., Benek, S., & Akdeve, E. (2006). Export Barriers of Small Firms in Turkey: A Study of Ankara-Ivedik Industrial District. *Problems and Perspectives in Management. 4(3).*

Scupola, A. (2003). The Adoption of Internet Commerce by SMEs in the South of Italy: An Environmental, Technological and Organizational Perspective. *Journal of Global Information Technology Management, 6 (1),* 52-71.

Scupola, A. (2009). SMEs' E-commerce Adoption: Perspectives from Denmark and Australia. *Journal of Enterprise Information Management,* 22 (1-2).

Tektas, A., Gunay, E. N., Karatas, A., & Helvacioglu, A. D. (2008). ICT Capability and Innovation Utilization in Turkish SMEs: The Case of Machinery Industry. *Communications of the IBIMA, Volume 5,* 34-41.

Thompson, F. (1998). Fordism, Post-Fordism and the Flexible System of Production. Retrieved from http://www.willamette.edu/~fthompso/MgmtCon/Fordism_&_Postfordism.html