TÜBİSAD TURKEY'S DIGITAL TRANSFORMATION INDEX 2020

TÜBİSAD
INFORMATICS INDUSTRY ASSOCIATION

TUBISAD's "Turkey's Digital Transformation Index" is prepared by Assoc. Prof. Ümit İZMEN, Prof. Dr. Yeşim ÜÇDOĞRUK GÜREL, and Assoc. Prof. Yılmaz KILIÇASLAN. The study aims to examine and document the challenges and opportunities facing the Turkish economy and society in the digitalization process. With this project, TUBİSAD would like to contribute to Turkey to take the right and timely measures and adopt a target-oriented approach for achieving digital transformation.

We would like to thank;

- TUBISAD's board members,
- Digital Economy Commission Heads Mehmet Ali AKARCA and Serdar URÇAR
- Sector representatives who have answered the surveys
- Representatives of the private sector and public institutions who have contributed greatly to the in-depth interviews

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Contents

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PREFACE

As TUBISAD, we continue our work in many areas for Turkey to benefit from the opportunities of what the digital age can bring. Developments in the field of information and communication technologies will lead to more important transformations than ever in all areas of economic and social life. It will not be possible for any sector or country to be out of this process. Those who cannot realize the opportunities created by the digital age and cannot adapt themselves to the dynamics will fall behind the times.

TÜBİSAD publishes original reports prepared as a result of its efforts to determine the position and development of our country in the information and communication technologies sector. The report "Informatics for Breakthrough - Turkey's Information and Communication Technology Sector for Economic Breakthrough Strategy 2023" to prove the importance of the information and communication technologies sector for Turkey to achieve its growth target was published in 2013. Published in 2018, "Turkey's Transformation to Digital Economy, Turkey's IT Sector: Place, Importance, Evolution and Capabilities" study assessed the period from 2009 to 2015 and found the progress made was not enough for digital transformation. Turkey's development pace was slow in some areas, but quick in others. This situation presented various opportunities and threats in several areas. The pace and pervasiveness of digital change required a holistic assessment in this field. For this purpose, TÜBİSAD launched this study, to consider all different aspects of digital transformation and summarize them to a single index number.

'Turkey's Digital Transformation Index' which is calculated out of 64 indicators in 10 different pillars under main sub-indices of Environment, Readiness, Usage, and Impact; will make it possible to identify how ready Turkey is for digital transformation, whether the digital transformation performance improves or not, and the areas in which it is better and in which there is need for more work. The index which is prepared by data from 139 countries as well as variables from a survey conducted by TUBİSAD among the IT industry experts will be updated annually. The report will help to evaluate Turkey's position in global digital transformation.

Index calculations show that although Turkey's digitalization performance has improved compared to the previous years, it is still mediocre. For Turkey to catch up with the digital age it needs to speed up and especially make considerable progress in areas such as digital skills and transition to the digital economy.

We would like to express our gratitude to the public institutions and sector representatives who completed our survey and took the time to share their valuable opinions with us. Their contributions played a huge role in the quality of the study. We were delighted to see that there was a very high awareness of the importance of digitalization, both in the industry and in the public. We believe that this awareness will bring important transformations in the digital economy in the upcoming period.

In a time when the dizzying speed of technology leads to pronounced changes in short periods, solutions for today's problems will not be the solution to the problems we will be facing in the future. What will help us in this process is the critical mind that will produce solutions to future problems.

The scope of the transformation requires bringing together different areas of expertise, different accumulations, and different perspectives and exhibiting harmonious and agile management in this process. This puts a great responsibility on all of us.In order not to fall behind the ICT-based economic transformation in the world and to make the most of the new opportunities, we understand that relying only on the guidance of the state is enough, but that big companies, SMEs, universities, and NGOs should take an active role. As TÜBİSAD, we are ready to take responsibility, as we have done so far.

We believe that the most critical success factor in adapting to the digitization process will be the vision adopted at the highest level of the state. We will be able to move our country among the winners of this process as the whole society unite around this vision,

It is our greatest wish that this study will contribute to the right, on-time, and target-driven steps that will help Turkey adapt to this digital transformation.

With Respect,
Chairwoman of the Board, TÜBİSAD
Kübra Erman KARACA

EXECUTIVE SUMMARY

How digital are we?

This is a question every actor in the economy, whether individuals or institutions, is wondering about. Because digitalization, that is, the ability to produce and use Information and Communication Technologies (ICT) is one of the most important sources of increased productivity. Therefore, individuals, firms, institutions make great efforts to measure and increase their digitalization levels. The most encompassing criterion for digitalization is undoubtedly how much the country's economy and society are digitalized. That is why this report, Turkey's Digitalization Index Report, shows the position of Turkey's economy and society's digitalization in the transition to the Fourth Industrial Revolution.

Turkey's adaptation to the digital transformation for 2019 and 2020 was assessed by a grade out of 5 which is calculated by using 64 indicators related to digitalization. 30 of the 64 indicators were obtained from the answers given to the questions asked in the survey conducted among business members. 34 numerical indicators are taken from various international databases.

There are 4 sub-indices and 10 pillars in Turkey's Digital Transformation Index. A relative index value was calculated for each indicator, pillar, and sub-index using data from 139 countries. Therefore, the index value for any indicator was not only determined by Turkey's level of digitization but by Turkey's relative position compared to other countries. Consequently, the performance presented by the calculated index values can be interpreted that there is still a long way to go in terms of digitalization compared to developed countries and those developing countries that Turkey competes with. Indeed, Turkey's performance is well below average as is evident from the analysis in the first chapter, where Turkey's performance is compared to developed countries and those developing countries that Turkey competes with.

Turkey's Digital Transformation Index was calculated as 2.94 and 3.06 out of 5 for 2019 and 2020, respectively. Considering that the lowest score is 1 and the highest is 5, Turkey's performance is average. The 4% improvement from 2019 to 2020 shows that there is still a considerable amount of progress to be made for Turkey's adaptation to digital transformation. Subcomponents of the index point to the factors that drive Turkey's digital transformation performance down. Turkey's most significant factor that negatively affects the score is the sub-index 'Impact' (2.81 in 2019 and 2.88 in 2020), meanwhile, the 'Readiness' sub-index is the factor that contributes most to the score. Yet, the 'Readiness' sub-index score for 2020 is 3.24.

Analyzing sub-indexes and pillars that constitute the Digitalization index individually portrays different pictures and stories; Turkey's 'Environment' sub-index was calculated as 2.87 in 2019 and 2.95 in 2020. There was a limited improvement from 2019 to 2020. The two pillars of this index score ("political and regulatory environment" and "Business and innovation environment" dimensions have the same weight on the 'Environment sub-index. Yet, the index values of these two pillars are pretty close. But, subcomponents of these pillars are nonhomogeneous. The worst performing subcomponent of the pillar of Environment sub-index," political and regulatory environment", is "Efficiency of the legal system in settling disputes". The index value of this sub-index was calculated at 1.87 in 2019 and 1.96 in 2020. The effectiveness of the legal system for resolving disputes is a serious obstacle to Turkey's digitalization, as it influences all economic and social life. One thing that negatively affects Turkey's "Political and regulatory environment" dimension is the pillar "Efficiency of the legal system in challenging regulations ". The value of this sub-index was calculated at 2.15 for 2020.

The two subcomponents that positively affected Turkey's "Political and regulatory environment" dimension are "Cost for enforcing contract (% of claim)" and "Number of days to enforce a contract". These two pillars were at 4.33 and 3.81 in 2020. It can be concluded that Turkey is relatively good in these two variables. It is known that the implementation cost of the contracts of the enterprises is 25% of the amount requested in the contract in Turkey. With these percentages, Turkey is ranked in the middle amongst the world. In terms of resolutions of commercial sales disputes through the court, Turkey is located in the middle again with 623 days.

Another dimension that is in the Environment sub-index is “Business and innovation environment”. Some factors that disturb the Business and innovation environment are the inadequacy of “Government procurement of advanced technology products” and “University-industry cooperation in the field of ICT” and hardships of “Venture capital availability”. The three pillars that Turkey is relatively good at in the innovation and investment environment are; “Availability of latest technologies”, “the number of procedures to start a business” and “total tax rate”. Total profit of 42% in terms of the cost of businesses places Turkey yet again in the middle. The number of days required to establish a company in Turkey is 7. This number is below the world average. The number of procedures required to establish a company in Turkey is 7, which ranks Turkey in the middle amongst the selected countries.

These indicators show, at the first instance it is the general framework, that is the ecosystem that should be more efficient for Turkey’s digitalization. Improving the innovation and investment environment with the legal and operational framework that the business is subject to when making decisions will have positive effects on business in general and will provide a favorable background for digitalization.

The second sub-index of the digitization index is "Readiness", a sub-index that shows how ready and adequate Turkey is for digitalization. In fact, this is one of two sub-indices that Turkey’s scores are the best. The score for the “Readiness” sub-index for 2019 and 2020 are 3.19 and 3.24, respectively. This sub-index has the highest value in the index. There are three dimensions to the “Readiness” sub-index: "Infrastructure", "Affordability" and "Skills". Among these three dimensions, usage costs contribute positively, while it is not the case for infrastructure and skills.

The worst dimension out of the three that determines the “Readiness” sub-index is “infrastructure”. The three factors that make infrastructure insufficient are "Electricity production", "international internet bandwidth" and "secure internet servers". The world average for annual electricity production per capita is 6947 kWh, meanwhile, it is 3670 kWh in Turkey. Turkey ranked fourth-worst among the selected countries in electricity production per capita. The number of secure internet servers per 1 million people in Turkey is 4.340. Turkey is well behind the average of selected countries, sharing the bottom ranks with South Korea, Brazil, China, Mexico, and India. One of the areas in which Turkey performs worst is "international internet bandwidth per internet user". The worst in this area, with 850 kb/s is Honduras, and the best, with 10 767 264 kb/s is Hong Kong. The world average is 429 665 kb/s and Turkey is well below this average with 94 995 kb/s.

Turkey’s best area in infrastructure is “mobile network coverage”. The best pillar of the “Readiness” sub-index is “affordability”. That is because both “Prepaid mobile cellular tariffs” and “Costliness of ICT infrastructure” are relatively cheap in Turkey. However, there has been a slight deterioration in the affordability of “fixed broadband internet tariffs”.

Another area in which Turkey is not the best in the “Readiness” sub-index is “skills''. Turkey’s worst dimension in skills is “quality of math and science education”. PISA test results confirm that Turkey is not good in this area. Two issues that negatively impact the Readiness of Turkey’s digitalization are “Readiness of the education system to teach ICT skills” and the low number of “Graduates in tertiary education in STEM”. There are 20,21 persons in 1000 20-29-year-olds that graduated from STEM (Science, Technology, Engineering, and Mathematics), which places Turkey fifth from last in this area. The two areas that Turkey is good at are the improvements in the "Literacy rate" and " Secondary education gross enrolment rate". We owe this improvement to the eight-year compulsory education that was put into effect in 1997 and the 12-year compulsory education policies that started in 2012. Nevertheless, Turkey ranked fifth-worst amongst the selected countries with a literacy rate of 97%.

To conclude, although operating costs are cheaper in Turkey, as the country moves forward in digitalization, the inadequacies in sought-after skills and infrastructure will become even more daunting.

The area Turkey is best at digitalization is “Usage”. The calculated 3.16 index value in 2020 for “Usage” sub-index is higher than all the other digitalization sub-indices. "Individual usage", "Business usage" and "Government usage" are three pillars of the usage sub-index. Improvements were observed in all three dimensions compared to last year. Unsurprisingly, business use is more effective than individual and public use. The public sector has the lowest performance. However, in the interviews with public sector officials, it was observed that rapid improvements were on the agenda.

Turkey which ranks 3rd after Mexico and Brazil in the individual use of the internet, only 71.04% of the population is individual Internet users. The household computer ownership ratio in Turkey is 57.25%. With that figure Turkey is well below selected countries, ranking fourth worst.

The two worst sub-dimensions in individual use are “mobile phone subscription” and “mobile broadband internet membership”. With 97.30 mobile phones per 100 people, Turkey ranks third worst, just after India and Mexico. However, with only 16.28 membership for fixed broadband internet in 100 people, Turkey is still below the average of selected countries located at the bottom of the list. Just like fixed broadband internet membership, with 74.20 mobile broadband membership of every 100 people, Turkey is located at the bottom against selected countries.

The area that Turkey is best in individual use is “the use of virtual social networks (Facebook, Twitter, LinkedIn, etc.)”. The second-best area is “Households with Internet access,”. We cannot say that both findings are very surprising. 83.79% of households in Turkey have internet access. This places Turkey in the middle against selected countries. Our findings show that the use of ICT in business is quite good. It can be said that the business is especially good in terms of " Business-to-consumer Internet use " and " ICT use for business-to-business transactions ". The worst area of business usage pillar is related to patent applications. The patent application for every 1 million people in Turkey is 19.17, well below the average of the selected countries. This number is even lower in patent applications in the field of ICT. Turkey ranked fourth-worst after Mexico, India, and Brazil in patent applications in the ICT field, with 1.68 per 1 million people.

Finally, when we look at the public usage of ICT, the first finding that we encounter is that the public is quite good at providing public services online. The “Online Public Services Index” value is 3.97 for 2020. On the other hand, by the evaluation of online government services by the Online Public Utilities Index (between 0-1 points), Turkey ranked below the average of the selected countries with 0.71 coming at fifth from last. While the worst performance in this indicator is Chad with 0.13, the best performance belongs to Denmark with 0.92.

Usage intensity expressed by the Index findings indicates the risks as well as advantages that Turkey is facing in the digitization process. Given Turkey doesn’t produce the products and services in information and communication technologies, growing usage of them may result in dependence on foreign sources.

Indeed, the digital transformation component refers to this risk. Turkey's worst area in digitization is the "Impact" sub-index. Impact sub-index for Turkey's is calculated as 2.88 for 2020. The "Impact" sub-index has two sub-dimensions: " Economic impacts " and " Social impacts ". When we examine the sub-dimensions of this sub-index, we can say that the digitalization of the society is more advanced than the digitalization of the economy thanks to the e-Government applications and digital applications in several services.

Turkey has two areas in "Economic impacts" where it is good at; “The impact of ICT on organizational models" and " impact of ICT on business models". The worst areas are “International trade in ICT services” and “International trade in digitally-deliverable service”. We know also from Turkey's foreign trade statistics that Turkey is not great at these two areas. The share of exports of ICT services in total trade in services, Turkey is well below the average of selected countries. With 0.34% Turkey ranks second-worst after Mexico. Similarly, with digitally deliverable services making up only 6.31% of total trade in services, Turkey has taken in the last place among selected countries.

While the digitalization of the economy is problematic, it can be said that the digitalization of society is relatively good. The index value of the “Social impacts” pillar was calculated as 3.58 for 2020. In this regard, it can be said that it performs

well in terms of “Impact of ICTs on access to basic services”, “ICT use and government efficiency” and “e-participation”. Although we are not bad at digitized society, the only issue we are not that good at is “Internet access in schools”.

As part of this study, a series of in-depth interviews were conducted within the business community and bureaucracy, besides international indicators and surveys among business members. What has been said in these interviews, were found to be largely in line with the findings of Turkey's Digital Impact Index. The main points emphasized by the authorities in the interviews overlap with the sub-indices with relatively low performance.

Index results and problems detected in the interviews can be summarized as follows:

Need for a Vision for Information and Communication Technologies

- Low social awareness about digital transformation affects the digital transformation process negatively.
- Resources are used inefficiently as digitization policies are not produced with a holistic approach.
- Laws enforcement is not strong
- Laws related to Information and Communication Technologies do not meet the needs.
- The legal system does not function effectively in the resolution of disputes.
- The judicial system does not work fairly in terms of individuals, civil society, and companies when they face disputes with public institutions.
- Protection of intellectual property rights is not sufficient.

Not-Supportive Business Ecosystem

- Public procurement law does not support the Information and Communication Technologies sector.
- The share allocated to R&D expenditure in GDP is low.
- Access to venture capital is limited.
- Disregard to international standards and no consultation with the sector in regulations such as digital service tax negatively affect companies' competitiveness and expansion opportunities.
- Incompliance of the regulations to comply with international standards prevents receiving funds from foreign investors.
- "Local and national" concept affects international investors negatively.
- The way of providing incentives for the sector prevents efficient use of resources.
- The way in which regulations and incentives are formulated causes competitive disruptions.
- Restrictions on internet access negatively affect access to information, originality, and creativity, the utmost important requirements of this ecosystem
- The prevalence of personal entrepreneurship over corporate entrepreneurship prevents the use of economies of scale.
- The fast-changing ecosystem makes it difficult to adapt to the changes.

Inadequate Infrastructure Investments

- Insufficient fiber infrastructure affects investments negatively.
- The non-competitive environment in infrastructure investments affects investments negatively.
- Resource inefficiency arises as different public institutions make separate infrastructure investments.
- Electricity production per capita is low.
- International internet bandwidth is not adequate.
- Secure internet servers are not enough.
- Investments in telecommunication services are not sufficient.
- High costs of data storage and processing affect digitalization negatively in the sector where there are many small and medium-sized companies.

Inadequate Qualified Workforce

- University graduates do not have the qualifications that are demanded by the sector.
- As public requirements are met local solution formulations, labor, and resource utilization become inefficient.

- As digital transformation leads to a reduction in existing occupational groups, this will heighten social risks.
- Math and science education is low in quality.
- Not enough graduates from higher education in the field of STEM.
- The education system has limited capacity in offering ICT skills.
- The business faces shortages in ICT skilled labor.

Individuals' Adaptation to Digital Economy

- Informatics crimes because of an individual's incompetence negatively affects digital services.
- Individuals' digital competencies being limited to social media is an obstacle for benefiting from digital services.
- Mobile subscription among individuals is not common enough.
- Fixed broadband internet membership among individuals is not common enough.
- Mobile broadband internet membership among individuals is not common enough.

Limited Digital Transformation in Business

- Traditional ways of doing business are not compatible with the digital ecosystem.
- Specialization in high-tech products and services are limited.
- Projects for reducing dependency on foreign digital products/services in Turkey are inadequate.
- Patent applications within the PCT framework are not sufficient.
- The public sector does not support the use of Information and Communication Technologies products and services.
- Patent applications in the field of ICT are not enough.
- The number of full-time telecommunications workers is inadequate.
- ICT services exports are not high.
- The trade on digitally available services is not advanced.
- Revenues from mobile networks are not abundant.

SMEs' Shortcomings Regarding Digital Transformation

- SMEs do not have sufficient information about digital transformation.
- SMEs cannot benefit from digital transformation opportunities due to economies of scale.
- The fact that traditional, small, and medium-sized companies cannot take bold steps to invest in digitization affects digital transformation negatively.
- Long payback periods adversely affect the digital transformation of SMEs.

The suggested solutions for the identified problems can be summarized as follows:

Need for a Vision for Information and Communication Technologies

- The need for digital transformation should be acknowledged at the highest level in the state and should be supported by a strong communication strategy to convey the idea to all parts of society.
- Digitization policies should be designed and implemented not only for the public sector but for the whole country.

- Arrangements to prevent companies from becoming disadvantaged in the international competition should comply with international standards.
- The regulations should take into consideration the differences within the Information and Communication Technologies sector.
- The “local and national” discourse should pay attention to the features of the digital economy.
- For resource efficiency, public institutions and organizations should act in harmony in their projects.
- A libertarian approach should be adopted whenever possible for internet accessibility.

Enhancing Business Ecosystem

- Improving the competitive environment and enhancing the business ecosystem should be targeted through incentives and regulations.
- Business models that will enable companies to be institutionalized should be developed.
- The public sector should adopt a strategic vision for the sector.
- The public sector should give priority to actions that improve the competitive environment rather than competing with the private sector.
- Projects in high technology products and services with a high probability of success should be supported.
- Incentives should be aligned with a targeted R&D policy.
- Tax rates should be determined in consultation with the industry and by considering international regulations.
- SMEs should be supported to change the traditional way of doing business.
- SMEs should be informed, guided, and supported about the requirements and processes of digital transformation.
- Financial support should be provided to SMEs in the digitalization process.
- Business models that bring SMEs together should be developed and encouraged.

Increasing Infrastructure Investments

- The imperfect competition that makes infrastructure investments difficult should be fixed.
- The state should play a facilitating and accelerating role in joint infrastructure projects.
- Infrastructure facilities of public institutions of different ministries need to be optimized.
- Firms should act through platforms to reduce data storage and processing costs.

Improving Skilled Workforce

- The education system should be revised from basic education to university education.
- The university education curriculum should be changed, updated, and new programs should be opened at universities to answer the sector’s needs.
- While designing training programs, the purpose should be to increase digital competencies in accordance with the requirements of the industry.
- In order to meet the demand for a qualified workforce, women's employment in the ICT sector should be encouraged.
- When improving education and human resources, not only the needs of Turkey, but the needs of the whole region should be taken into consideration.
- In terms of effective use of human resources, public sector needs should not be taken on a project basis, but be determined and resolved as a whole, or private sector cooperation should be sought in this regard.
- Wage and immigration policies should be formulated to ensure that people with high digital competencies remain in the country and to attract human resources from abroad.
- Joint projects for Turks working in the field of ICT abroad should be framed.
- The existing workforce should be equipped with skills that are required by the new technologies.
- Strategies should be formulated to increase digital literacy. Table 1

	INDEX 2018	INDEX 2019
TUBİSAD Digitalization Index	**2.94**	**3.06**
ENVIRONMENT SUBINDEX	**2.87**	**2.95**
1st pillar: Political and regulatory environment	**2.76**	**2.82**
1.01 Effectiveness of law-making bodies	2.24	2.36
1.02 Laws relating to ICTs	2.58	2.72
1.04 Efficiency of legal system in settling disputes	1.87	1.96
1.05 Efficiency of legal system in challenging regulations	2.06	2.15
1.06 Intellectual property protection	2.41	2.42
1.07 Software piracy rate, % software installed	2.75	2.78
1.08 Cost for enforcing contract (% of claim)	4.33	4.33
1.09 Number of days to enforce a contract	3.85	3.81
2nd pillar: Business and innovation environment	**2.98**	**3.09**
2.01 Availability of latest technologies	3.07	3.89
2.02 Venture capital availability	2.48	2.38
2.03 Total tax rate, % profits	3.73	3.66
2.04 Number of days to start a business	4.89	4.89
2.05 Number of procedures to start a business	3.74	3.74
2.06 Intensity of local competition	2.79	2.66
2.08 Quality of management schools	2.16	2.46
2.09 Government procurement of advanced technology products	2.11	2.29
2,10 Research and development expenditure (% of GDP)	1.85	1.83
READINESS SUBINDEX	**3.19**	**3.24**
3rd pillar: Infrastructure	**2.34**	**2.27**
3.01 Electricity production, kWh/capita	1.23	1.23
3.02 Mobile network coverage, % population	4.99	4.97
3.03 International Internet bandwidth, kb/s per user	1.04	1.03
3.04 Secure Internet servers per million population	1.09	1.07
3,05Annual investment in telecommunication services/Revenue from all telecommunication services	1.23	1.65
3.06 Gross capital formation (% of GDP)	3.53	2.68
3.07 Firm-level investment on ICT	2.49	2.64
3.08 Quality of ICT infrastructure (firm)	3.11	2.91
4th pillar: Affordability	**4.54**	**4.54**
4.01 Prepaid mobile cellular tariffs, PPP $/min.	4.75	5.00
4.02 Fixed broadband Internet tariffs, PPP $/month	4.88	4.55
4.03 Internet and telephony sectors competition index	3.98	4.06

5th pillar: Skills	**2.69**	**2.89**
5.01 Quality of education system	2.19	2.23
5.02 Quality of math and science education	1.69	1.78
5.03 Secondary education gross enrollment rate, %	3.40	3.94
5.04 Adult literacy rate, %	4.72	4.81
5.05 Graduates in tertiary education, in STEM, by sex per 1000 of population aged 20-29	2.20	2.16
5.06 Staff availability	1.95	2.45
USAGE SUBINDEX	**2.88**	**3.16**
6th pillar: Individual usage	**3.20**	**3.22**
6.01 Mobile phone subscriptions per 100 population	2.14	2.01
6.02 Percentage of individuals using the Internet	3.55	3.66
6.03 Percentage of households with computer	3.34	3.33
6.04 Households with Internet access, %	4.24	4.30
6.05 Fixed broadband Internet subscriptions per 100 population	2.27	2.40
6.06 Mobile broadband Internet subscriptions per 100 population	2.12	2.14
6.07 Use of virtual social networks	4.63	4.45
6,08 Use of ICT by households	3.33	3.49
7th pillar: Business usage	**2.77**	**3.32**
7.01 Firm-level technology absorption	3.05	3.78
7.02 Capacity for innovation	2.62	3.82
7.03 PCT patent applications per million population	1.07	1.12
7.04 ICT use for business-to-business transactions	3.58	3.86
7.05 Business-to-consumer Internet use	3.78	3.87
7.06 Extent of staff training	2.54	3.50
8th pillar: Government usage	**2.66**	**2.92**
8.01 Importance of ICTs to government vision	2.34	2.48
8.02 Government Online Service Index, 0–1 (best)	3.35	3.97
8.03 Government success in ICT promotion	2.3	2.31
IMPACT SUBINDEX	**2.81**	**2.88**
9th pillar: Economic impacts	**2.36**	**2.18**
9.01 Impact of ICTs on business models	3.87	3.77
9.02 ICT PCT patent applications per million population	1.03	1.04
9.03 Impact of ICTs on organizational models	3.68	3.71
9.04 Knowledge intensive jobs, % workforce	2.39	2.24
9,05 Full-time equivalent telecommunication employees	1.10	1.09
9,06 Creative goods exports, % of total trade	3.10	3.12
9,07 International trade in ICT services (% of total trade in services)	1.02	1.02
9.08 International trade in digitally-deliverable service (% of total trade in services)	1.20	1.16
9.09 Revenue from mobile networks (% of all telecommunication services)	3.88	2.47

10th pillar: Social impacts	**3.26**	**3.58**
10.01 Impact of ICTs on access to basic services	3.47	3.56
10.02 Internet access in schools	2.78	2.81
10.03 ICT use and government efficiency	3.38	3.55
10.04 E-Participation Index, 0–1 (best)	3.43	4.39

INTRODUCTION

How digital are we?

This is a question every actor in the economy, whether individuals or institutions, is wondering about. Because digitalization, that is, the ability to produce and use Information and Communication Technologies (ICT) is one of the most important sources of increased productivity. Therefore, individuals, firms, institutions make great efforts to measure and increase their digitalization levels. The most macro criterion for digitalization is undoubtedly how much the country's economy and society are digitalized. That is why this report, Turkey's Digitalization Index Report, shows the position of Turkey's economy and society's digitalization in the transition to the Fourth Industrial Revolution.

Various indices related to the digital transformation of economies are prepared by different international and national institutions. That's because digital indicators related to digital transformation are extremely important for policy design. Perhaps the most important of the digital transformation indices is the Networked Readiness Index, which is prepared by the World Economic Forum (WEF) lastly in 2016 and presented in the Global Information Technology Report (WEF, 2016). This index includes the 139 countries which are also included in the Global Competitiveness Report published by the World Economic Forum. However, the Global Information Technology Report, which was last published in 2016, is no longer published. Another important digitalization index is the Digital Economy and Society Index 2019 (DESI, 2019) prepared by the European Commission. Another index study that measures digitalization, although different and older in technique than WEF and DESI indices, is the Information and Communication Technology Development Indices (UNCTAD, 2003).

There have been efforts for digitalization indices prepared in order to contribute to the development of effective policies and strategies for digital transformation in the past. The most important of these is the Accenture Digitization Index (Accenture, 2016). This index, calculated by the data obtained from interviews with 104 companies in 2015 and 106 companies in 2016, aimed to calculate the digitalization level of different sectors.

We can say that Turkey's Digital Transformation Index, prepared by TUBISAD, is an important first initiative in terms of being an index covering the impact of digital transformation in legislation, infrastructure, usage, skills, economy, and social areas. Furthermore, Digital Transformation Index, in addition to internationally comparable data, encompasses the views of managers on how Turkey is prepared for and ready for digital transformation. In this work, we present for Turkey, an overall digitization index along with four sub-indices and 10 pillars. Digital Transformation Index values are calculated for 2019 and 2020. This index will be prepared and published in the following years. While calculating the index, along with Turkey, data from 139 countries is used. Thus, not only the digitization in Turkey determines the index values, but the position of other countries along with Turkey in global digitalization affects the values of the indices.

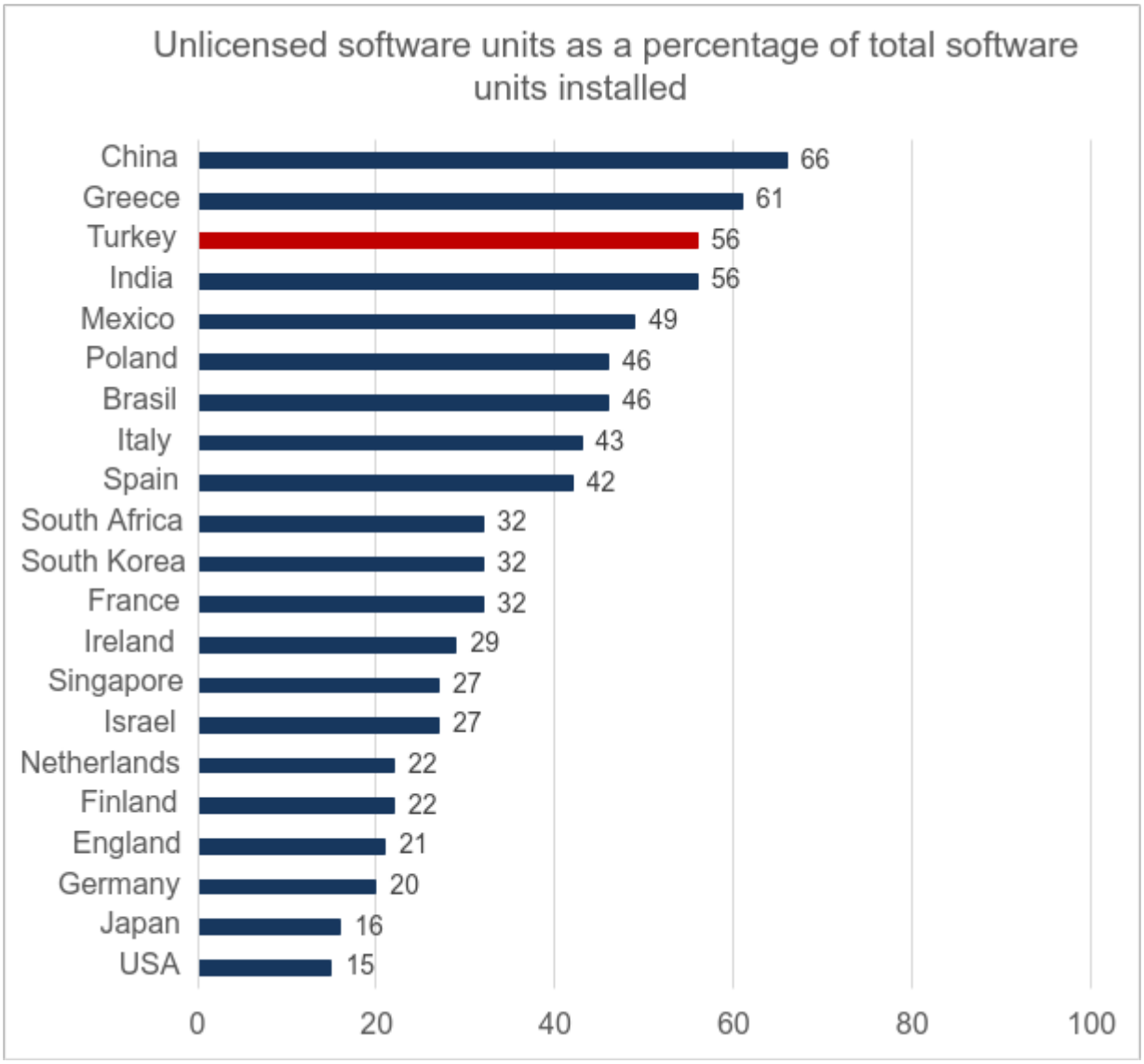
The plan of the report is as follows: In the next section, there is a descriptive analysis of some of the variables used in the calculation of the Digital Transformation Index, by comparing Turkey with some selected countries in order to identify the place of Turkey in digital transformation. In the following section, Turkey's Digital Transformation Index and its all sub-components were assessed. In the third section, the results of this report are presented.

STATUS OF DIGITAL TRANSFORMATION IN TURKEY

In this chapter, the descriptive analysis of variables used in the calculation of the index for Turkey's Digital Transformation is presented in comparison with selected countries to identify Turkey's position in digital transformation. For these analyses, 19 countries were selected along with Turkey, which all are different in development and size. Those countries are the USA, Germany, Brazil, China, Finland, France, South Africa, South Korea, India, the Netherlands, England, Ireland, Israel, Italy, Japan, Mexico, Poland, Singapore, and Greece. This analysis will provide important points about Turkey's position in digital transformation.

Figure 1 presents the use of unlicensed software units. The widespread use of unlicensed software reduces the willingness for developing new software. Therefore, the low unlicensed software ratio of the countries indicates that the transition to the digital economy will be easier in those countries. The unlicensed software ratio shows the proportion of unlicensed software on the software installed on computers. It includes operating systems, systems software such as databases and security packages, business applications, and consumer applications such as games, personal finance, and reference software. It does NOT include software loaded onto tablets or smartphones. It also excludes software that runs on servers or mainframes and routine device drivers, as well as free downloadable utilities, such as screen savers, that would not displace paid-for software or normally be recognized by a user as a software program.

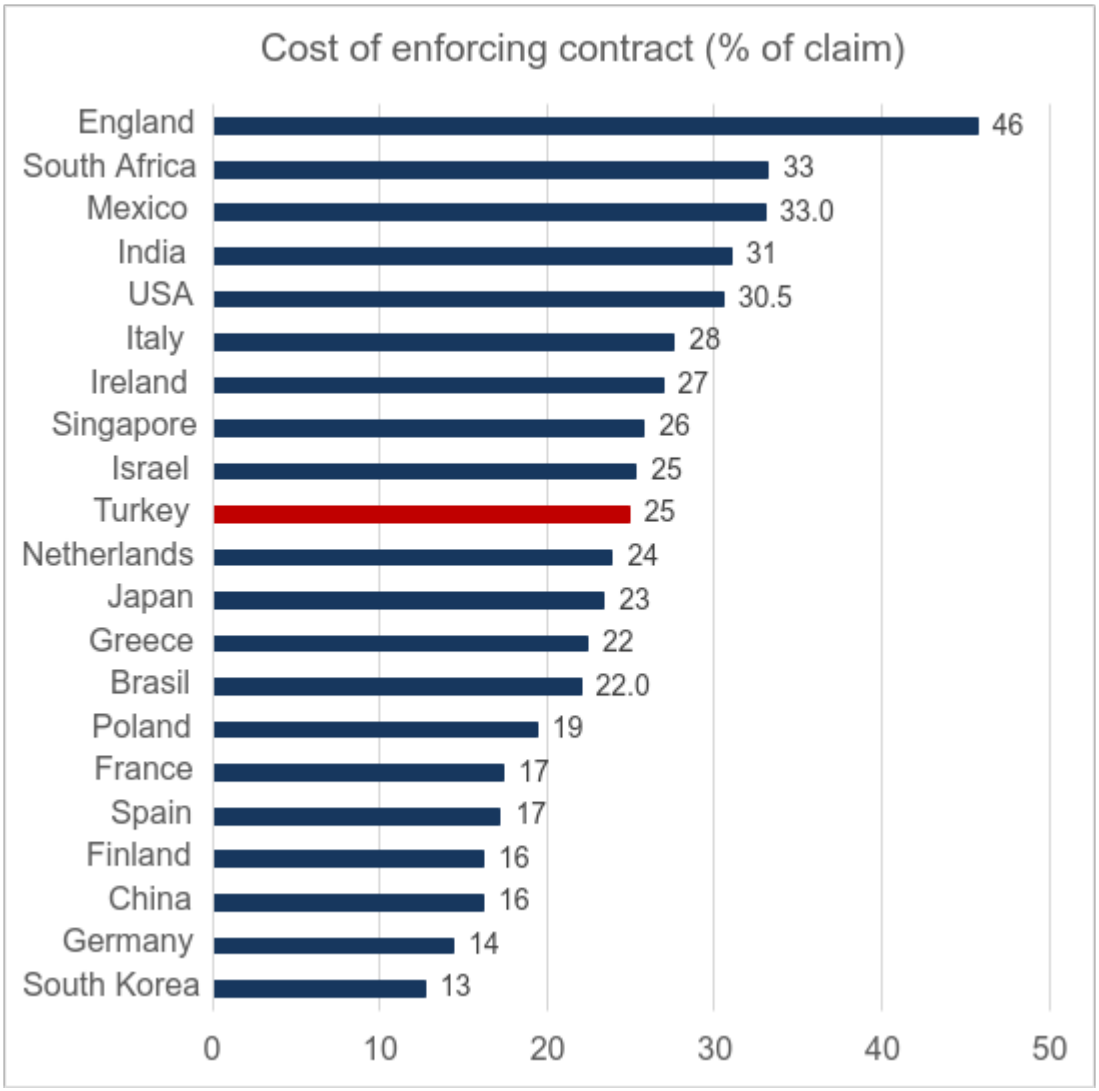
Figure 1.



As of 2019, the country with the highest unlicensed software rate among the selected countries with 66% is China, while the United States is the country with the lowest unlicensed software ratio with 15%. Turkey is in second place with 61% of unlicensed software ratios after Greece took third place with India, with 56% (cf. Figure 1). When the per capita national income of the countries with the highest unlicensed software ratio is analyzed, it is observed that the income of these countries is lower than countries with low unlicensed software ratios. So, it would not be wrong to say that per capita national income and unlicensed software usage are inversely proportional. But it should not be that easy to conclude the direction of the relationship.

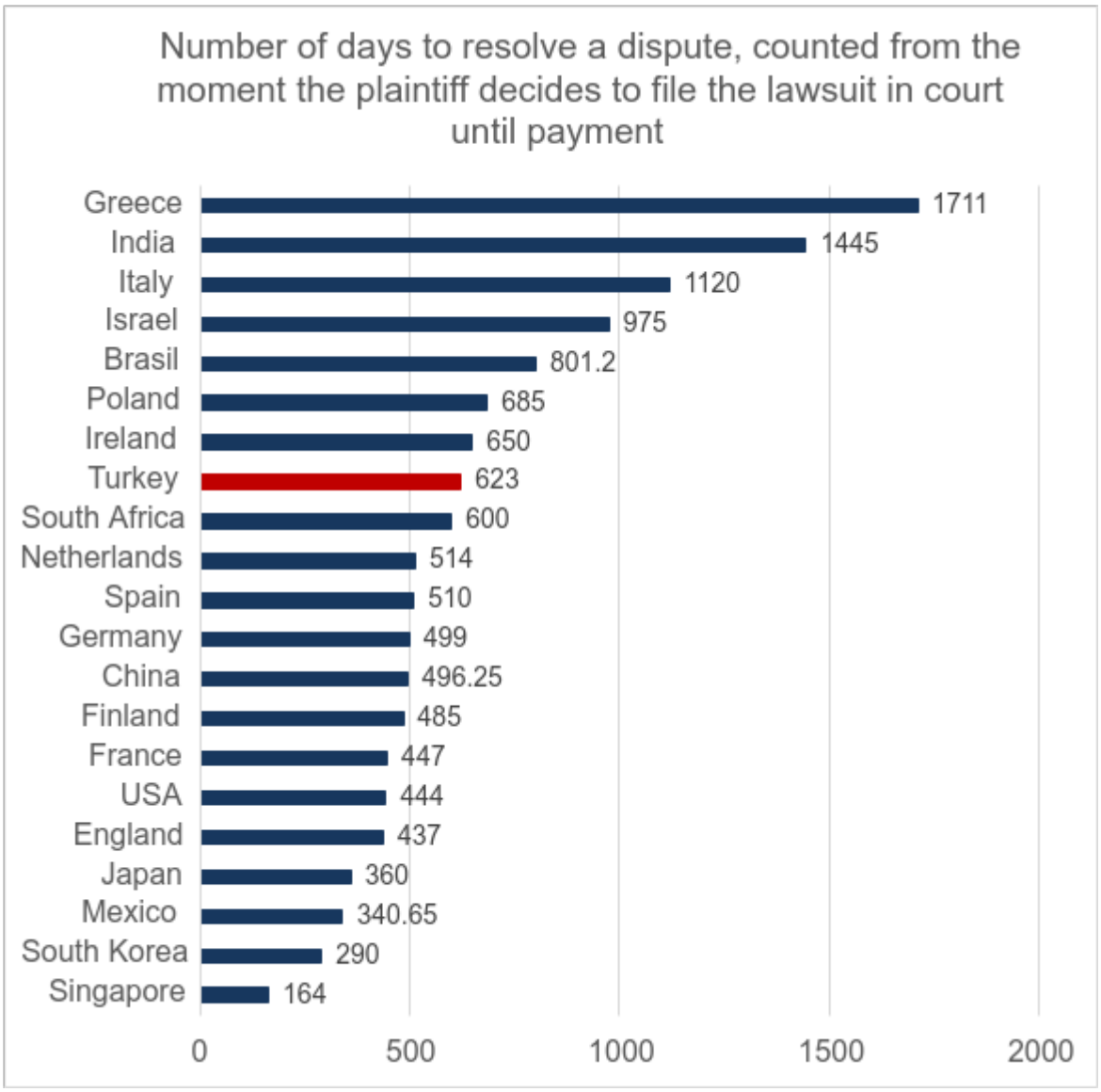
The cost of enforcing contracts in a country is a general indicator of the business and investment environment. In order for a business to enforce its commercial contracts in the face of any negativity, it has to take some legal procedures, time, and cost to follow these procedures. When this rate is high, it decreases predictability and increases uncertainty for investors. The cost of enforcing contracts measures the cost needed to resolve a commercial dispute through a local court of the first instance. The cost of enforcing contracts is calculated as a percentage of the contractual right amount (200% of per capita income or $ 5,000, whichever is higher) in the chart below. Three types of costs are mentioned here: average attorney fees, court costs, and enforcement costs. Countries with the highest and lowest rates in contract enforcing costs are the UK (46%) and South Korea (13%) respectively, while Turkey took place in the middle of the ranking with 25% (see Figure 2).

Figure 2



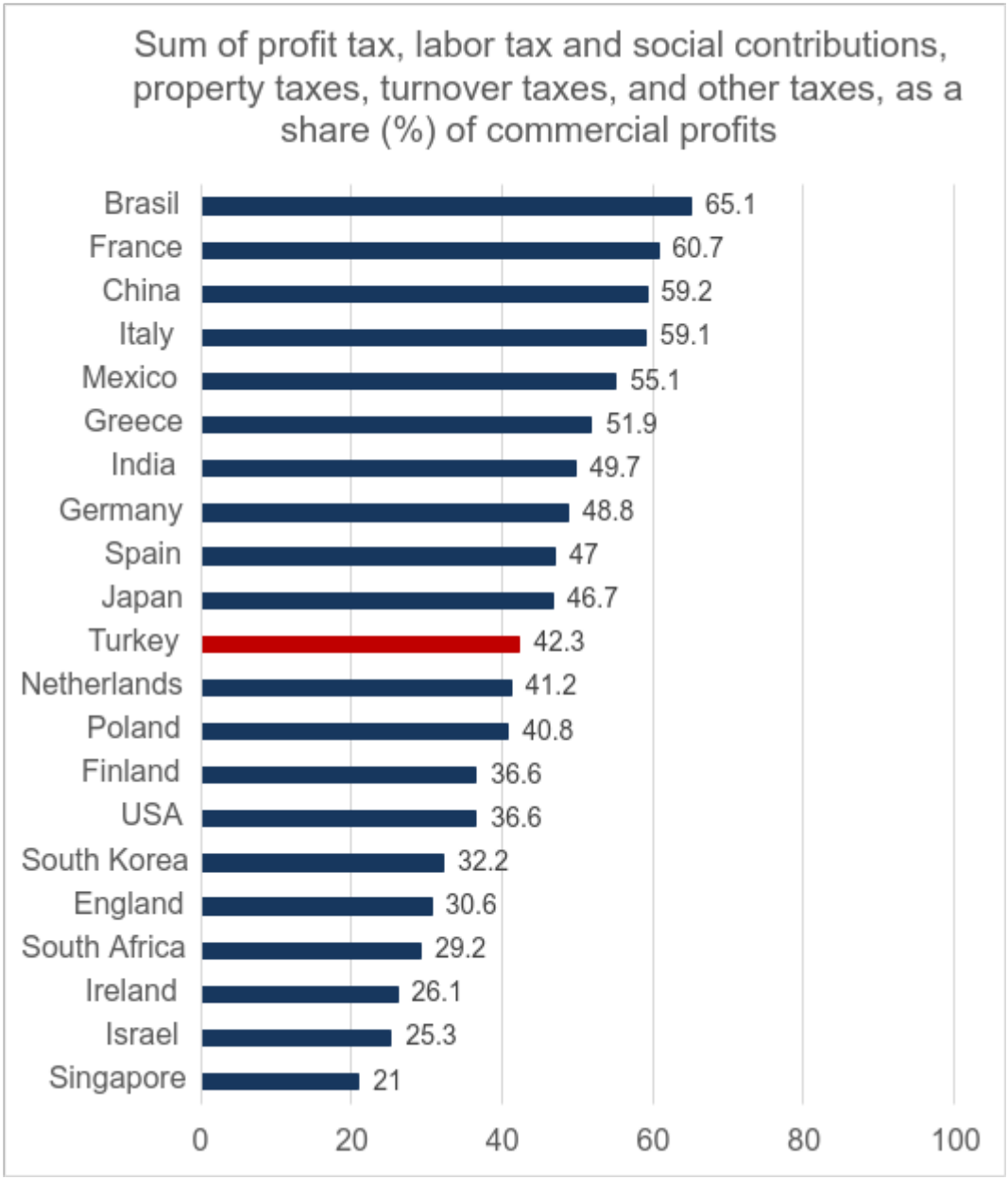
While the cost of the rights obtained by commercial contracts by enforcing those contracts is important for a business, the number of days to resolve a dispute in court is equally important. This period starts from the plaintiff's decision to file the lawsuit and continues until the day it receives the payment. This period includes the days of the proceedings and the waiting periods between them. In Turkey, it takes, on average 623 days (see. Fig 3). Compared to selected countries, this period corresponds to approximately one-third of Greece, which is the country with the longest execution period of contracts, and about four times that of Singapore, which is the country with the shortest execution period of contracts.

Figure 3



One of the most important factors for a strong business sector is the low rate of tax. Countries with low tax rates have more advantages in attracting investments both domestically and abroad. The total tax rate measures the amount of tax and compulsory contributions from commercial profit in the second year of operation and is expressed as a percentage of commercial profit. The total tax rate is the total amount of taxes collected, the sum of all different taxes and contributions payable after the allowable deductions and exemptions are recognized. Taxes that are not paid by the company (such as personal income tax) or collected by the company and transferred to the tax authorities (such as value-added tax) but are not covered by the company are excluded. The taxes included are corporate tax, social contributions paid by the employer, and labor taxes, real estate taxes, turnover taxes, and other taxes (such as municipal taxes). The total tax rate for Turkey corresponds to 42.3% of the total profit. The countries with the highest and lowest total tax rate are Brazil (65.1%) and Singapore (21%) while Turkey is positioned in the middle row among the selected countries (see. Figure 4).

Figure 4

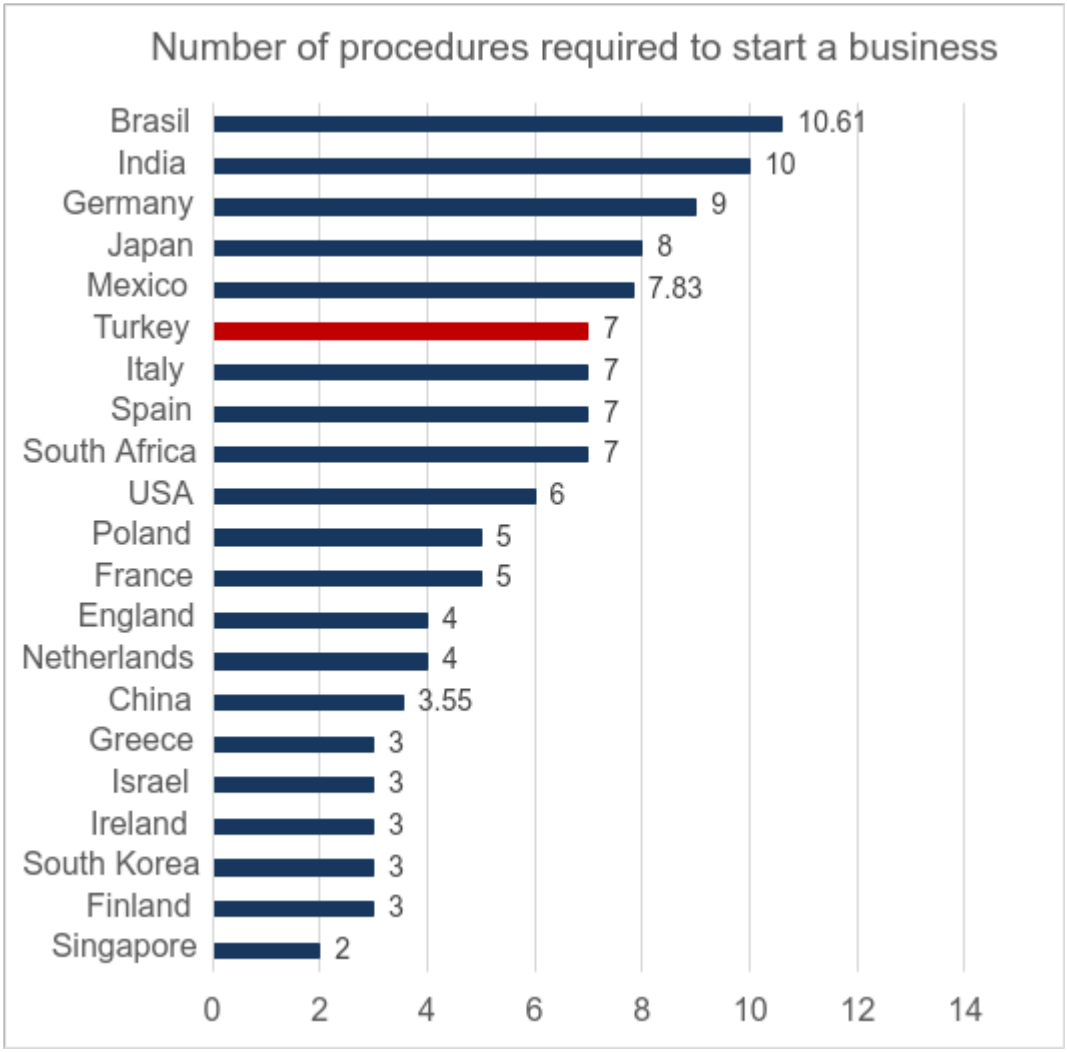


One of the most important determinants of a vibrant competition environment is the low barriers to enter the market. One of the factors that create entry barriers is the length and cost of the transactions that need to be incurred to establish a company. The number of days required to set up a company is calculated on calendar days and refers to the minimum time required for procedures to be carried out with government agencies, without informal payments to lawyers and notaries. The number of days required to establish a company in Turkey is 7 (see. Figure 5). Compared to the selected countries, it can be said that this period is relatively short. Because this period was calculated as 40 days in South Africa and 37 days in Poland. In Singapore, this period is 1.5 days. These statistics are directly proportional to the number of procedures required to establish a company. So it makes more sense to interpret it together with the number of procedures required to start a company.

Figure 5

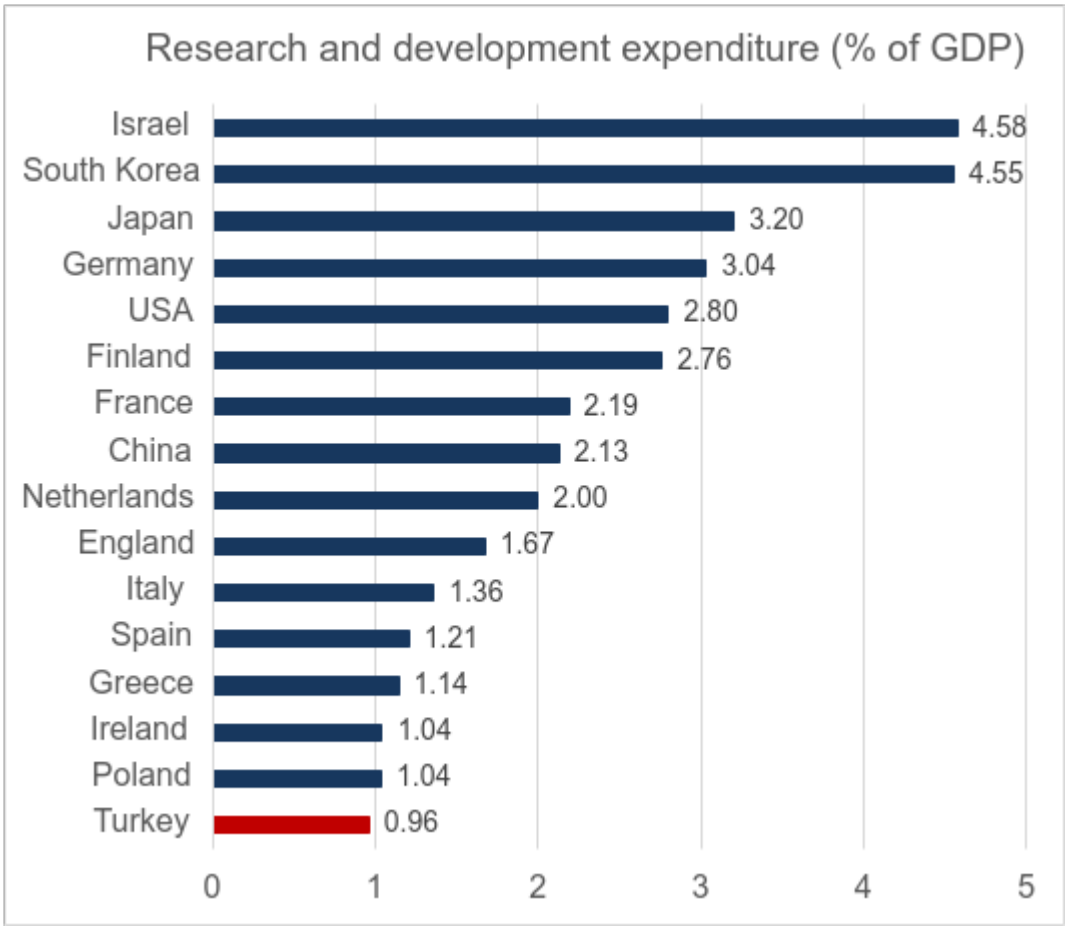
The procedures mentioned as the number of procedures required to establish a company are defined as any interaction of the founders of the company with third parties (e.g. government agencies, lawyers, auditors, or notaries). Interactions between company founders or company officials and employees are not considered procedures. Procedures that need to be completed in the same building but different offices or different counters are counted as separate procedures. If the founders have to visit the same office several times for different consecutive procedures, each is counted separately. If the services of professionals are required, the procedures carried out by these professionals on behalf of the company are counted as separate procedures. These statistics only include procedures required for all businesses. Industry-specific procedures are excluded. The number of procedures required to establish a company in Turkey is 7 (see. Figure 6). Compared with selected countries, Turkey is situated in the middle at the number of procedures required to establish a company. Meanwhile, the number of procedures to be completed in Brazil is 10.61 and 10 in India. These countries are the countries that require the most procedures to establish a company. On the other hand, Singapore takes first place with only 2 procedures, while Finland, Greece, Ireland, Israel, and South Korea are second with 3 procedures.

Figure 6



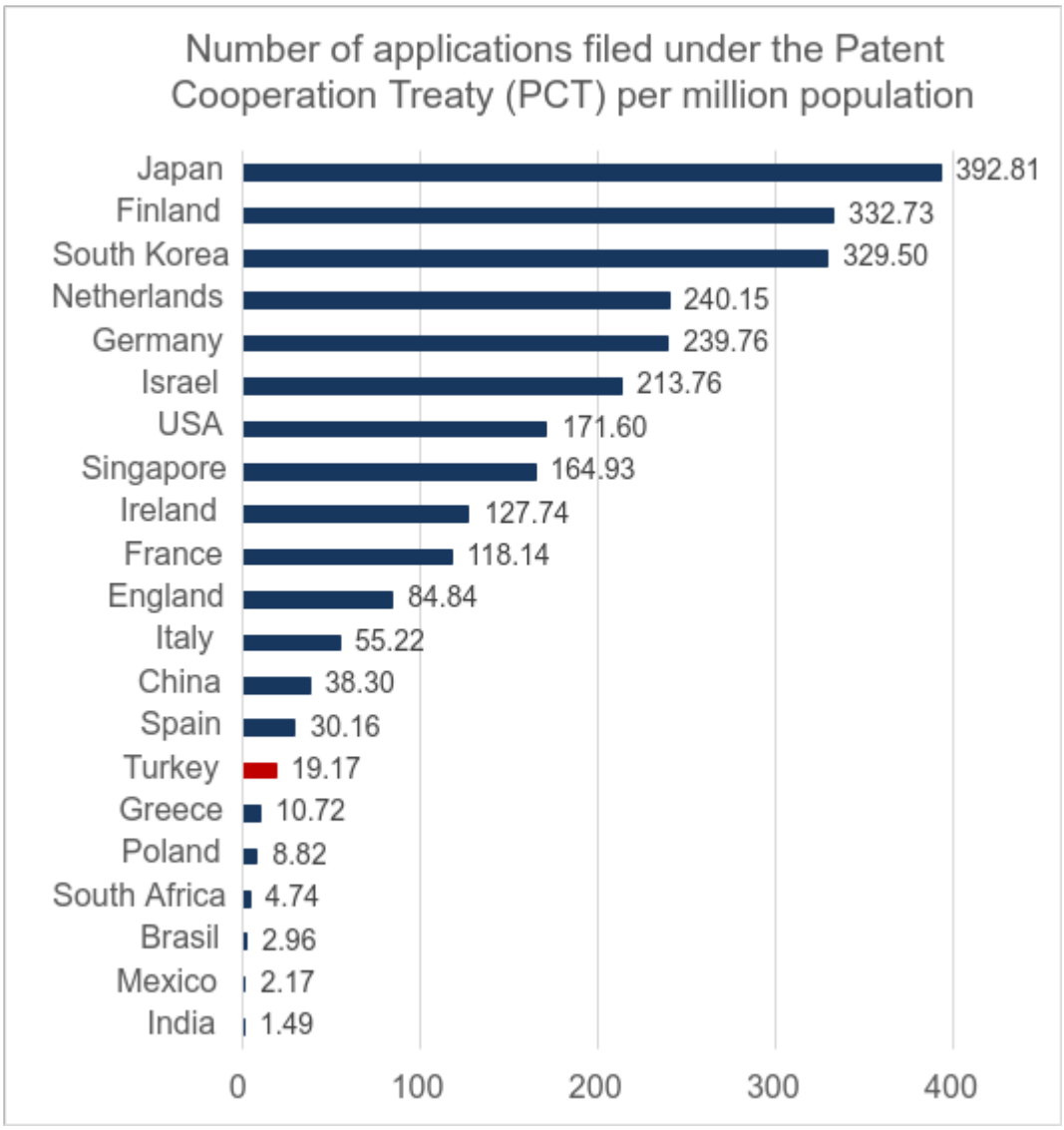
R&D expenditure statistics not only show the interest shown by the country to research and development activities but also as an estimator of that country's future innovation and technology production and economic growth. Therefore, countries with high R&D expenditure are considered to be more advantageous in the transition to the digital economy. The best explanatory variable about R&D expenditures is the ratio of R&D expenditures to gross national product and this shows how much of that country's income is spent on research and development activities. Among the selected countries, Israel is the country with the highest share with 4.58%, followed by South Korea with 4.55%. In Turkey, the R&D spending to gross domestic product ratio shows significant progress in recent years, it ranks last among the selected countries with 0.96% (see. figure 7). It may not be correct to interpret R&D expenditures alone as an indicator of innovation. If R&D spending is an input, patent applications are also an output and can be interpreted as the efficiency of R&D spending.

Figure 7



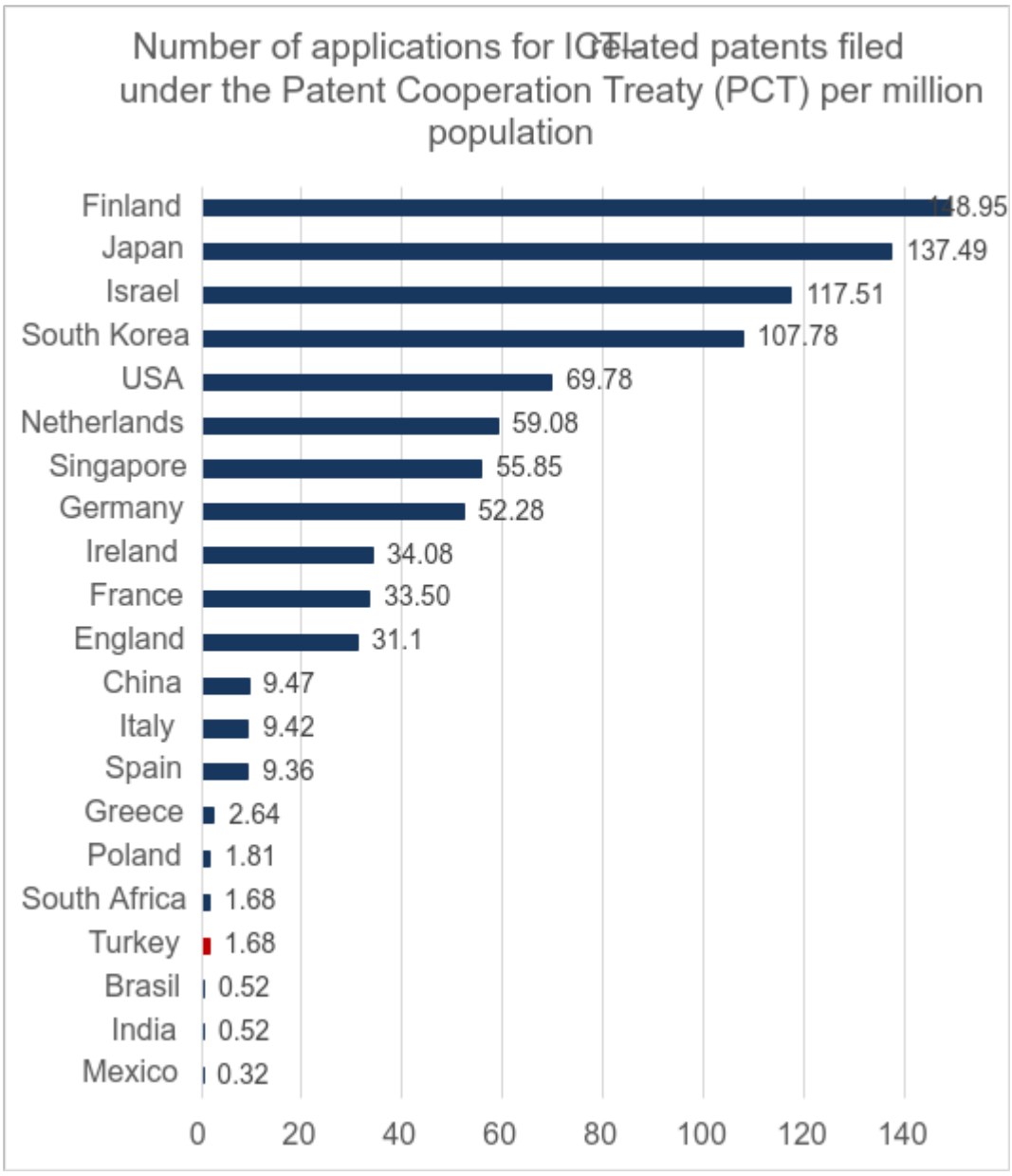
The commercialization process of innovation and technology production in companies within a country can be monitored by patent applications. The patent application under the PCT (Patent Cooperation Treaty) represents the number of patent applications per 1 million people. The number of patent applications per 1 million people per capita in Turkey is 19.17 (see. Figure 8). Compared to selected countries, this figure is quite low. The country with the highest number of patent applications per 1 million people in Japan (392.81), which is interesting to note that it is nearly 20 times Turkey's patent application. On the other hand, Turkey's parent application ratio within the confines of PCT is nearly 13 times of the country with the lowest number of patent applications per 1 million, India (1.49). (see Figure 8)

Figure 8



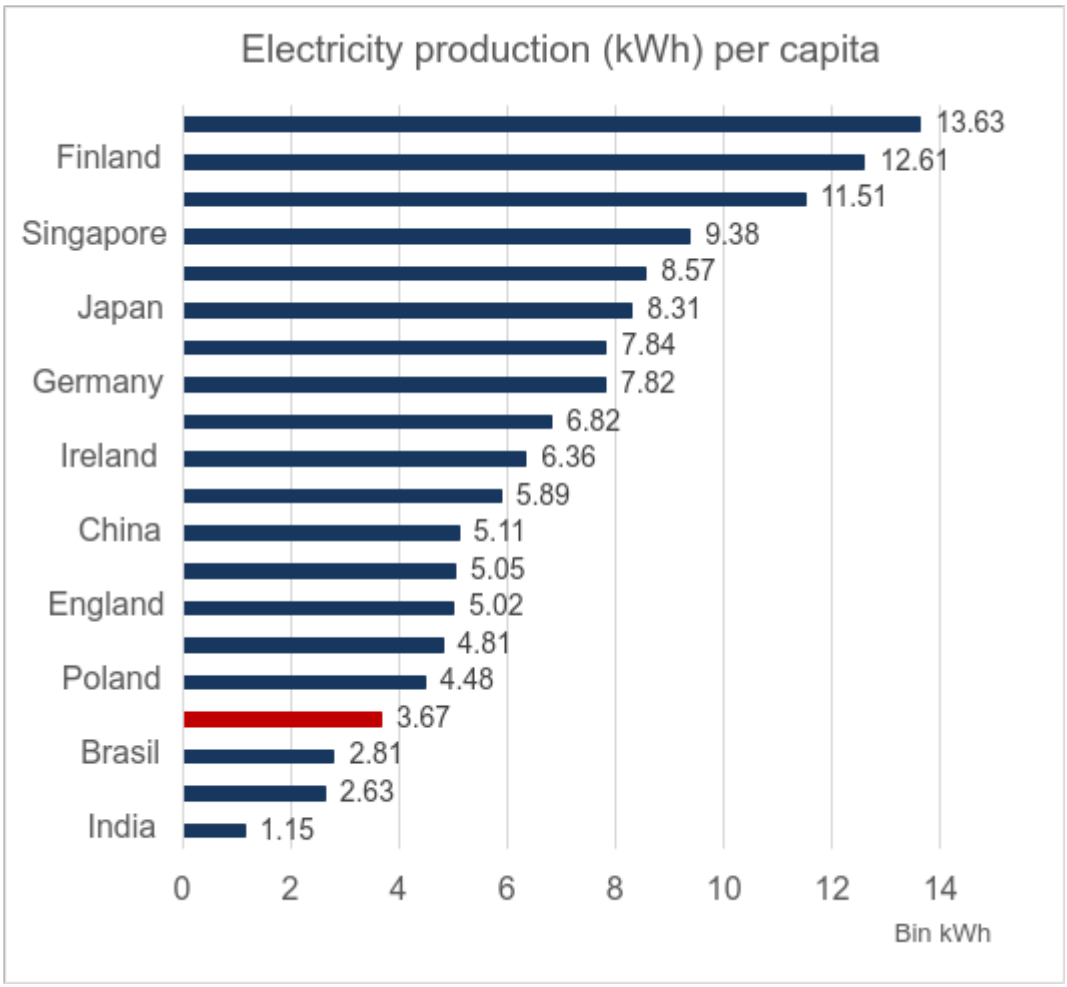
While evaluating patent applications, it is also of great importance from which sectors these applications are made. In order to be ready for the fourth industrial revolution, innovations are expected to be in digital fields rather than the locomotive sectors of previous industrial revolutions. Indeed, information and communication-based technological products are considered among the products that provide the highest added value. Therefore, it would not be surprising for developed countries to have a voice in world trade in this field. For this reason, while evaluating patent applications per million people, applications made in the field of ICT (Information and Communication Technologies) should also be evaluated. The number of patent applications per 1 million people in Turkey in the field of ICT is 1.68. With this statistic, Turkey is in third place within selected countries. To clarify, less than 10% of Turkey's patent applications are made in the field of ICT. Considering Finland (148.95) and Japan (137.49), which are the leading countries in ICT-based patent applications per million people, it is seen that patent applications in the field of ICT constitute approximately 45% and 35% of the total patent applications, respectively (See Figure 9). Countries with a high number of patent applications per capita in the field of ICT are among developed countries.

Figure 9



The electricity generation industry is very important, while it is one of the most polluting industries, also the amount of production is a representative variable that shows production and welfare in a country. Countries with strong electricity generation are considered to have a more advanced infrastructure in the transition to a digital economy. In addition to hydroelectric, coal, petroleum, gas, and nuclear energy production, electricity generation statistics per capita per hour (kWh) include geothermal, solar, wind, tidal and wave energy, as well as production from flammable renewable energy and waste. Turkey, with 3,670 kWh per capita and Brazil (2,810 kWh), Mexico (2,630 kWh), and India (1,150 kWh) are ranked lowest among selected countries across electricity consumption per capita (see. Figure 10). When we look at the country with the highest electricity production per capita, production in the United States is about 4 times that in Turkey (13,630 kWh) (see. Figure 10).

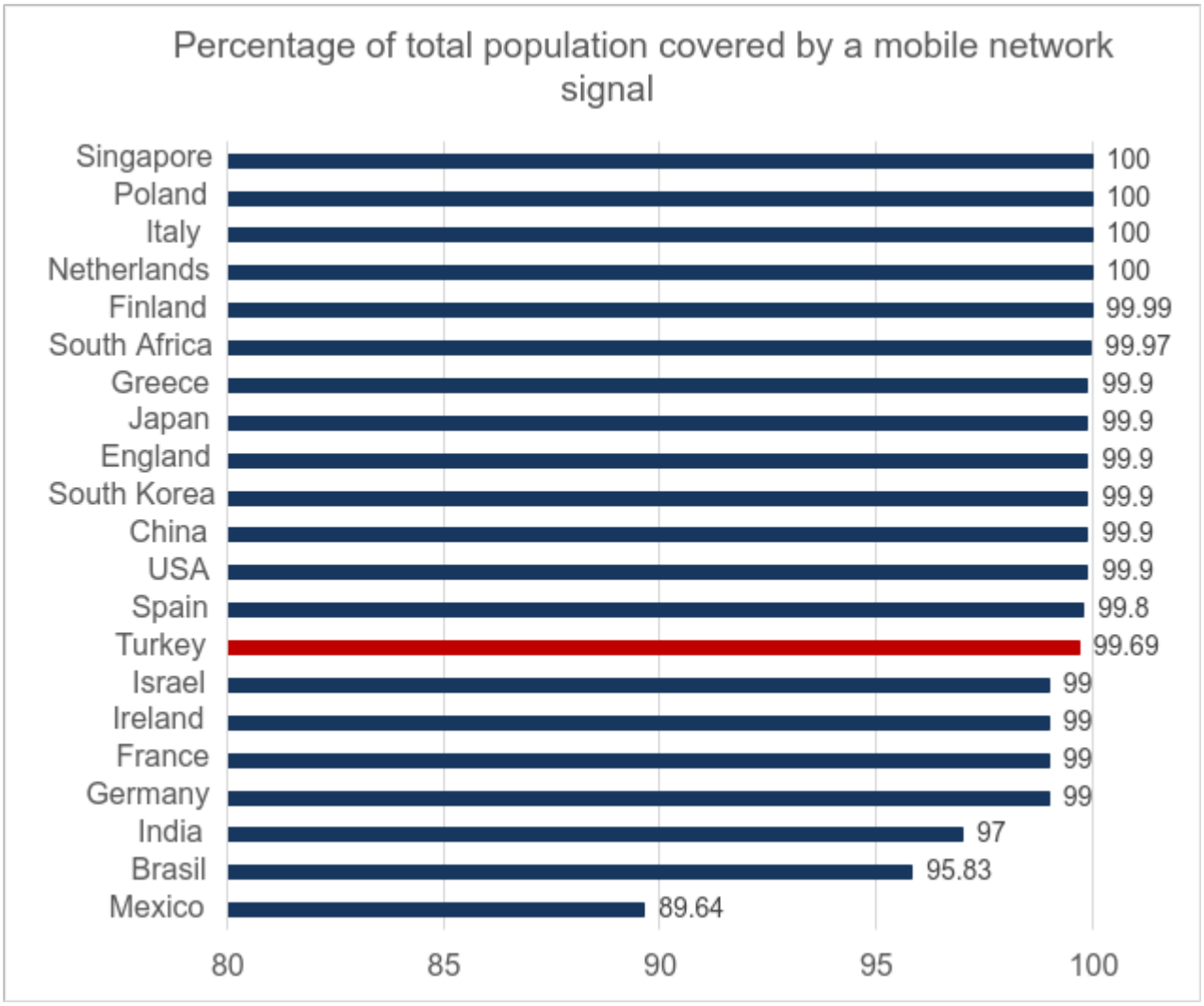
Figure 10



The most important determinant of the transition to the digital economy is to what extent the required infrastructure has been developed. Mobile network coverage measures the percentage of residents covered by any mobile cellular signal, regardless of whether they are subscribers. This statistic is calculated by dividing the number of residents in any mobile cellular signal range by the total population. 99.69% of the population of Turkey is covered by a mobile network (see. figure 11).

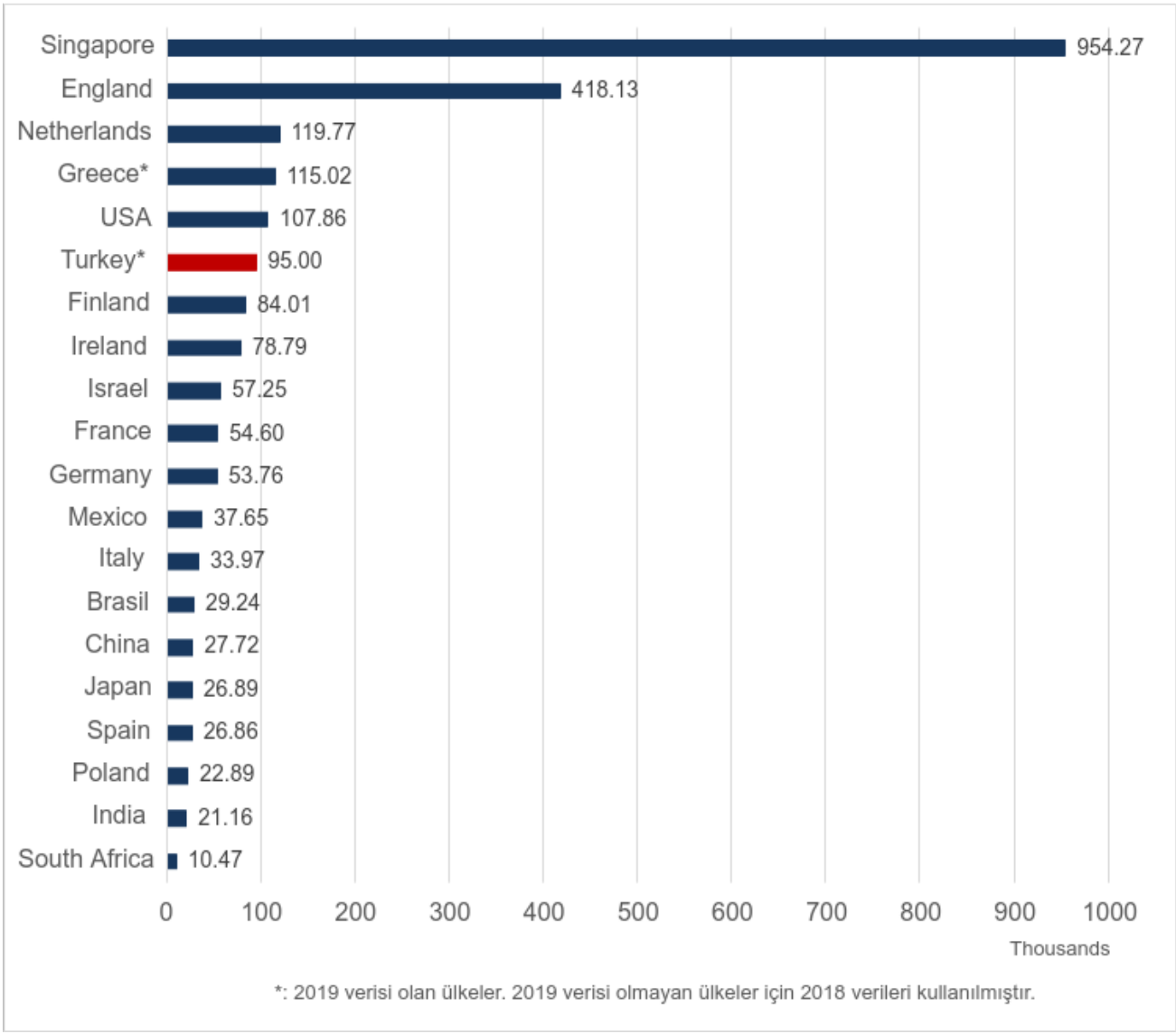
To make a comparison between selected countries, Singapore, Poland, the Netherlands, and Italy are the top 4 countries in terms of mobile coverage with coverage for 100% of the population. In Mexico, the country with the lowest mobile network coverage, 89.64% of the population is covered by a mobile network (see Figure 11).

Figure 11



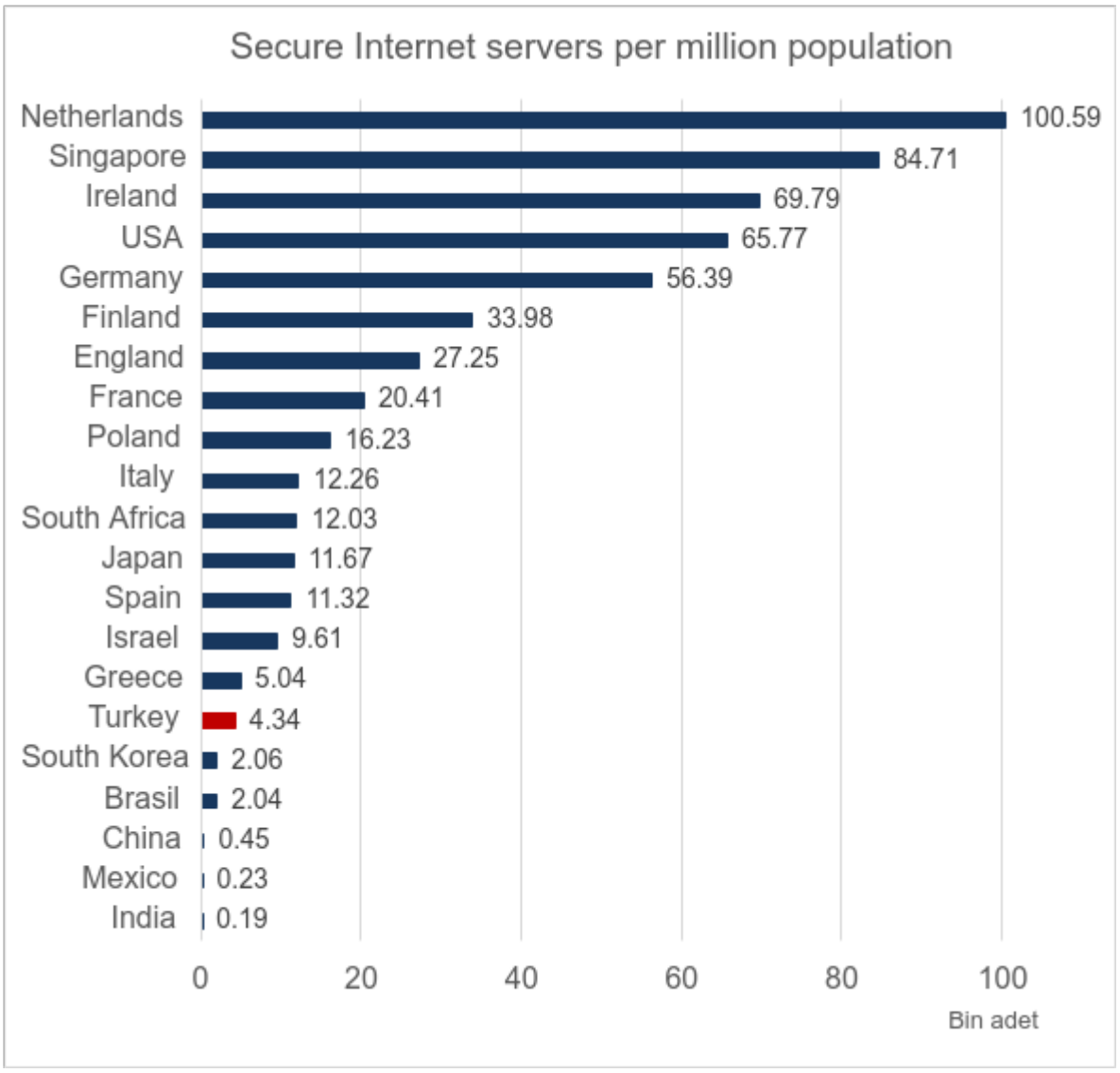
International internet bandwidth is the sum of all internet usage capacity that offers international bandwidth measured in kilobits per second (kb / s). Turkey, with 95 thousand kb/s per second per user ranks as the 6th country among the selected countries in international Internet bandwidth per user (see. Figure 12). The top three in the list are Singapore (954 thousand kbps), England (418 thousand kbps) and the Netherlands (119 thousand kbps), while Poland (22 thousand kbps), India (21 thousand kbps) and South Africa (10 thousand kb / s) took the last place.

Figure 12



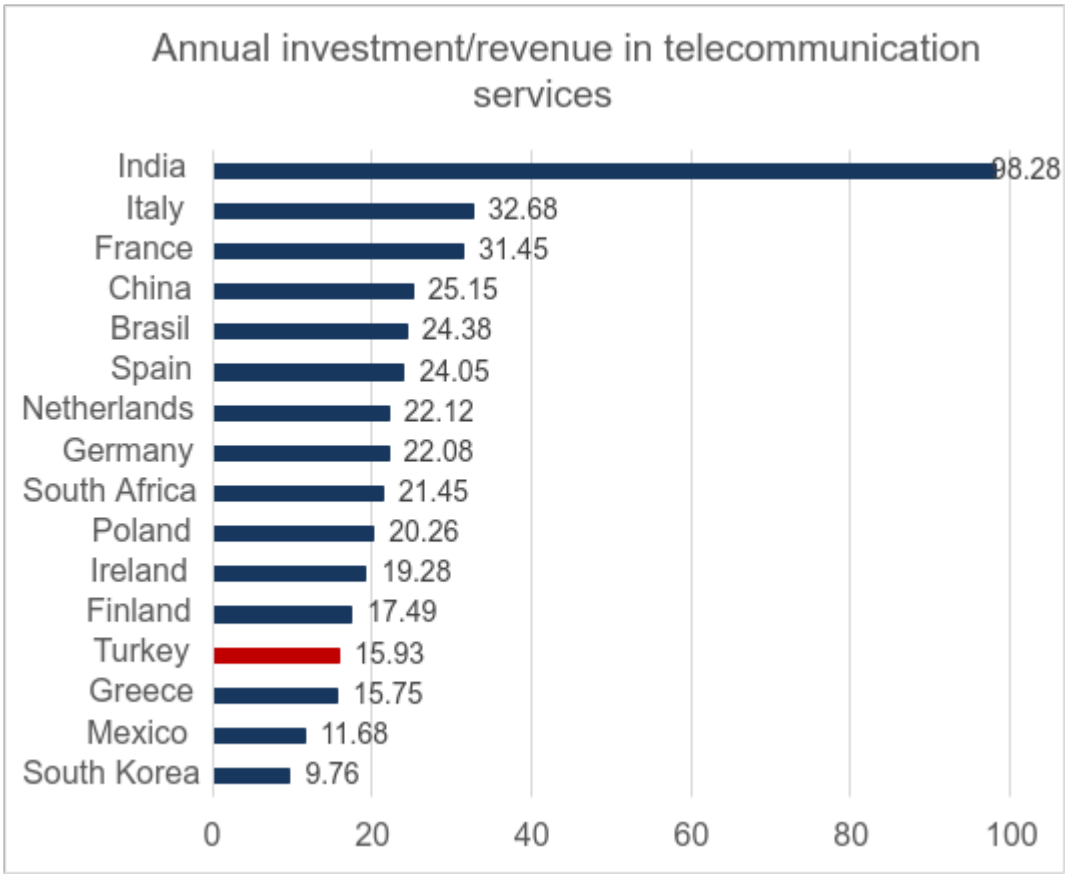
In addition to the prevalence of the infrastructure, its quality and cost are also important. The quality of the infrastructure of an economy is an important factor in investment decisions for both domestic and foreign investors. The increase in ICT technology users day by day has increased the need for secure internet servers. For this reason, the number of secure internet servers per 1 million people is considered to be a very important statistic. The number of secure Internet servers per 1 million people in Turkey is 4.340 (see. Figure 13). When a comparison is made with selected countries, Turkey is below average along with South Korea (2060), Brazil (2,040), China (450), Mexico (230), and India (190), located at the bottom row of the list. When we look at the countries ranked at the top, Holland comes first with 100 thousand, and Singapore has over 84 thousand secure internet servers for every 1 million people (see Figure 13).

Figure 13



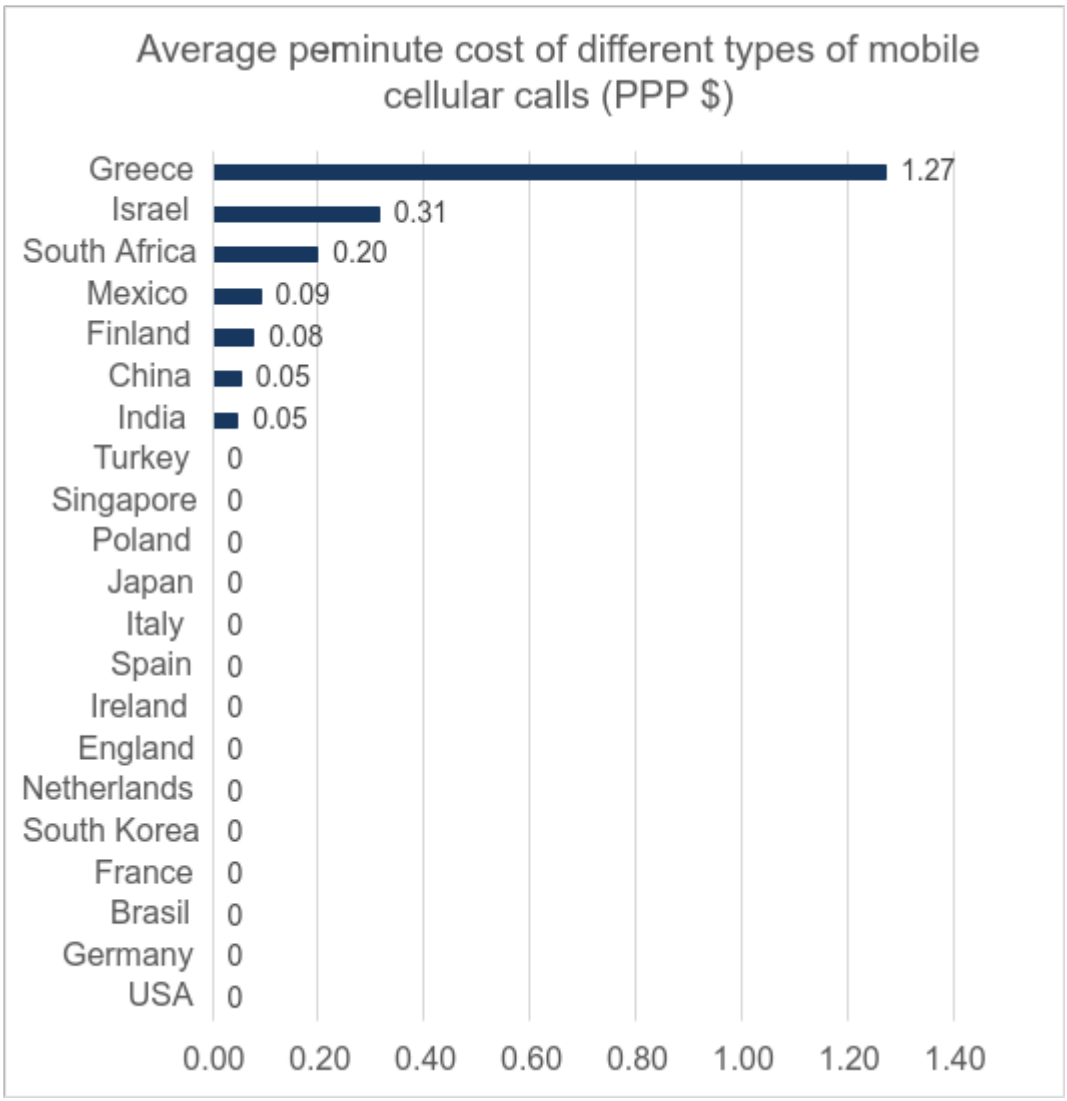
The telecommunications sector is a sector that requires constant renewal as it is closely related to the ICT sector and at the same time has to adapt itself by closely following the developments in the ICT sector. For this reason, it is very important how much of the telecommunication revenues are used as telecommunication investment. The high rate of this investment is an indicator that the infrastructure has been improved. 15.93% of Turkey's telecommunications revenue is used as the reinvestment of telecommunications services (see. Figure 14). Compared with selected countries Turkey is placed fourth-worst, followed by Greece (15.75%), Mexico (11.68%), and South Korea (9.76). It is seen that India, which is at the top of the ranking, utilizes almost all of its annual telecommunication revenues (98.28%) as an investment in telecommunications services (see Figure 14).

Figure 14

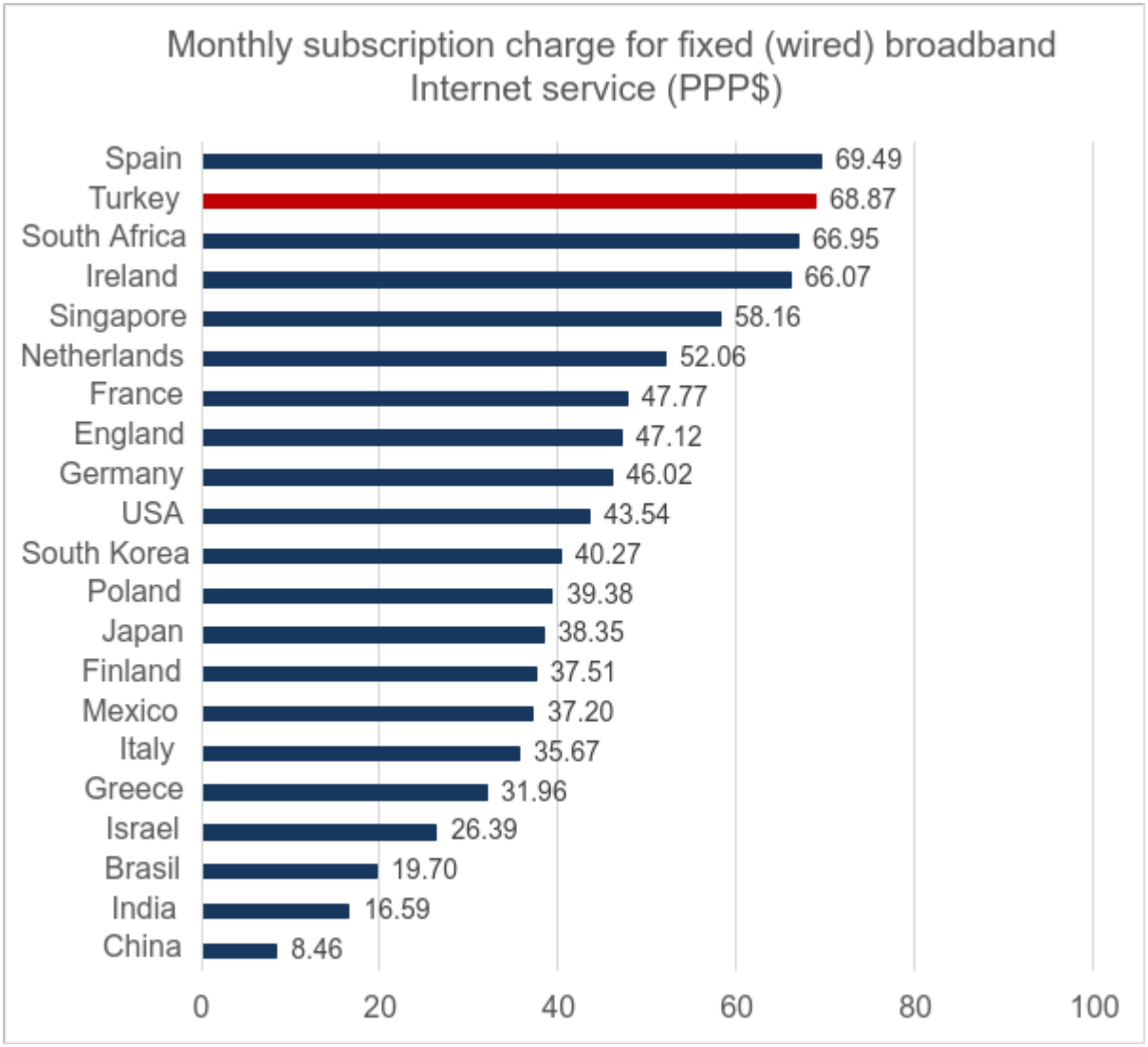


One of the important telecommunications statistics is the average mobile cellular tariffs that show the cost of use. This data is first created by taking the average cost per minute of a local call to a mobile phone in the same network and another network. The cost per minute of a local call to a fixed telephone line is then calculated. However, comparing these data directly between countries may lead to biased results. Because the purchasing power of 1 American Dollar is not the same in every country. For this reason, with the purchasing power parity (PPP) taken from the World Bank's World Development Indicators, dollar amounts have been converted into international dollars. The 1-minute average PPP dollar cost of mobile cellular tariffs in many countries, along with Turkey is close to zero (see. Figure 15). The countries with the highest cost of one-minute local calls are Greece ($ 1.27 SGP), Israel ($ 0.31 SGP), and South Africa ($ 0.20 SGP) respectively.

Figure 15



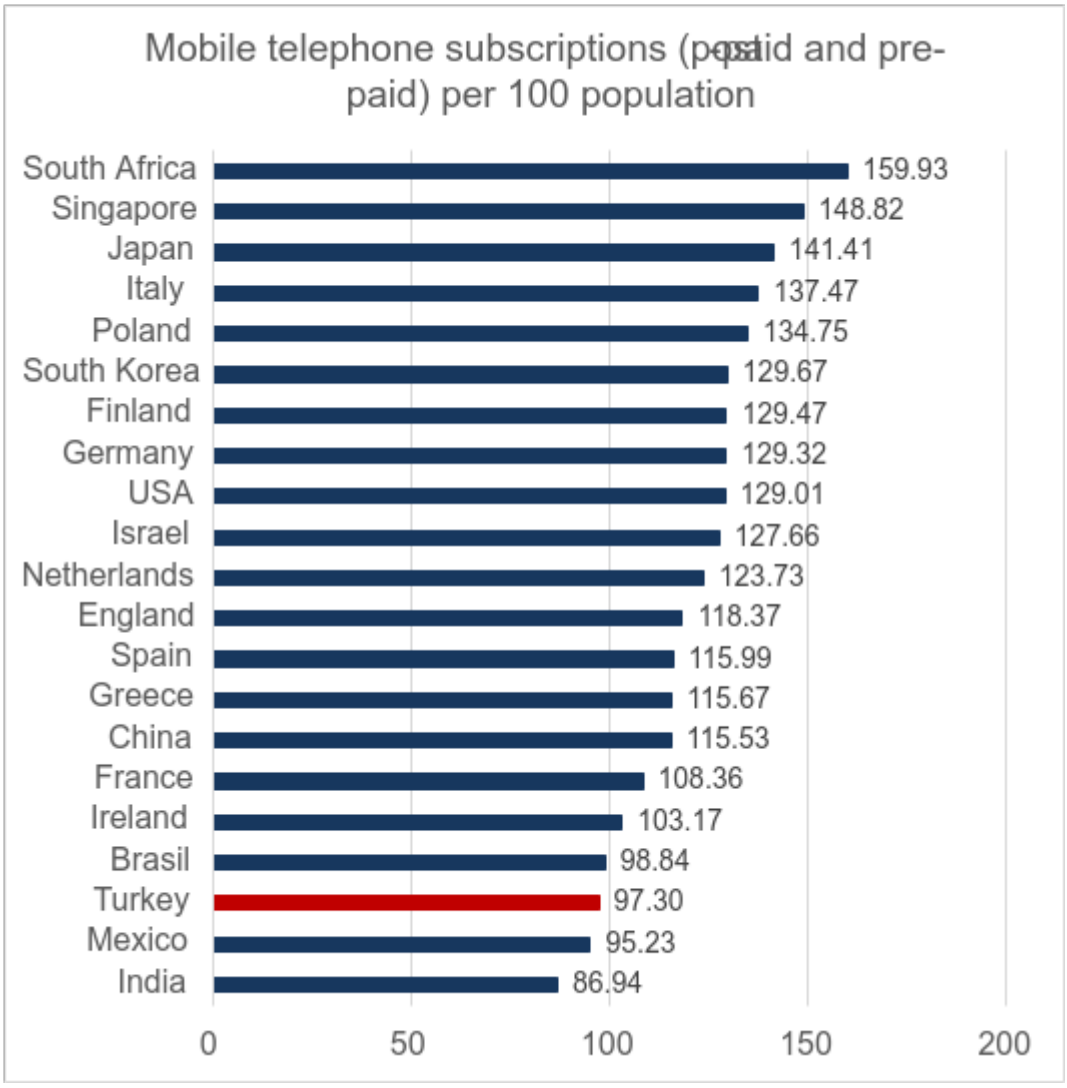
It may be erroneous to interpret prepaid mobile cellular call charges alone. Indeed, the vast majority of communication today takes place as messaging and calls over the Internet. For this reason, it is very important to compare internet call rates as well as mobile call rates. Internet fees are compared over fixed broadband internet tariffs. Fixed (wired) broadband is considered to be any special connection to the Internet at flow rates of 256 kilobits per second or higher. Considering the differences in living costs, the dollar amounts have been converted into international dollars with the purchasing power parity (PPP) taken from the World Bank's World Development Indicators. Turkey, with 68.87 PPP$ comes second after Spain, the countries with the highest broadband fixed monthly tariff fee ($ 69.49 SGP) (see. Figure 16). The countries with the lowest monthly fixed broadband internet tariff fees are China ($ 8.46 SGP), India ($ 16.59 SGP), and Brazil ($ 19.70 SGP). It should be kept in mind that the high populations of China and India may allow internet tariff fees to drop, causing fixed costs per user to be very low.



Today, the importance of mobile phones is increasing in digital transactions. Mobile phone subscription refers to a subscription to a public cellular phone service that provides access to the Public Switched Telephone Network using cellular technology, including active prepaid SIM cards in the past three months. The countries with the highest number of cell phone subscriptions per 100 people in selected countries are South Africa (159.93), Singapore (148.82), and Japan (141.41), respectively.

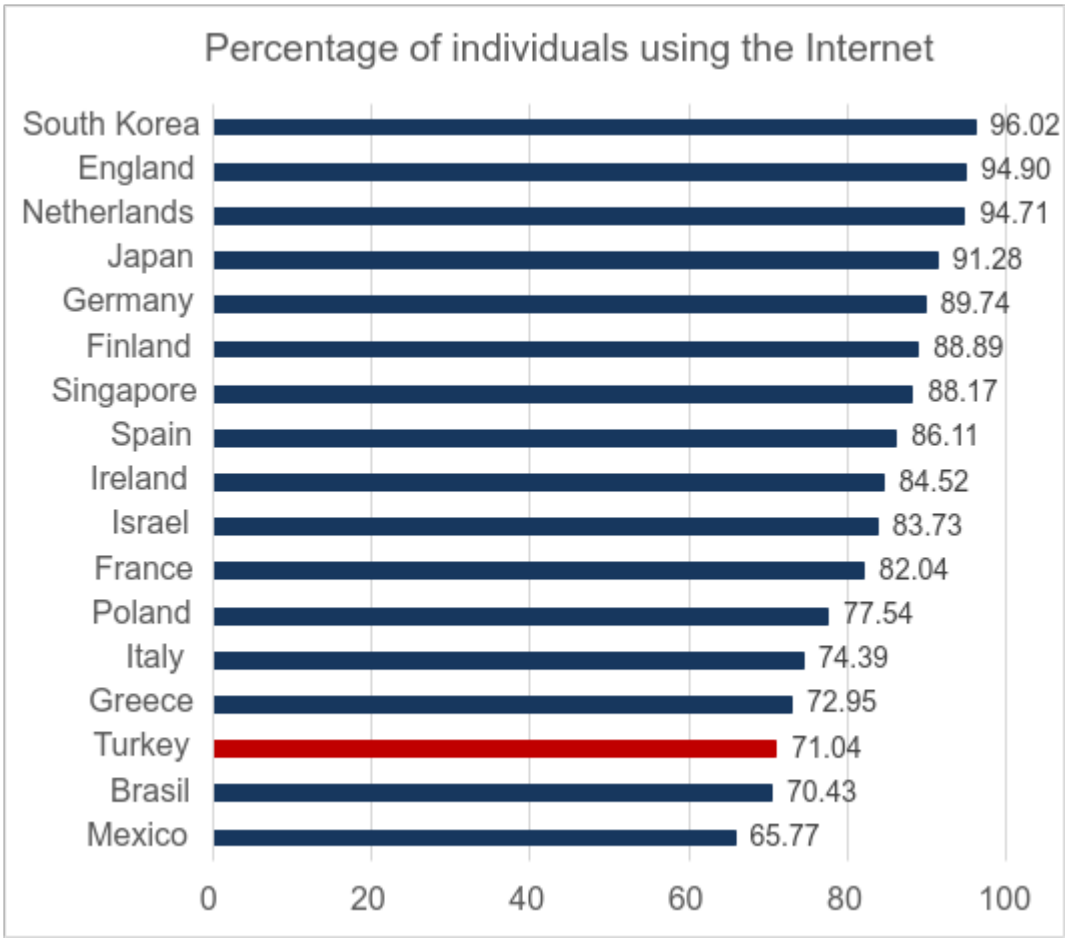
The number of mobile phone subscriptions per 100 people in Turkey is 97.30 (see. Figure 17). Turkey with this number is at a lower placement in the list along with Mexico (95.23) and India (86.23 (see. Figure 17).

Figure 17



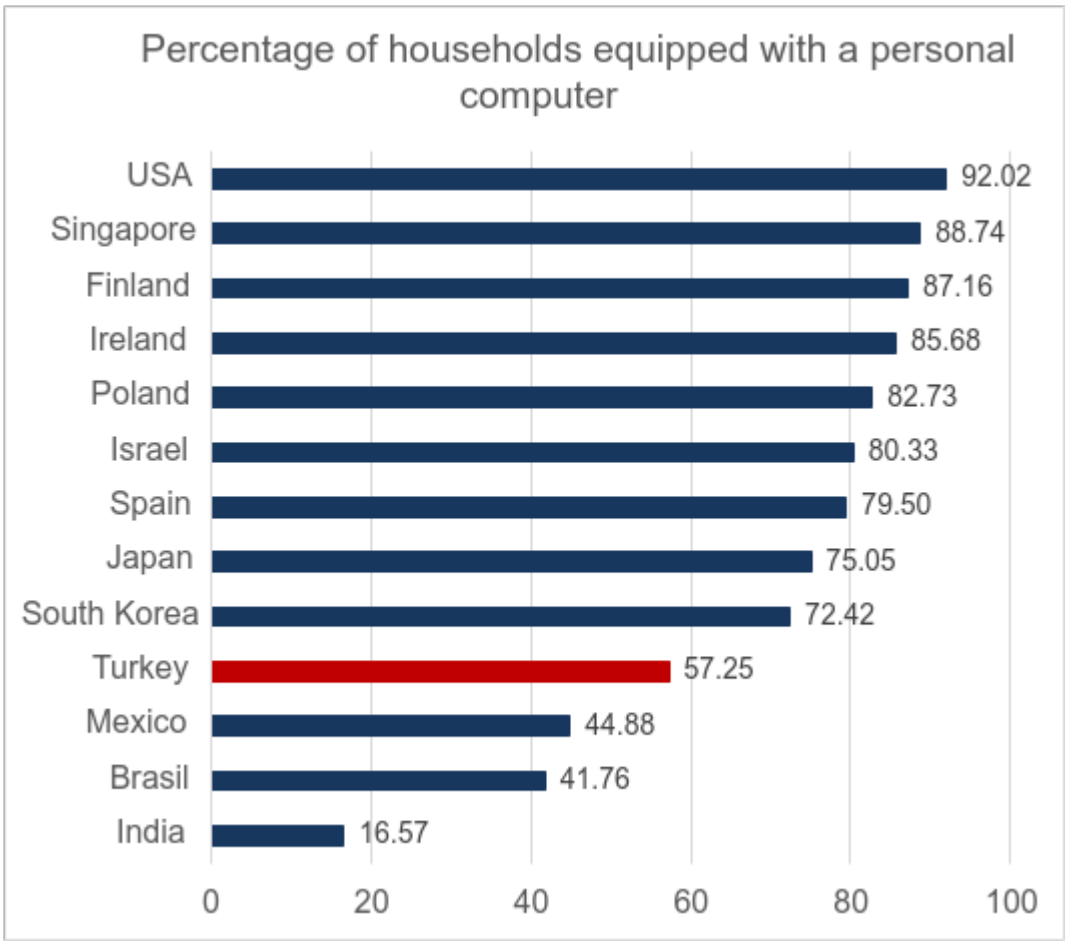
One of the important elements of the transition to the digital economy is the use of individuals' digital technologies on the demand side. In this respect, the high level of individuals using the internet is an important indicator. The percentage of individuals using the internet refers to the ratio of people using the internet to the total population in the last 12 months. The data is usually based on surveys conducted by national statistical offices or estimated by the number of internet subscriptions. The ratio of individuals using the internet in Turkey is 71.04% (Figure 18). Turkey takes the third worst place with below average rates among the selected countries, coming just before Mexico (65.77) and Brazil (70.43). The countries with the highest percentage of individuals using the internet are South Korea (96.02), England (94.90), and the Netherlands (94.71), respectively (see Figure 18).

Figure 18



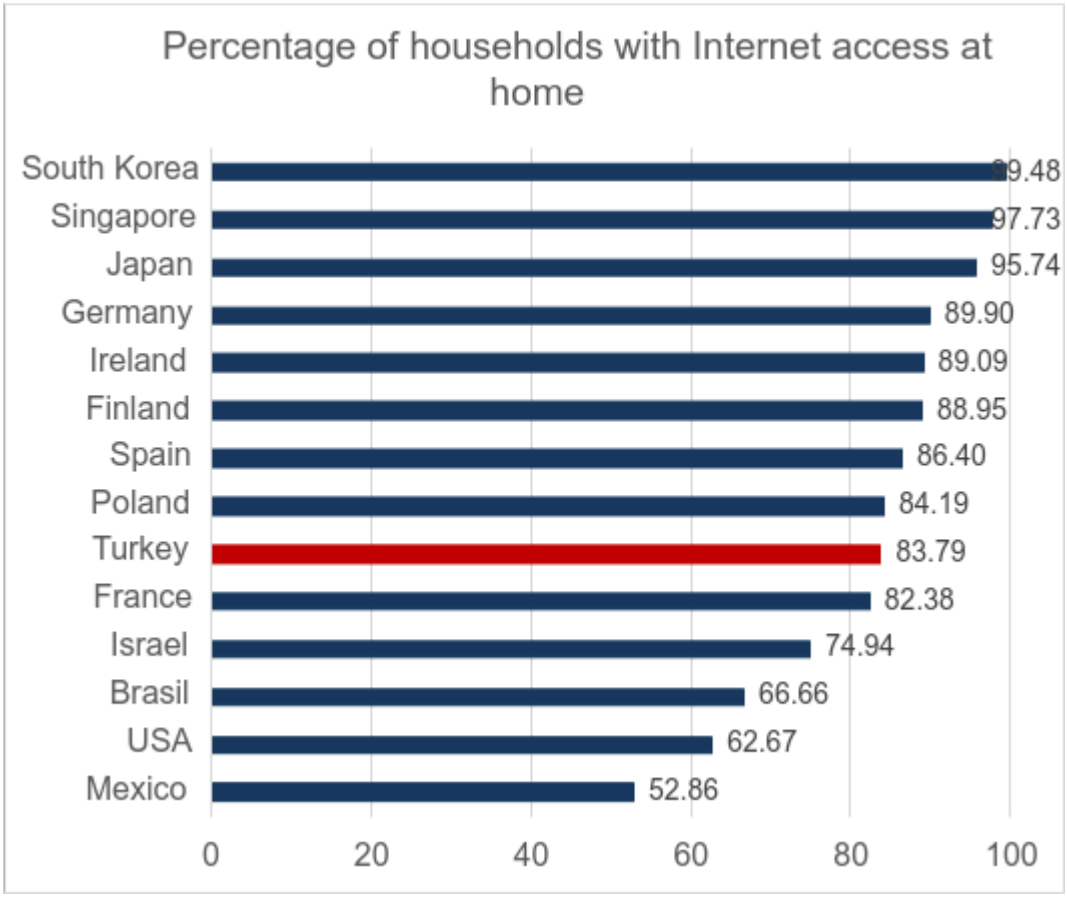
Computer refers to a desktop or a laptop. It does not include equipment with some embedded computing capabilities such as mobile cell phones, personal digital assistants (PDAs), or TV sets. When a comparison is made with selected countries, Turkey with 57,25% is below the average coming in fourth worst place before India (16.57%), Brazil (41.76%), and Mexico (44.88 (See Figure 19). While the country with the highest computerized household ratio is the USA (92.02%), it is followed by Singapore and Finland, respectively, with a computer ownership ratio of 88.74% and 87.16% (see Figure 19).

Figure 19



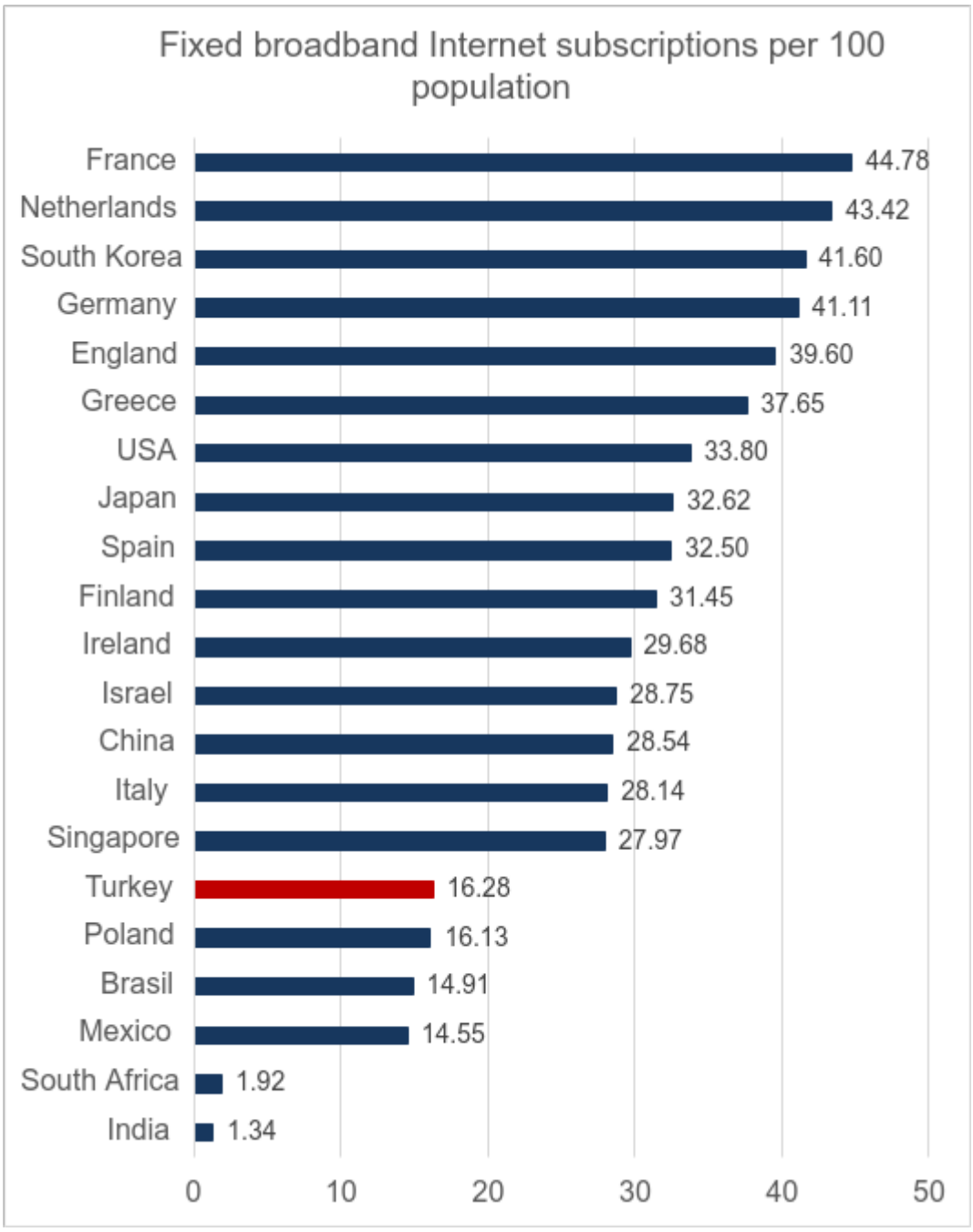
Internet access is undoubtedly as important as computer ownership. The share of households with internet access in households is calculated by dividing the number of households (at least one household member aged 15-74) covered by the total number of households. 83.79% of households in Turkey have internet access (see Figure 20). When a comparison is made with selected countries, Turkey is situated in the middle row of the countries. South Korea (99.48%), is the country with the highest internet access rate in households, followed by Singapore and Japan, respectively, with internet access rates of 97.73% and 95.74%. The countries with the lowest internet access in households are Mexico (52.86), the USA (62.67), and Brazil (66.66) (see Figure 20).

Figure 20



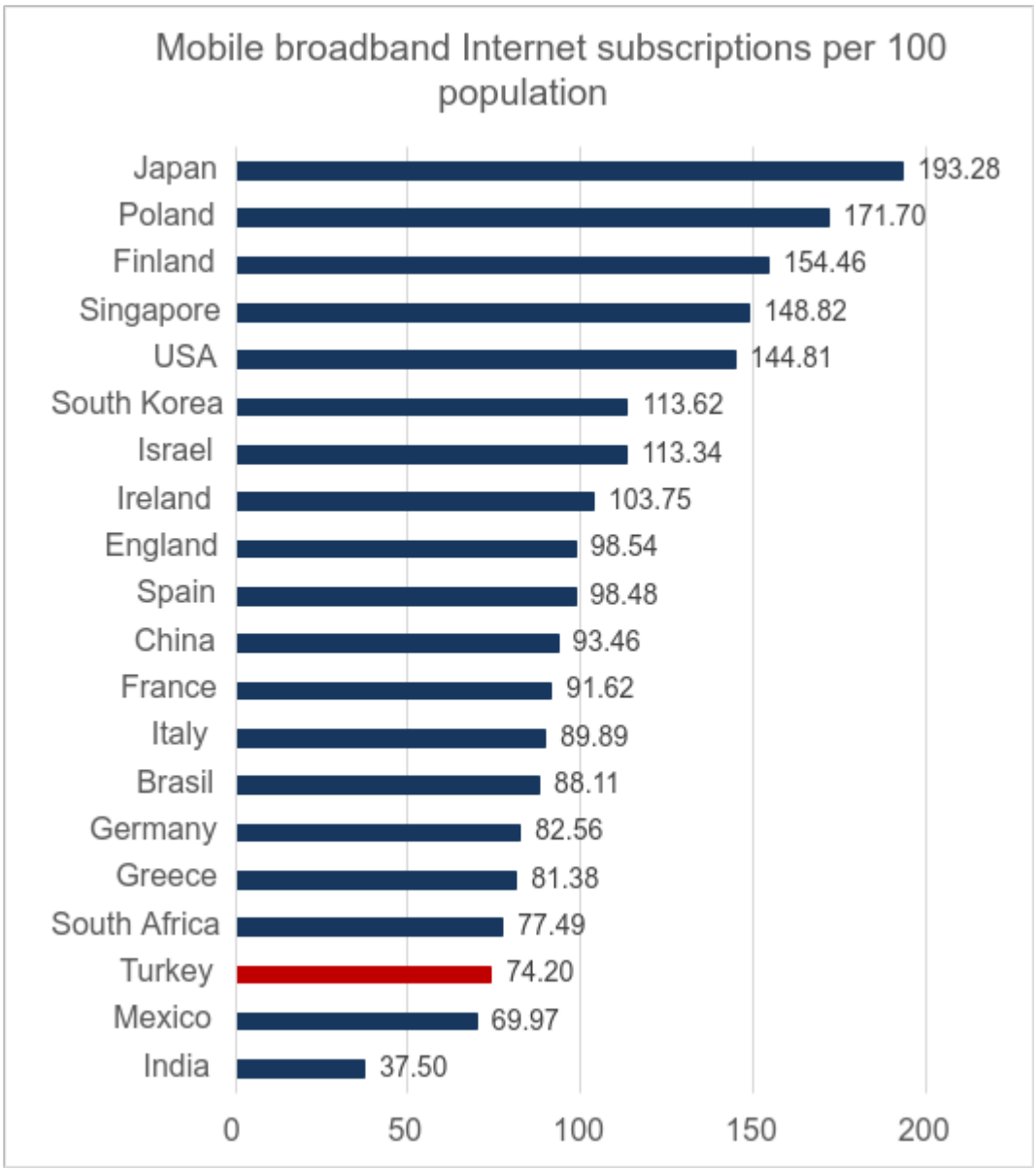
Fixed broadband internet subscriptions include total fixed (wired) broadband internet subscriptions (high-speed access subscriptions to the public internet - a TCP / IP connection - at 256 kbps or greater flow rates). This includes cable modem, DSL, fibre from home/building, and other fixed (cable) band subscriptions. This total is measured regardless of the payment method. It does not include subscriptions with data access via mobile-cellular networks and wireless broadband technologies. Turkey has 16.28 people with fixed broadband internet subscriptions in every 100 people (see. Figure 21). When we compare this with the number of selected countries, we see that Turkey remained below the average of the selected countries. As a matter of fact, the ratio of fixed broadband internet subscriptions in many countries is over 25%. While in France, which is the country with the highest rate, the fixed broadband internet subscription is 44.78%, the percentage of fixed broadband internet subscription in India is only 1.34%.

Figure 21



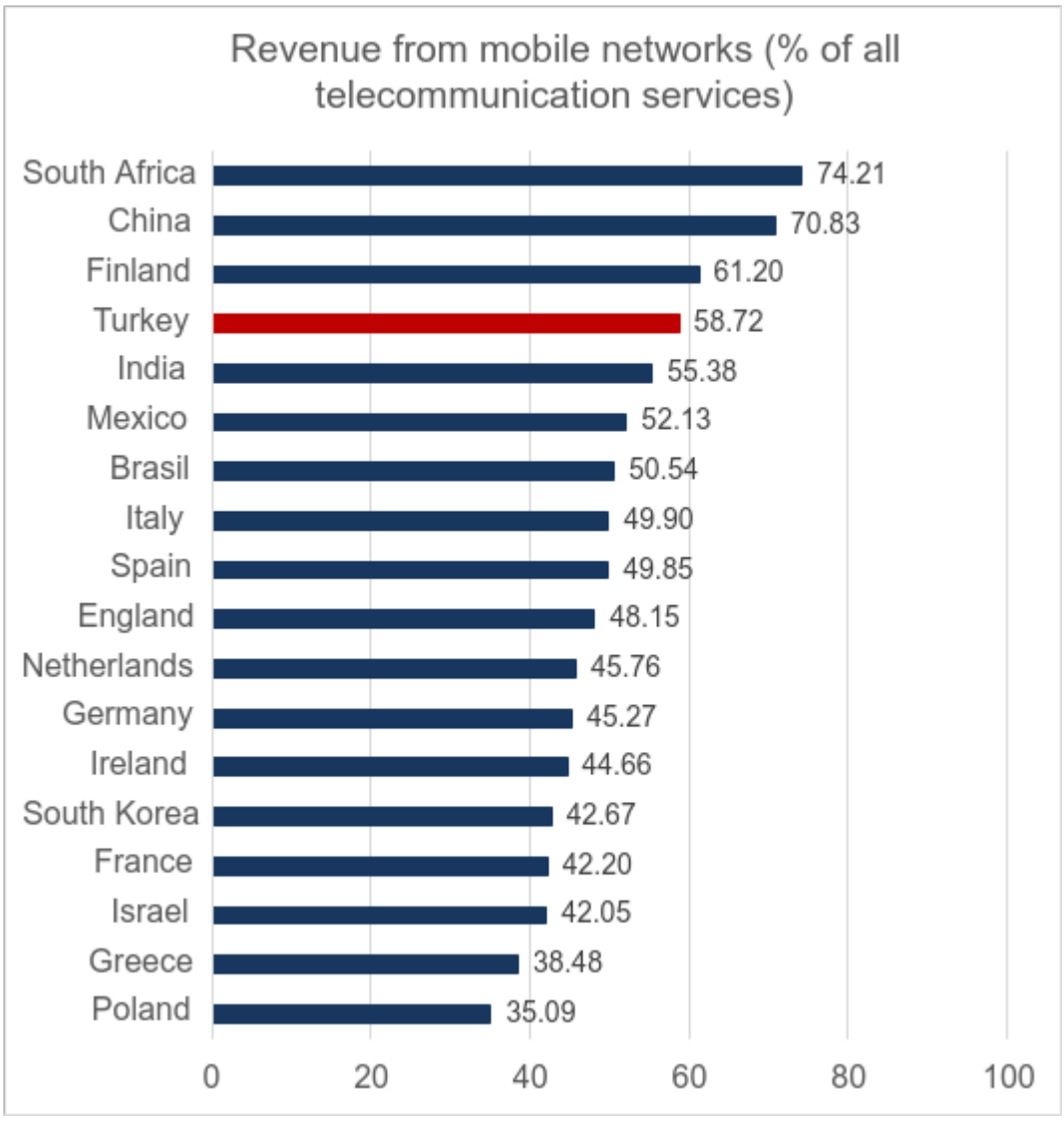
Mobile broadband internet subscription refers to the total of standard mobile broadband and mobile broadband subscriptions allocated to the public internet. It covers real subscribers, not potential subscribers with broadband phones. In Turkey, every 74.20 in 100 people has a mobile broadband internet subscription (see. Figure 22). When we compare this rate with selected countries, Turkey appears to be below average. As a matter of fact, while Japan has 193,28 mobile broadband memberships per 100 persons, which has the highest number of mobile broadband internet memberships, this number is 171,70 and 154,46 in Poland and Finland respectively. Meanwhile, Turkey ranks third-worst just before India (37.50) and Mexico (69.97).

Figure 22



58.72% of the total telecommunications revenue in Turkey consists of income derived from mobile networks (see. Figure 23). This ratio shows that mobile networks have the majority of the market share in the telecommunication sector. Compared to selected countries, this ratio is above average. Among the selected countries, the highest ratio of revenues from mobile networks to total telecommunication services is South Africa (74.21%), China (70.83%), and Finland (61.20%). The countries with the lowest rate are Poland (35.09%), Greece (38.48%), and Israel (42.05%).

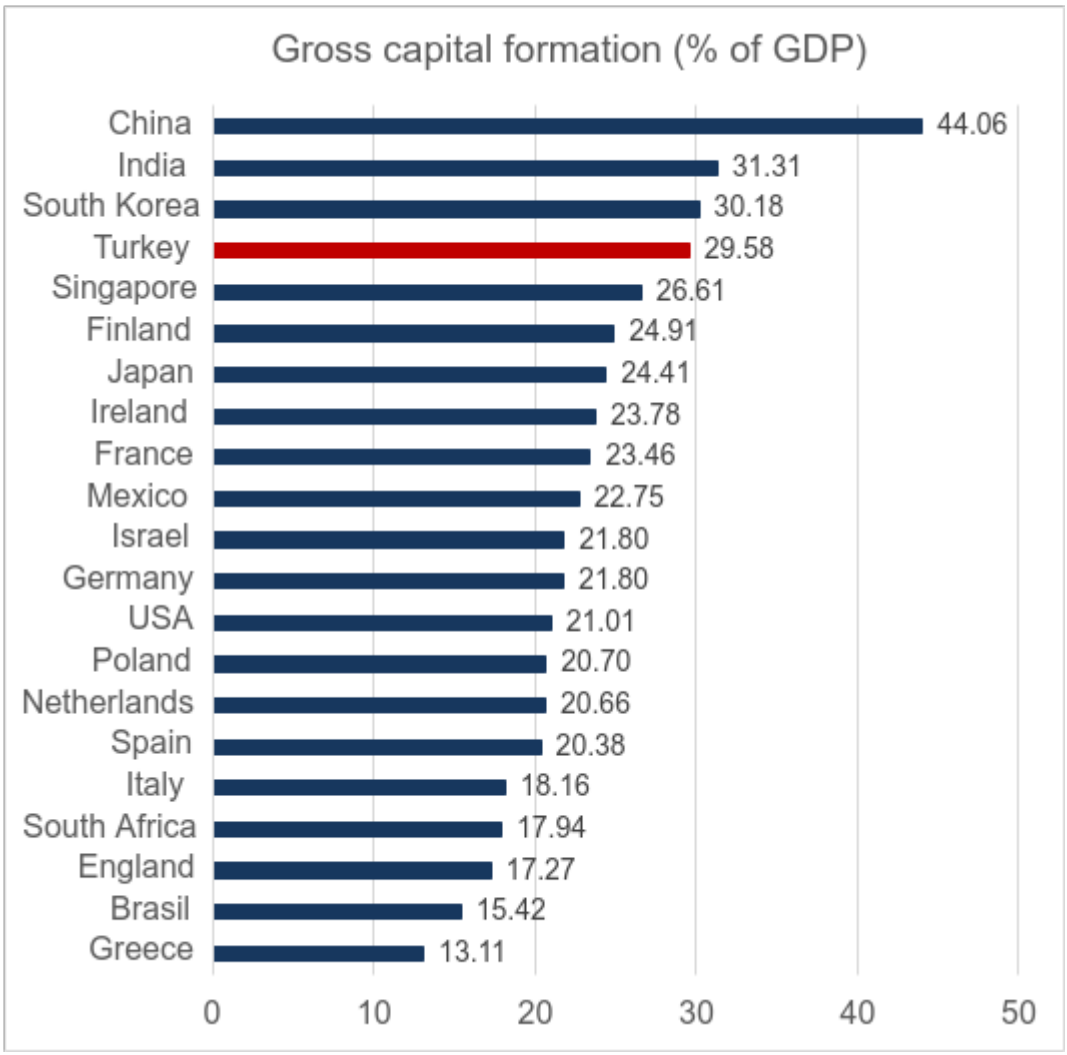
Figure 23



The investment level of a country determines the future production capacity of that country. Gross capital formation is a term used to describe the net capital accumulation for a given country over an accounting period. This term refers to the addition of capital goods such as equipment, tools, transport assets, and electricity.

Countries need new capital goods to renew old capital used in the production of goods and services. If a country does not renew its capital goods despite the end of its useful life, production will decrease. In general, the higher the capital formation of an economy, the faster it can increase its total income. Turkey's gross capital formation ratio is 29.58% (see. Figure 24). When a comparison is made with selected countries, this ratio is above average. While the ratio in China, which is the country with the highest gross capital formation, is 44.06%, this ratio is 13.11% in Greece, which is the lowest country.

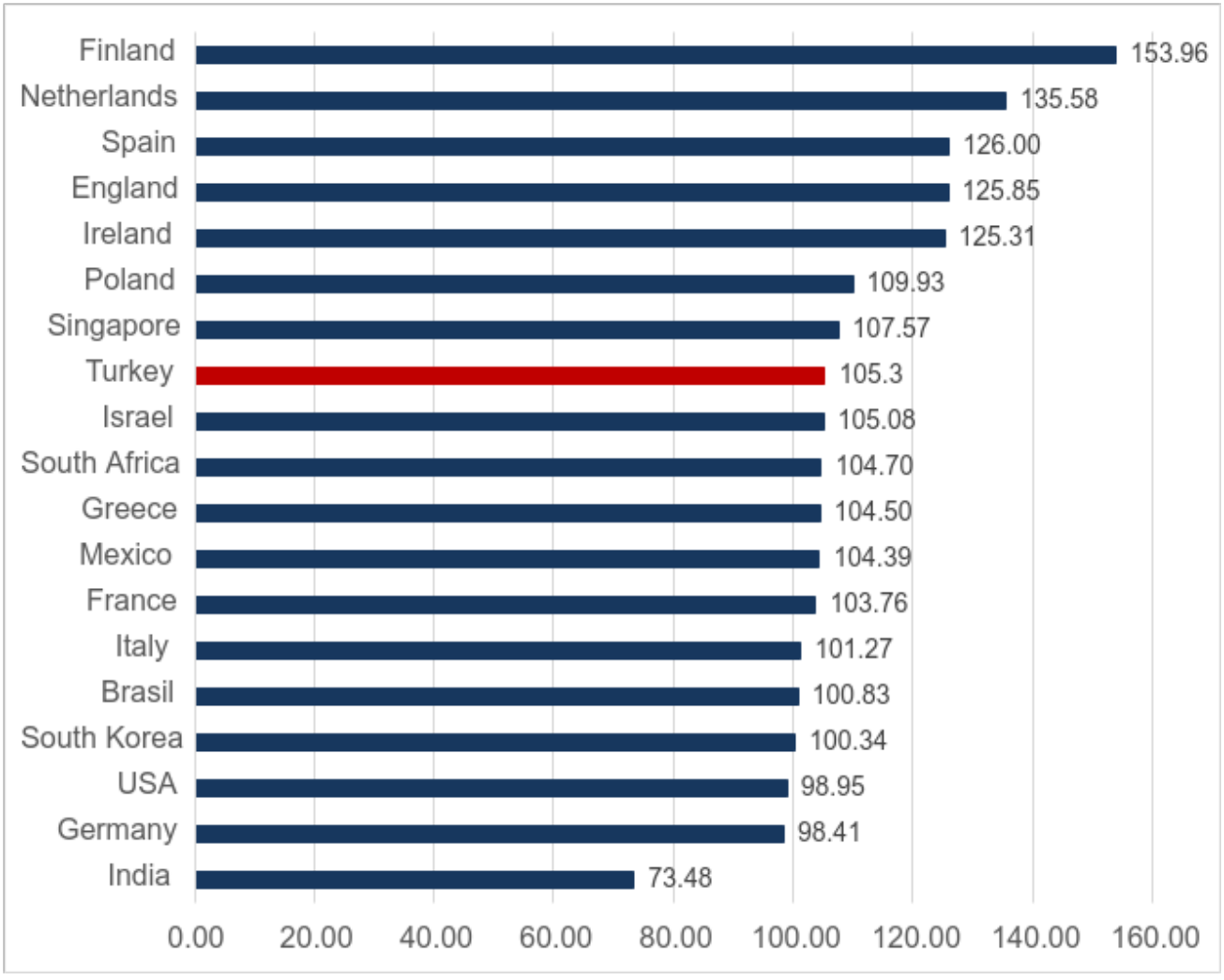
Figure 24



Another development indicator related to education is the enrolment rate in secondary education. The enrolment rate in secondary education corresponds to the ratio of the total enrolment rate (regardless of age) to the population of the age group corresponding to the secondary level. The most important point to be considered in interpreting this statistic is that this rate may exceed 100%.

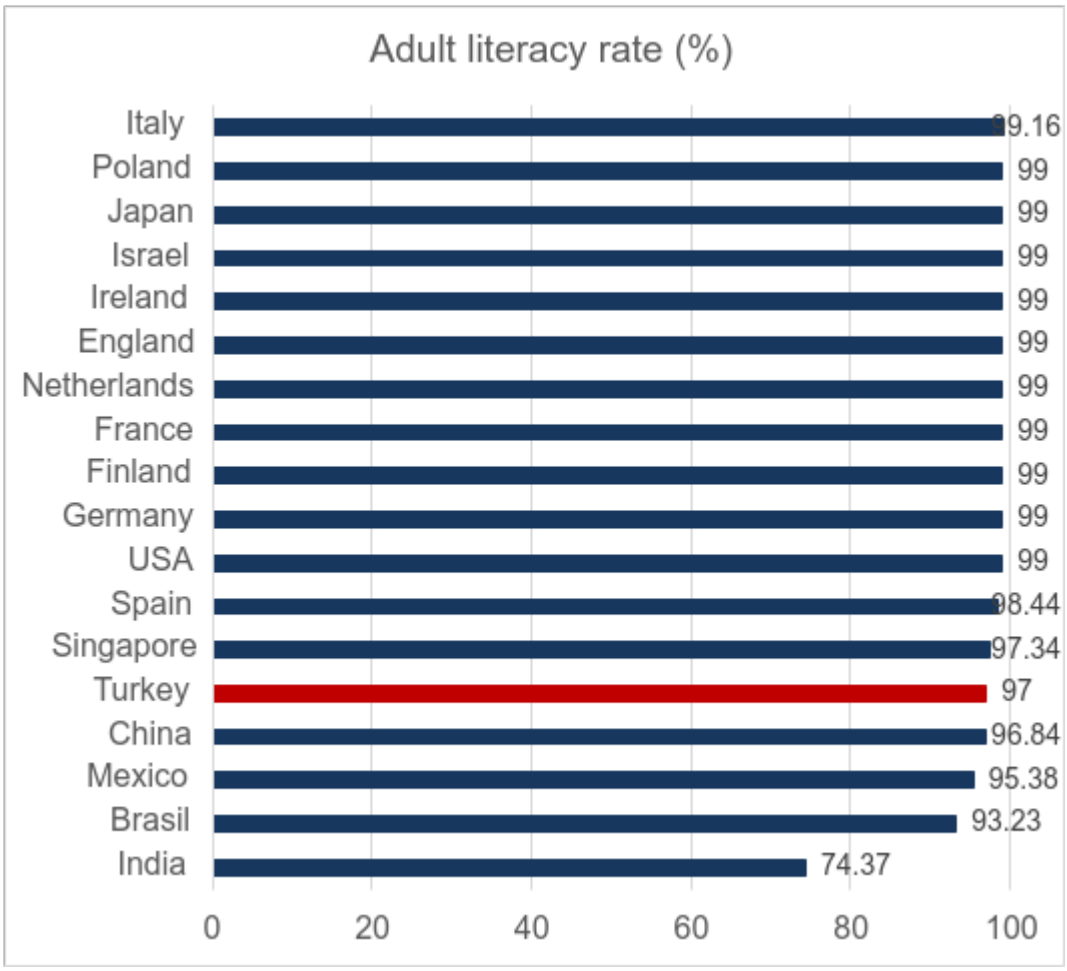
Even if it is over 100%, it does not mean that the entire age group corresponding to the secondary level enrolls in secondary education. As a matter of fact, with the philosophy of "lifelong education" in many countries, age barriers to education have been removed, and with this policy, people in middle and advanced age groups who have not had the opportunity to enroll in secondary education have also enrolled in secondary education. Turkey is positioned in the middle with a secondary education gross enrolment rate of 105.3% among selected countries (see. Figure 25). In Finland and India, which have the highest and lowest enrolment rates in secondary education, this rate is 153.96% and 73.48%, respectively.

Figure 25 Secondary education gross enrollment rate (%)



The literacy rate is one of the important indicators of development in a country and has been important in the spread and deepening of all industrial revolutions in the past. The literacy rate is defined as the percentage of the population aged 15 and over in a country who can read and write, understand a short, simple statement about daily life. In Turkey, the literacy rate is 97% (see. Figure 26). In comparison with selected countries, the literacy rate of Turkey, along with China (96.84), Mexico (95.38), Brazil (93.23), and India (74.37) appears to be lower than the average. The country with the highest literacy rate is Italy with a rate of 99.16%.

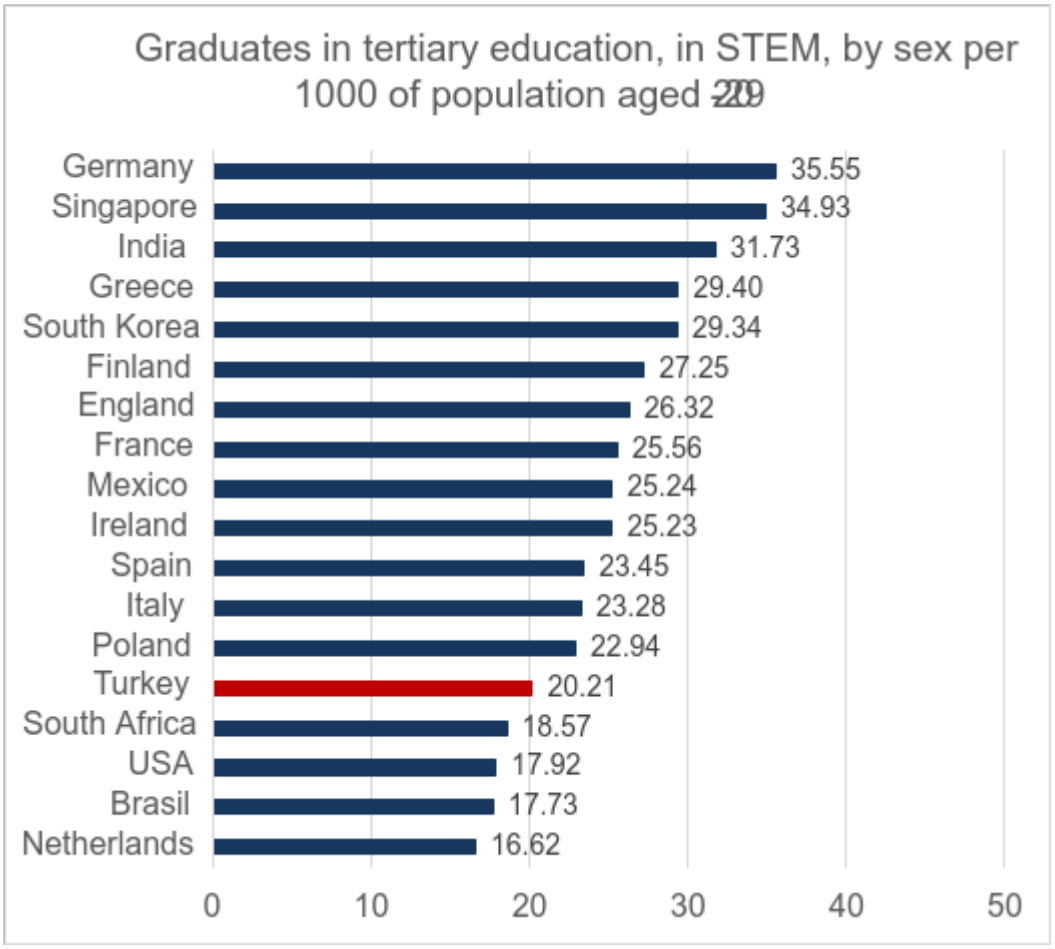
Figure 26



The capacity required by the Fourth Industrial Revolution in the field of science and technology is greater than in any previous industrial revolutions. Continuous and striking changes in the field of science and technology today affect the demand in the labor market, increasing the need for more and more qualified employees in the field of STEM (science, technology, engineering, and mathematics). The number of higher education graduates in the STEM fields in Turkey in the 20-29 age range is 20.21 in every 1000 people (see. Figure 27).

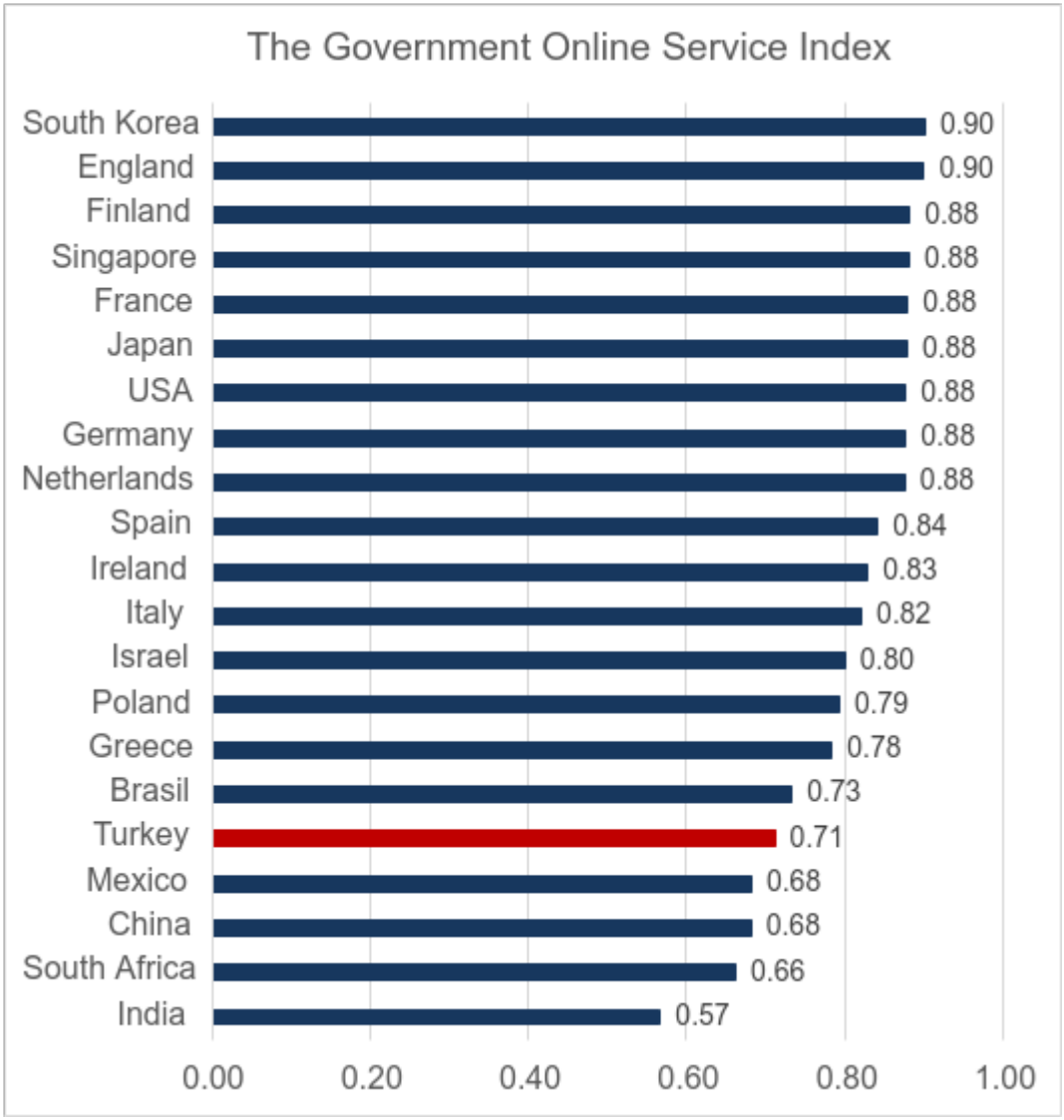
Compared to selected countries, this figure is below average. The Netherlands is at the bottom of the list, with 16.62, while in Germany, which is at the top of the list, this figure is 35.55.

Figure 27



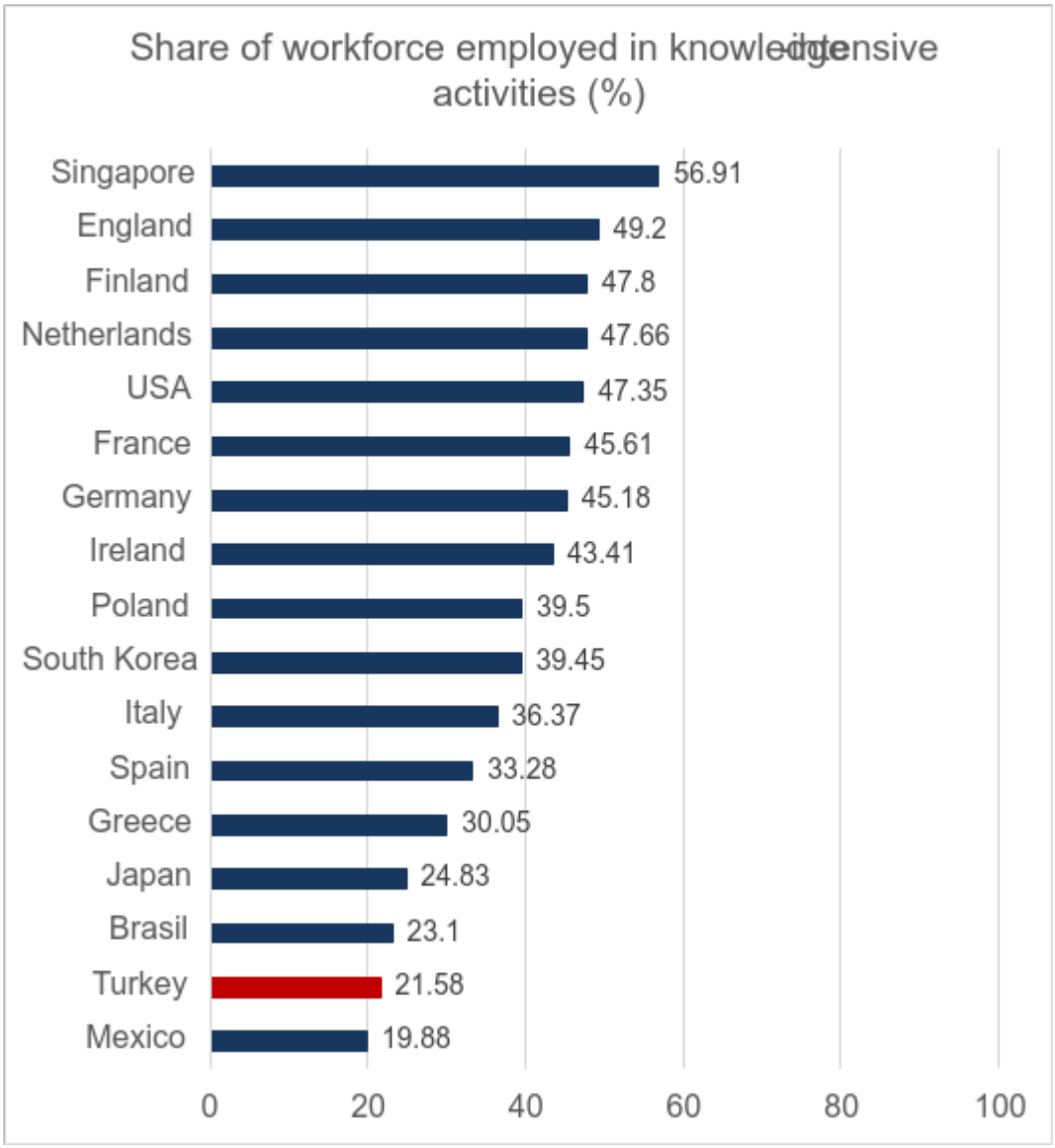
When we look at the countries that stand out in all previous industrial revolutions, it is seen that public policies in these countries have played a very important role. According to the United Nations Public Administration Network, the Government Online Service Index measures a government's performance in providing online services to citizens. There are four stages of service delivery: emerging, advanced (enhanced), online transactional, and connected. Online services are assigned to each stage according to their degree of development. In each country, the government's performance in each of the four phases is measured as a percentage of the maximum number of services that can be offered at that stage. Finally, an Online Utilities Index between 0 and 1 is created with percentages from all stages. The proliferation of online public services is important in terms of reducing processing time and costs. Turkey's Online Utilities Index value is 0.71 (see. Figure 28). Compared with selected countries Turkey is ranked 5th worst just before India (0.57) South Africa (0.66), China (0.68), and Mexico (0.68). The index scores of South Korea and England, which are at the top of the list, are 0.90.

Figure 28



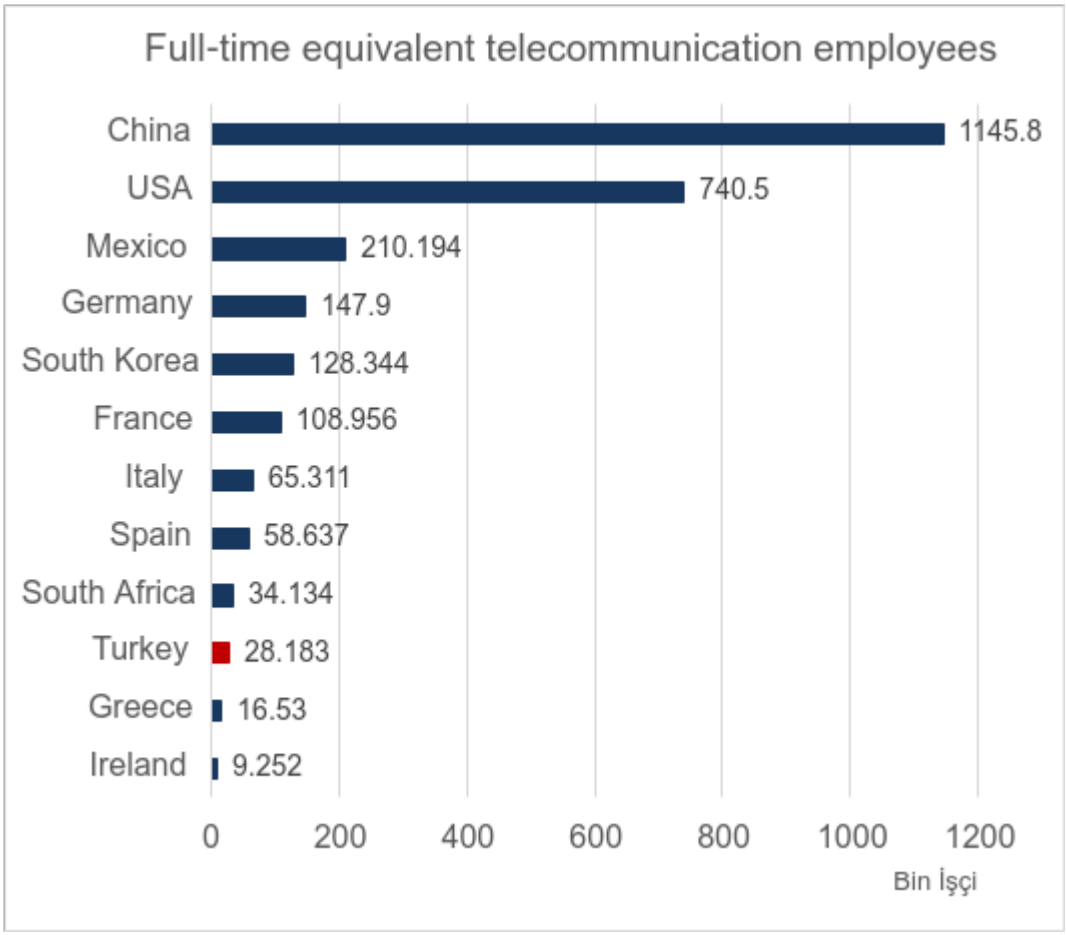
The prevalence of information-intensive activities in a country is important for the potential of that country to switch to a digital economy. The rate of the workforce employed in knowledge-intensive activities corresponds to the "Managers, professionals and technicians" from the aggregated International Labor Organization (ILO) occupational categories specified in the ILOSTAT database. This ratio is important in terms of giving an idea about the employment and production structure of the country. The proportion of the workforce employed in knowledge-intensive activities in Turkey is 21.58% (see. Fig. 29). This rate is quite low compared to selected countries. Indeed, Turkey is second from last with 21.58%, followed by Mexico (19.88%). The countries with the highest labor force employed in knowledge-intensive activities are Singapore (56.91%), England (49.20%), and Finland (47.80%).

Figure 29



The telecommunications sector is of particular importance in information-intensive activities in a country. The number of full-time telecommunications employees corresponding to a population of 1 million people shows the size of the communication sector in a country, the importance, and capacity of the sector. In Turkey, there are 342 full-time telecommunication employees in every 1 million people in the population (see. Figure 30). With this number, Turkey ranks last with a clear gap compared to the selected countries. South Korea (2486) USA (2263) and Ireland (1906) are the countries with the highest number of full-time telecommunications employees serving each population of 1 million. This statistic shows that Turkey isn't sufficiently developed in the telecommunications industry and is limited in service capacity.

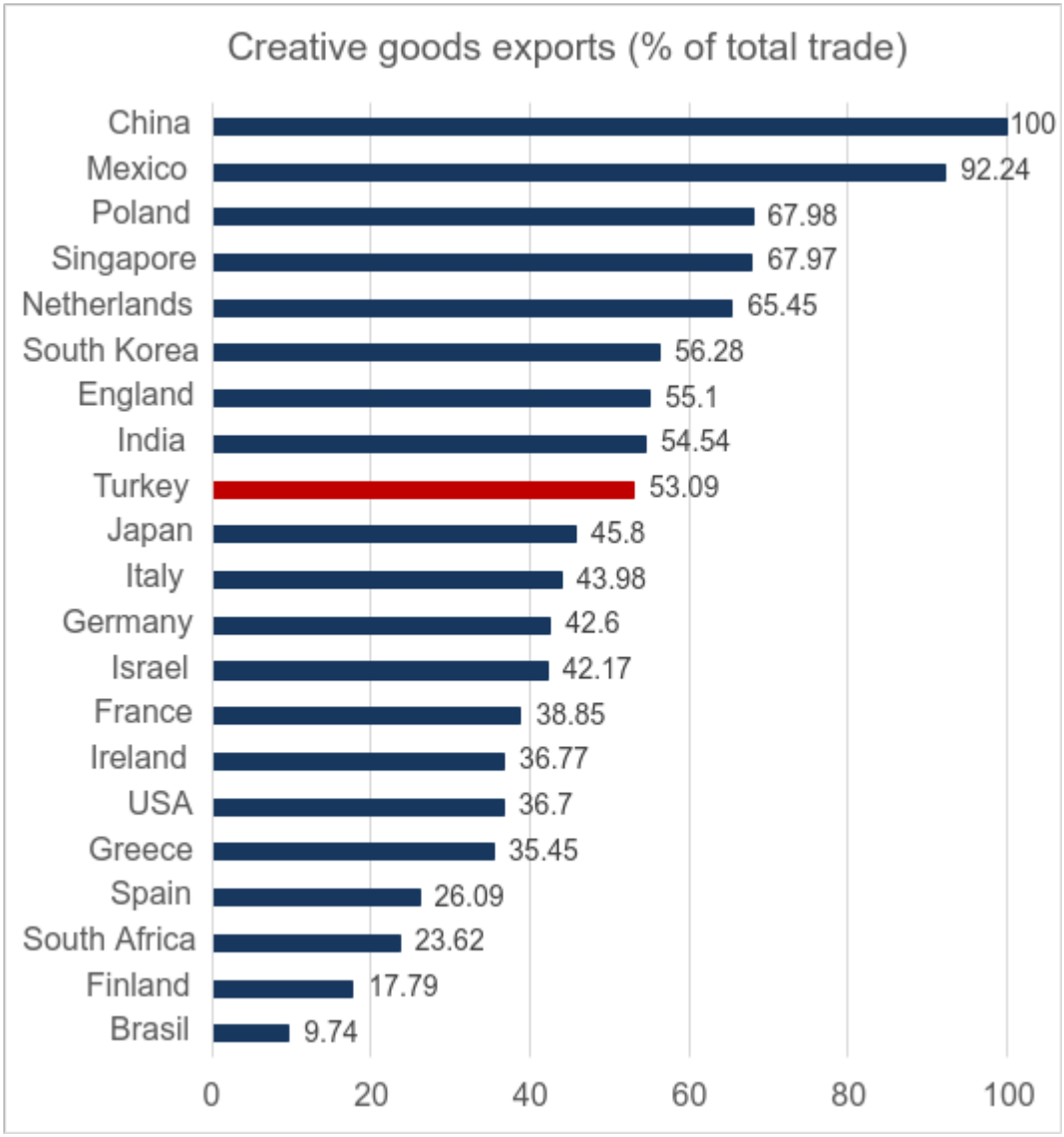
Figure 30



Today, creative industries are among the most dynamic sectors in the world economy, offering new opportunities for developing countries to achieve higher growth rates. Export of creative industries such as advertising, architecture, arts and crafts, design, fashion, film, video, photography, music, performing arts, publishing, research and development, software, computer games, electronic publishing, and TV/radio is included in the exports of creative goods. These products are considered a source of commercial and cultural value. Looking at the share of total exports of design products, we see that Turkey's exports amounted to 53.09% of the total trade of design products (see. Figure 31). When a comparison is made with selected countries, Turkey is seen to be in the middle row.

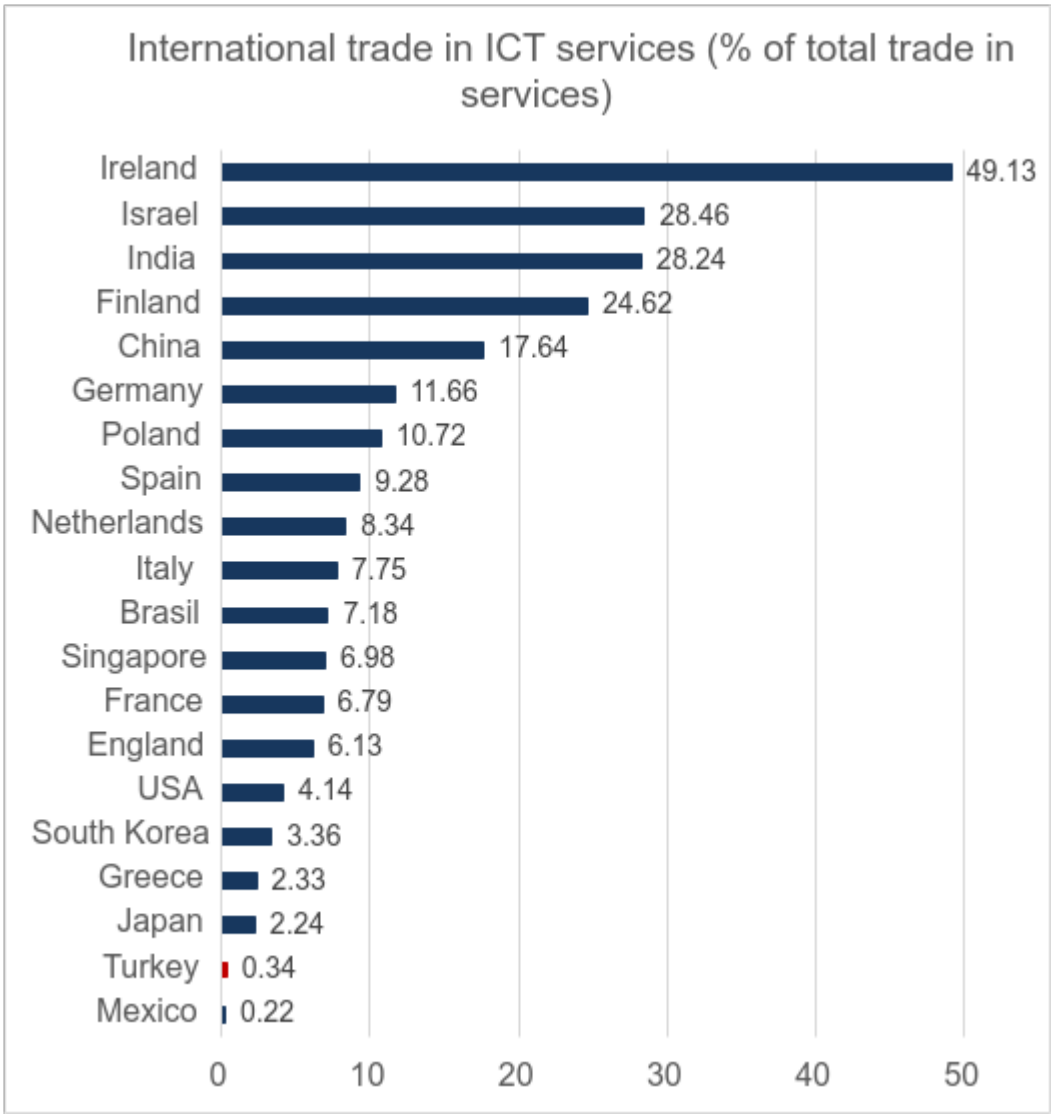
The whole of total trade of China, which is the country with the highest ratio of design exports to total trade, consists of exports of creative goods. Only 9.74% of the total trade of Brazil, the country with the lowest ratio, is from creative goods exports.

Figure 31



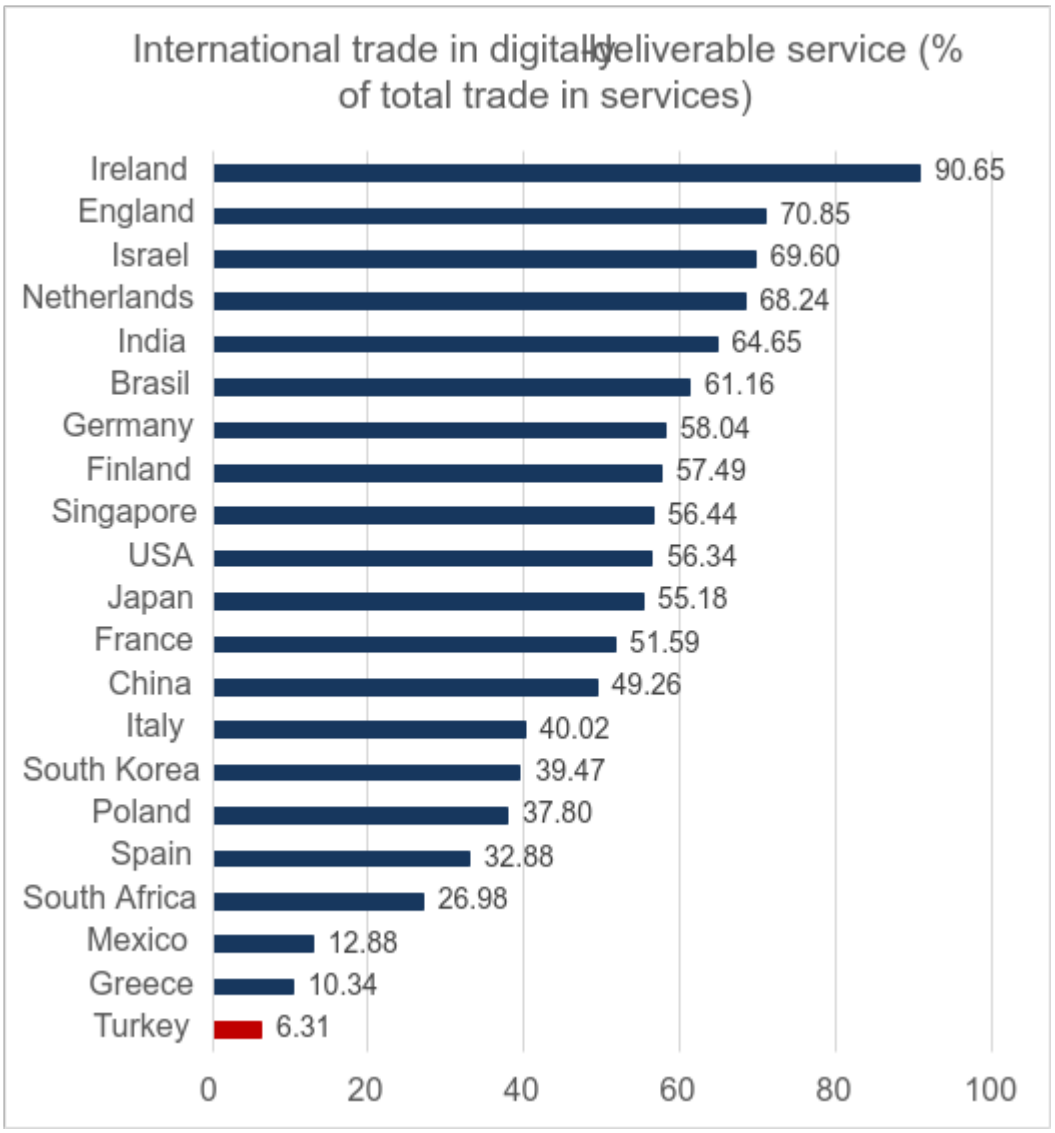
As much as it is important to export creative goods as products, it is equally important for an economy to export ICT services as a service export. Because the share of the exports of ICT services in the total services trade shows both how developed that country is in ICT services and how much it has a say in the world ICT services trade. Only 0.34% of total trade in services exports in Turkey is composed of ICT services. This ratio is quite low compared to other selected countries but in this case, this may be caused by the Telegraph and Telephone Law No. 406 where all kinds of telecommunication services and telecommunications infrastructure business executive authority in Turkey is issued to Turk Telekom. While the lowest share of ICT services exports in total services trade is Mexico (0.22%), the highest countries are Ireland (49.13%), Israel (28.46%), and India (28.24%) (See Figure 32).

Figure 32



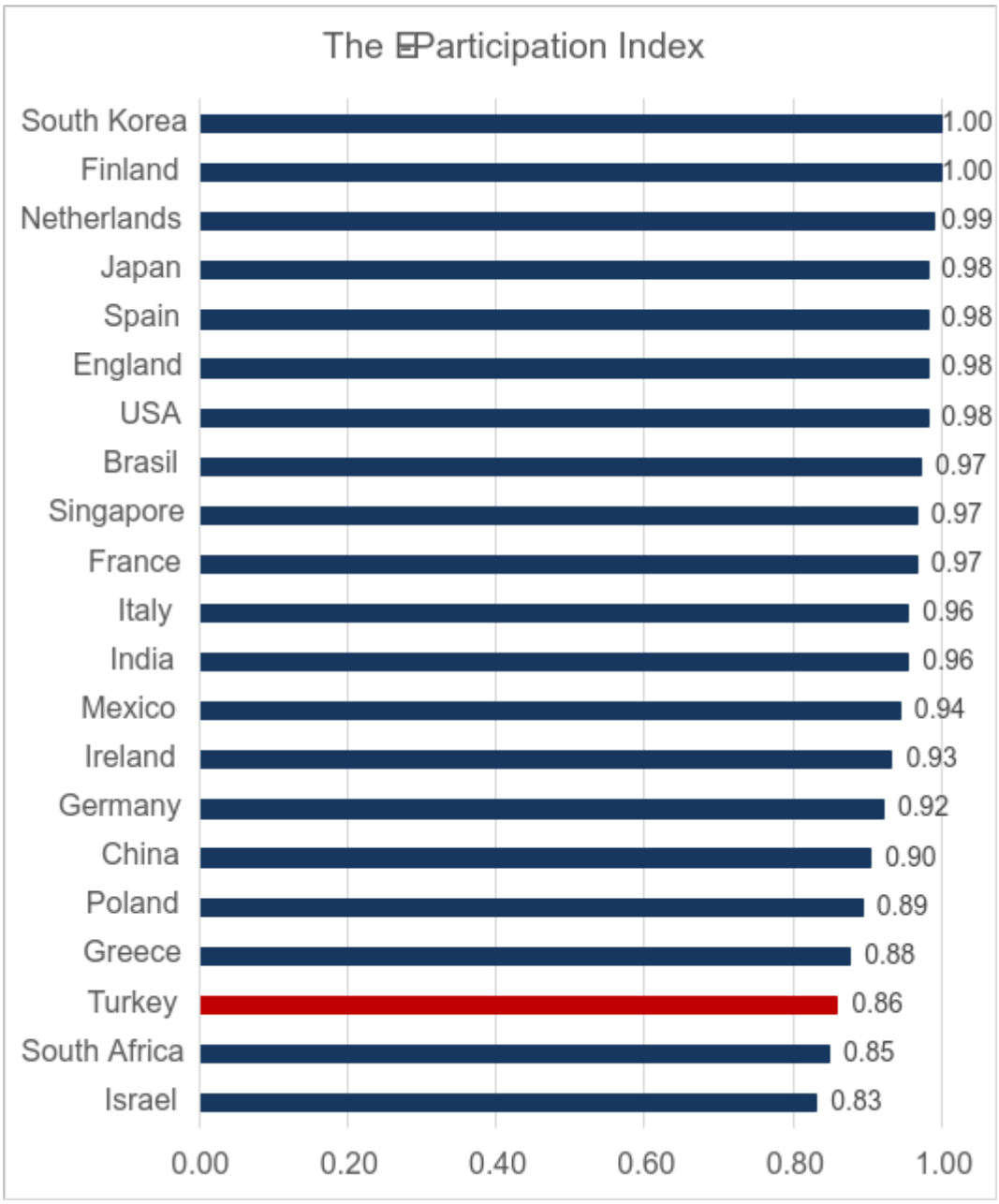
The Internet has an effect similar to the effect of container transportation on commodity trade, enabling the services trade, which was once impossible to trade, to be delivered without any limitation. In this way, all kinds of services that can be sold and distributed online to anyone with internet access are defined as digitally deliverable services. Digitally deliverable service exports are measured by their share in total service trade. Digitally deliverable services in Turkey's exports constitute only 6.31% of the total trade in services (see. figure 33). This rate is 90.65% in Ireland, which is the highest share of digitally deliverable service exports among the selected countries in total service trade, 70.85% in England, and 69.60% in Israel.

Figure 33



The public sector can be one of the important accelerators of transition to a digital economy with its e-Government services. According to the United Nations, the e-participation Index evaluates the quality and usefulness of the information and services provided to involve its citizens in public policymaking, using the e-Government programs provided by a country. In the e-participation Index, countries are compared in three areas: e-information, e-consultation, and e-decision making. The index measures the capacity and willingness of the state to encourage citizens to make participatory decision-making and access to their own social inclusive governance program in public policy. When the e-participation index values between 0 and 1 in selected countries, Turkey's index score of 0.86 positions Turkey at third-worst followed by Israel(0.83), and South Africa (0.85) (see. Fig. 34). South Korea and Finland, the countries with the highest e-participation Index score, have an index score of 1.00.

Figure 34



TURKEY'S DIGITAL TRANSFORMATION INDEX

Turkey’s adaptation to digital transformation is calculated on a grade out of 5. For constructing the Index, along with the extensively examined indicators in the section entitled "Status of digital transformation in Turkey”, we also benefited from in-depth interviews with opinion leaders and the results of a survey administered within the business community. Details of the method are explained in the chapter Calculation of the Digital Transformation Index.

In Table 1 **Digitalization Index** and the numerical values of the sub-components of this index are given for the years 2019 and 2020. Turkey's Digitization Index for 2019 and 2020 is calculated as 2.94 and 3.06 out of five respectively. It can be said that there is a 4% improvement in the index value in 2020 from 2019. While the sub-index that negatively affects the index the most is “Impact” (for 2019 it is 2.81 and for 2020 it’s 2.88), the sub-index that contributes most is “Readiness”. The index value of "Readiness" is 3.24 for 2020.

It is useful to examine each component that forms the digitization index and each sub-dimension that creates these components separately.

1. Environment Sub-index

Turkey's "Environment" sub-index was calculated as 2.94 for 2019 and 3.06 for 2020 (see Table 3). It can be said that there has been a relative improvement from 2019 to 2020. The two pillars of this index value ("Political and Regulatory Environment" and "Business and Innovation Environment") contribute similarly to the environment sub-index. The index values of these two sub-dimensions are very close to each other. However, it can be said that the sub-components of these two pillars display a highly heterogeneous structure.

Table 3

	2019	2020
TUBİSAD Digitalization Index	**2,94**	**3,06**
ENVIRONMENT SUBINDEX	**2,87**	**2,95**
1st pillar: Political and regulatory environment	2,76	2,82
2nd pillar: Business and innovation environment	2,98	3,09
READINESS SUBINDEX	**3,19**	**3,24**
3rd pillar: Infrastructure	2,34	2,27
4th pillar: Affordability	4,54	4,54
5th pillar: Skills	2,69	2,89
USAGE SUBINDEX	**2,88**	**3,16**
6th pillar: Individual usage	3,20	3,22
7th pillar: Business usage	2,77	3,32
8th pillar: Government usage	2,66	2,92
IMPACT SUBINDEX	**2,81**	**2,88**
9th pillar: Economic impacts	2,36	2,18
10th pillar: Social impacts	3,26	3,58

The worst performing sub-component of the “Political and Regulatory Environment” pillar that constitutes the “Ecosystem” sub-index is the “Effectiveness of law-making bodies” sub-component (see Table 4). The index value of this component was calculated as 1.87 in 2019 and 1.96 in 2020. It can be said that this situation is a very serious obstacle for Turkey’s digitalization. Another important sub-component adversely affecting "Political and Regulatory Environment” is “Efficiency of the legal system in settling disputes". The value of this component has been calculated as 2.15 for the year 2020.

Table 4. Political and regulatory environment

	2019	2020
ENVIRONMENT SUBINDEX	**2,87**	**2,95**
1st pillar: Political and regulatory environment	**2,76**	**2,82**
1.01 Effectiveness of law-making bodies	2,24	2,36
1.02 Laws relating to ICTs	2,58	2,72
1.04 Efficiency of legal system in settling disputes	1,87	1,96
1.05 Efficiency of legal system in challenging regulations	2,06	2,15
1.06 Intellectual property protection	2,41	2,42
1.07 Software piracy rate, % software installed	2,75	2,78
1.08 Cost for enforcing contract (% of claim)	4,33	4,33
1.09 Number of days to enforce a contract	3,85	3,81

The two subcomponents that positively affect the pillar "Political and regulatory environment" in Turkey's digitization index are "Cost for enforcing contract" and "number of days to enforce a contract". These two sub-components are 4.33 and 3.81, respectively, in 2020. It can be said that Turkey's relatively good at these two topics. Another dimension that constitutes the "Environment" pillar is "Business and innovation Environment''. The worst index value of this pillar, at 1.85, is "Research and Development expenditure (% of GDP)" (see Table 5). This is a phenomenon we already encountered in every analysis regarding Turkey. Other factors that disrupt innovation and the investment environment in Turkey are "Government procurement of advanced technology products" and the lack of "Quality of management schools" and "venture capital availability" challenges. The three subcomponents that Turkey is good at in Innovation and investment environment are "availability of latest technology", "number of procedures to start a business" and "total tax rate".

Table 5. Business and innovation environment

	2019	2020
ENVIRONMENT SUBINDEX	**2,87**	**2,95**
2nd pillar: Business and innovation environment	**2,98**	**3,09**
2.01 Availability of latest technologies	3,07	3,89
2.02 Venture capital availability	2,48	2,38
2.03 Total tax rate, % profits	3,73	3,66
2.04 Number of days to start a business	4,89	4,89
2.05 Number of procedures to start a business	3,74	3,74
2.06 Intensity of local competition	2,79	2,66
2.08 Quality of management schools	2,16	2,46
2.09 Government procurement of advanced technology products	2,11	2,29
2,10 Research and development expenditure (% of GDP)	1,85	1,83

2. Readiness sub-index

The second sub-index that forms the digitization index is “Readiness". This sub-index shows how ready and adequate Turkey is for digitalization. In fact, this sub-index is the component that is the best in Turkey’s index. The scores for the “Readiness” sub-index were calculated as 3.19 and 3.24, respectively, for 2019 and 2020 (see Table 6). This sub-index, which had a small improvement in 2020 compared to 2019, is the sub-index with the highest value. The "Readiness" sub-index has three pillars: "Infrastructure", "Affordability" and "Skills".

Table 6. Infrastructure

	2019	2020
READINESS SUBINDEX	**3,19**	**3,24**
3rd pillar: Infrastructure	**2,34**	**2,27**
3.01 Electricity production, kWh/capita	1,23	1,23
3.02 Mobile network coverage, % population	4,99	4,97
3.03 International Internet bandwidth, kb/s per user	1,04	1,03
3.04 Secure Internet servers per million population	1,09	1,07
3.05 Annual investment in telecom services/Revenue from all telecommunication services	1,23	1,65
3.06 Gross capital formation (% of GDP)	3,53	2,68
3.07 Firm-level investment on ICT	2,49	2,64
3.08 Quality of ICT infrastructure (firm)	3,11	2,91

Table 7. Affordability

	2019	2020
READINESS SUBINDEX	**3,19**	**3,24**
4th pillar: Affordability	**4,54**	**4,54**
4.01 Prepaid mobile cellular tariffs, PPP $/min.	4,75	5,00
4.02 Fixed broadband Internet tariffs, PPP $/month	4,88	4,55
4.03 Costliness of ICT infrastructure	3,98	4,06

The worst of the three dimensions that determine the “Readiness” sub-index of digitalization is “infrastructure”. The three most important factors that make the infrastructure inadequate for digitalization are “electricity production”, “international internet bandwidth” and “secure internet servers”. Turkey's best areas for infrastructure is "mobile network coverage". This sub-component scores almost five out of five.

Turkey’s best "Readiness" sub-component is "affordability". Because "prepaid mobile cellular tariffs" in Turkey is relatively inexpensive. However, there was a slight decline in the affordability of “fixed broadband internet tariffs” from 2019 to 2020.

Table 8. Skills

	2019	2020
READINESS SUBINDEX	**3,19**	**3,24**
5th pillar: Skills	**2,69**	**2,89**
5.01 Quality of education system in ICT skills	2,19	2,23
5.02 Quality of math and science education	1,69	1,78
5.03 Secondary education gross enrollment rate, %	3,40	3,94
5.04 Adult literacy rate, %	4,72	4,81
5.05 Graduates in tertiary education, in STEM, per 1000 of population aged 20-29	2,2	2,16
5.06 Availability of staff with ICT skills	1,95	2,45

Two important issues that negatively affect Turkey's readiness are the inadequateness of "Quality of the education system in ICT skills" and the low number of "Graduates in tertiary education, in STEM".

The two subcomponents that show that Turkey is good at "Skills" are "adult literacy rate" and improvement in "Secondary education gross enrolment rate." We owe this improvement to the eight-year compulsory education that was put into effect in 1997 and the 12-year compulsory education policies that started in 2012.

3. Usage Sub-index

The second-best area of Turkey in digitization is "Usage". The index value of the "Usage" component calculated as 3.16 for 2020 is the second-highest valued sub-index after "Readiness" (See Table 9). The usage component is analyzed in three sub-dimensions: "Individual Use", "Business Use" and "Government Use". The index values of business use (3.32) and individual use (3.22) are close to 2020. The lowest performance is "Government Usage".

The two worst sub-components in individual usage are "mobile phone subscription" and "mobile broadband internet subscription". The area that Turkey is best in individual usage is the "use of virtual social networks". The second-best area is "households with Internet access". We cannot say that both findings are very surprising.

Table 9. Individual Usage

	2019	2020
USAGE SUBINDEX	**2,88**	**3,16**
6th pillar: Individual usage	**3,2**	**3,22**
6.01 Mobile phone subscriptions per 100 population	2,14	2,01
6.02 Percentage of individuals using the Internet	3,55	3,66
6.03 Percentage of households with computer	3,34	3,33
6.04 Households with Internet access, %	4,24	4,30
6.05 Fixed broadband Internet subscriptions per 100 population	2,27	2,40
6.06 Mobile broadband Internet subscriptions per 100 population	2,12	2,14
6.07 Use of virtual social networks	4,63	4,45
6,08 Use of ICT by households	3,33	3,49

Our findings show that business usage of ICT is relatively good. It can be said that the business world is very good especially in terms of "business-to-customer internet use" and "ICT use for business-to-business transactions". The worst area of business usage pillar is related to patent applications. This is of course the natural result of Turkish enterprises' lack of innovation capacity.

Table 10. Business Usage

	2019	2020
USAGE SUBINDEX	**2,88**	**3,16**
7th pillar: Business usage	**2,77**	**3,32**
7.01 Firm-level technology absorption	3,05	3,78
7.02 Capacity for innovation	2,62	3,82
7.03 PCT patent applications per million population	1,07	1,12
7.04 ICT use for business-to-business transactions	3,58	3,86
7.05 Business-to-consumer Internet use	3,78	3,87
7.06 Extent of staff training	2,54	3,50

Finally, when we look at the ICT usage of the government, the first finding that we encounter is that the government is quite good at providing public services online. The “Government Online Service Index” value is 3.97 for 2020. According to the index we have calculated, we can easily say that the factor that affects the public usage the worst is “Government success in ICT promotion”.

Table 11. Government Usage

USAGE SUBINDEX	**2,88**	**3,16**
8th pillar: Government usage	**2,66**	**2,92**
8.01 Importance of ICTs to government vision	2,34	2,48
8.02 Government Online Service Index, 0–1 (best)	3,35	3,97
8.03 Government success in ICT promotion	2,30	2,31

4. Impact Sub-index

Turkey's worst areas in digitization are in the "Impact" sub-index. This sub-index for Turkey's digitalization is calculated as 2.88 for 2020. The "Impact" sub-index has two pillars: "Economic Impacts" and "Social Impacts". When we examine the pillars of this sub-index, we can say that the digitalization of society is ahead of the digitalization of the economy.

Table 12. Economic Impacts

IMPACT SUBINDEX	**2,81**	**2,88**
9th pillar: Economic impacts	**2,36**	**2,18**
9.01 Impact of ICTs on business models	3,87	3,77
9.02 ICT PCT patent applications per million population	1,03	1,04
9.03 Impact of ICTs on organizational models	3,68	3,71
9.04 Knowledge intensive jobs, % workforce	2,39	2,24
9,05 Full-time equivalent telecommunication employees	1,10	1,09
9,06 Creative goods exports, % of total trade	3,10	3,12
9,07 International trade in ICT services (% of total trade in services)	1,02	1,02
9.08 International trade in digitally-deliverable service (% of total trade in services)	1,20	1,16
9.09 Revenue from mobile networks (% of all telecommunication services)	3,88	2,47

Table 13. Social Impact

Two areas where Turkey is good at "Economic Impact" are "Impact of ICTs on business models" and "Impact of ICTs on organizational models" is. The worst areas are “ICT PCT patent applications” and “International trade in ICT services”. We know also from Turkey's foreign trade statistics that Turkey is not great at these two areas.

While the digitalization of the economy is problematic, it can be said that the digitalization of society is relatively good. The index value of the “Social Impact” pillar was calculated as 3.58 for 2020. In this regard, it can be said that it performed very well in terms of “use of e-Government services”, “Impact of ICTs on access to basic services” and “e-participation”. Although we are not bad as a digitized society, the only issue we are not that good at is “Internet access in schools”.

	2019	**2020**
IMPACT SUBINDEX	**2,81**	**2,88**
10th pillar: Social impacts	**3,26**	**3,58**
10.01 Impact of ICTs on access to basic services	3,47	3,56
10.02 Internet access in schools	2,78	2,81
10.03 ICT use and government efficiency	3,38	3,55
10.04 E-Participation Index, 0–1 (best)	3,43	4,39

CONCLUSION

This study, Turkey's Digitalization Index Report, intends to demonstrate how Turkey, in terms of its economy and society, performs in digitalization in the face of the transition to the fourth industrial revolution. Turkey's adaptation to the digital transformation was assessed by a grade calculated out of 5 from 64 indicators about digitalization for 2019 and 2020. 30 of the 64 indicators were obtained from the answers given to the questions asked in the survey conducted among business members. 34 numerical indicators are taken from various international databases. Turkey's Digital Transformation Index is formed of 4 sub-indexes and 10 pillars. A relative index value was calculated for each indicator, pillar, and sub-index using data from 139 countries. Therefore, the index value for any indicator does not only show Turkey's position of digitalization, it also shows its relative position compared to other countries.

Turkey's Digital Transformation Index for 2019 and 2020 is calculated as 2.94 and 3.06 respectively. Considering the minimum value is 1, and the highest value is 5 Turkey scores an average grade. Although we see a small improvement from 2019 to 2020, this average performance of Turkey points to a significant distance to cover. The sub-indices reveal the factors that pull Turkey's digital transformation performance. From 2019 to 2020, we see that there is a 4% improvement in the index value. The sub-indices that pull down Turkey's performance the most is the sub-index named "Impact" (2.81 for 2019 and 2.88 for 2020), meanwhile, the "Readiness" sub-index contributes most to the score (with 3.24 for 2020).

10 areas where Turkey is worst in 64 indicators used in the calculation of the Digital Transformation Index are as follows (index values are given in brackets): International trade in ICT services (1.02), international Internet bandwidth (1.03), ICT PCT patent applications (1.04), secure internet servers (1.07), full-time equivalent telecommunications workers (1.09), PCT patent applications (1.12), international trade in ICT services (1.16), electricity production (1.23), annual investment in telecommunication services (1.65) and the quality of mathematics and science education (1.78). Note that the index value of the other eight indicators is below 1.25, except for the last two indicators. Considering that the lowest value can be 1, Turkey's performance in the above-cited indicators is really unfortunate. The best 10 indicators for Turkey are: Costliness of ICT infrastructure (4,06), households have internet access (4.3), cost for enforcing contract (4.33), e-participation index (4.39), use of virtual social networks (4.45), fixed broadband internet subscription (4.55), literacy rate (4.81), the number of days required to start a business (4.89), mobile network coverage (4.97) and prepaid mobile cellular tariffs (5,00).

These indicators show, at the first instance it is the general framework, that is the ecosystem that should be more efficient for Turkey's digitalization. Improving the innovation and investment environment with the legal and operational framework that the business is subject to when making decisions will have positive effects on business in general and will provide a favorable background for digitalization. In terms of readiness, there is a positive outlook for usage cost but not for infrastructure and skills.

Although operating costs are cheap in Turkey, as digitalization moves forward, bottlenecks in infrastructure and the hardships of obtaining the sought-after skills can turn into a serious problem.

The usage component of the index has revealed that individual usage and business usage are satisfactory and that there is progress each year. Although the public sector usage is slightly lower than the others, there is an increase in 2020. In addition, the interviews with public sector representatives revealed that rapid improvements were on the agenda. Usage intensities also indicate risks as well as advantages that Turkey faces in the digitization process.

If the Communication Technology products and services are not produced nationally, increasing usage may lead to an increase in foreign dependency for Turkey. Indeed, the digital transformation component refers to this risk. The

digitalization of society is more advanced than the digitalization of the economy thanks to the e-Government applications and digital applications in several services.

Indicators that pull the Index value down, suggest the areas that Turkey needs to act for improvement.

According to the methodology for calculating the index values, the indicators other than those that come from the survey, are calculated by the relative position of Turkey vis-a-vis the 138 countries which includes the least developed countries. Therefore, the index numbers indicate a performance that Turkey has a long journey ahead when compared with the developed countries and with its peers. Indeed, in the first chapter, the indicators examined other than those coming from the surveys reveal that Turkey is well below the average against the developed countries and their peers.

As part of this study, a series of in-depth interviews were conducted within the business community and bureaucracy, besides international indicators and surveys among business members. What has been said in these interviews, were found to be largely in line with the findings of Turkey's Digital Impact Index. The main points emphasized by the authorities in the interviews overlap with the sub-indices with relatively low performance.

What Turkey should do to catch up with the digital transformation was a question that was asked in in-depth interviews with the business community and the bureaucracy. Bringing together the answers given to this question and the index components with a score under 2.5, reveal a road map for Turkey. Any improvement in these areas will increase the index scores in the coming years. According to the findings from this study, measures to be taken for Turkey's digital transformation is as follows:

Measures for Turkey's Digital Transformation

Turkey needs to improve firstly the ecosystem for digital transformation. For this, a strategy and roadmap should be adopted at the highest level. In order to be successful, the digital transformation strategy must be holistic and the work carried out by different institutions in different fields must be coordinated. The operation of legal legislation and legal processes is one of the most fundamental elements in investment decisions for the business community. For companies operating in Turkey not to be disadvantaged in international competition, regulations must be made compatible with international standards. In this regard, one of the important topics is tax regulations. Tax rates should be determined by considering international regulations and in consultation with the industry. The “local and national” discourse may have negative effects on foreign investments. Industrial policy should be applied by taking this situation into account.

The incentive system must be actively used for Turkey to be ready for the transformation. In designing technology and R&D supports, the R&D policy should be a targeted one. Projects with a high probability of success in developing high-tech products and services should be supported.

The prerequisite for successful businesses in a newly developing industry is to have a competitive environment and avoiding market failures. In this regard, conditions of fair competition should be established especially in infrastructure, in the Information and Communication Technologies sector. SMEs are the segment where the destructive effects, as well as the positive effects of digital transformation, will be felt most intensely. SMEs should be informed, encouraged, and financially encouraged in the face of a lack of understanding of technology and how to adapt. To take advantage of the economies of scale, business models that bring SMEs together should be developed and SMEs should be encouraged to work together.

Although in the past Turkey has shown rapid progress in infrastructure, in recent years the slowdown in infrastructure investments is noteworthy. The competitive environment being not strong is a serious obstacle for developing infrastructure. The government should play a facilitating and accelerating role in eliminating competition disruptions and building up joint infrastructure.

A qualified workforce is the most important condition both on the supply side in terms of producing basic products and on the demand side in terms of individual, government, and business usage of information technologies. It is also one of

the main areas that need improvement. It is necessary to improve the education system starting from basic education to university and change and update the university education curriculum considering the needs of the sector and to open new programs in universities. While improving the curriculum in order to equip young people with the needed qualifications, there should also be projects to support the current workforce with new technologies. Otherwise, both difficulties in finding a qualified workforce and unemployment may increase simultaneously.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