ISTANBUL TECHNICAL UNIVERSITY ★ GRADUATE SCHOOL

THE DIGITAL DIVIDE IN TURKEY

PhD THESIS

Deniz Ece DALGIÇ-TETİKOL

Department of Economics

Economics PhD Programme

APRIL 2023

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TÜRKİYE'DE DİJİTAL BÖLÜNME

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Deniz Ece DALGIÇ-TETİKOL, a Ph.D. student of ITU Graduate School 412162004, successfully defended the thesis entitled "THE DIGITAL DIVIDE IN TURKEY", which she prepared after fulfilling the requirements specified in the associated legislations, before the jury whose signatures are below.

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To my family,

FOREWORD

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Deniz Ece DALGIÇ-TETİKOL
(Research Associate)

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ABBREVIATIONS

A4AI : The Alliance for Affordable Internet
ADSL : Asymmetric digital subscriber line
AME : Average marginal effect
AUC : Area under curve
CA : Correspondence analysis
DESI : Digital Economy and Society Index
DSL : Digital subscriber line
DTO : Digital Transformation Office
EBA : Egitim Bilisim Agi/Education Information Network
EGDI : E-Government Development Index
EU : The European Union
EuroStat : European Statistical Office
FCC : Federal Communications Commission
GDP : Gross domestic product
GNI : Gross national income
GSMA : Global System for Mobile Communications Association
HHI : Herfindahl-Hirschman Index
ICT : Information and communication technologies
ICTA : Information Communication Technologies Authority
ILO : International Labour Organization
ISP : Internet service provider
IT : Information technology
ITU : The International Telecommunication Union
IXPs : Internet exchange points
LAN : Local area network
LAU : Local administrative units

LCDs : Least developed countries

MAN : Metropolitan area network

MCA : Multiple correspondence analysis

MNOs : Mobile network operators

NUTS : Nomenclature of Territorial Units for Statistics

OECD : Organization for Economic Co-operation and Development

OxCGRT : Oxford Coronavirus Government Response Tracker

PAN : Personal area network

PCA : Principal component analysis

ROC : Receiver operating characteristics

SSDE : Safe schooling and distance education

TurkStat : Turkish Statistical Office

UN ESCAP : United Nations Economic and Social Commission for Asia and the Pacific

UNCTAD : United Nations Conference on Trade and Development

UNDESA : United Nations Department of Economic and Social Affairs

USAC : Universal Service Administrative Company

USF : Universal service fund

VoIP : Voice over internet protocol

VPN : Virtual private network

VSAT : Very small aperture terminal

WiMAX : Worldwide interoperability for microwave access

SYMBOLS

α : Intercept term

β : Coefficient of the explanatory variable

p : Probability

P_H : The rate of access/use of the social category with the highest penetration

P_L : The rate of access/use of the social category with the lowest penetration

R^2 : McFadden's R-squared

X : Set of explanatory variables

Y_{access} : Dependent variable (internet access)

Y_{use} : Dependent variable (internet use)

$Y_{activitytype}$: Dependent variable (internet activity type)

u : Error term

$\psi(.)$: Cumulative distribution function of the standard logistic distribution

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THE DIGITAL DIVIDE IN TURKEY

SUMMARY

Information and communication technologies (ICT), which broadly include telecommunications, mobile telephony, the Internet, and various Internet-enabled devices, have permeated most aspects of life by offering new and more efficient ways for people to communicate, access information, and learn. With applications in education, banking, e-commerce, health, and government services, among other areas, ICT are a major force behind economic growth and productivity, connecting people to essential services and jobs while enabling businesses to operate.

The digital divide describes the uneven distribution of ICT in society. At a high level, the digital divide is the gap between those who have and do not have access to the Internet. However, the digital divide is not a binary but multifaceted and includes many factors such as connectivity, access to equipment, affordability, quality of service, motivation to use the technology, digital skills, and so on. Therefore, the digital divide encompasses various Internet-related challenges, which results in different types (levels) of digital inequality. The digital divide literature categorized those challenges as follows: differences in access (first-level digital divide), usage and digital skills (second level digital divide), and outcomes of Internet use (third level digital divide). These digital gaps exist at the international level as well as within a country. Often these gaps fall along other social inequalities in a country – that is, the different levels of the digital divide usually reflect the gaps between individuals from different demographic backgrounds and at different socioeconomic levels with regard to their opportunity and ability to access and utilize ICT.

This thesis empirically examines the different aspects of the digital divide in Turkey. It explores the demographic and socioeconomic determinants of the first level and second level of digital divide in Turkey and analyzes the data that substantiates digital inequalities between years 2008-2020.

Digital transformation and technological advancements in ICT offer tremendous opportunities for countries, especially for emerging economies. However, the full potential of digital advancements cannot be achieved by focusing solely on supply-side policies such as investing in infrastructure deployment. Despite increased Internet penetration rates, Turkey has failed to create a digitally inclusive society and risk missing out on the benefits of digitization. One of the leading factors contributing to this problem is the lack of effective demand-side solutions mitigating the digital divide. The results of this thesis suggest that significant disparities persist between different social groups in Turkey in terms of Internet access and Internet usage patterns.

The findings of this thesis point out the target groups of first priority to address the first level and second level digital divide in Turkey. We can conclude from the results that special initiatives and programs are required to increase widespread adoption of the Internet. Those initiatives and programs should be designed and implemented with a participatory approach, targeting the high priority groups: women, older citizens, citizens with lower household income, citizens with low educational background, homemakers, and retired people, as well as citizens of the Northeast Anatolia, Central East Anatolia, Southeast Anatolia and West Black Sea regions of Turkey in particular, while considering the factors that make Internet access and use difficult.

TÜRKİYE'DE DİJİTAL BÖLÜNME

ÖZET

Telekomünikasyon, mobil telefon, internet ve internete bağlanma özelliğine sahip çeşitli cihazları içeren bilgi ve iletişim teknolojileri (BİT), kişilerin iletişim kurması, bilgiye erişmesi ve öğrenmesi için yeni ve daha verimli yollar sunmak suretiyle hayatın birçok yönüne nüfuz etmiştir. Eğitim, bankacılık, e-ticaret, sağlık ve devlet hizmetlerindeki uygulamalarıyla BİT, ekonomik büyüme ve üretkenliğin arkasındaki ana güçtür, insanları temel hizmetlere ve işlere bağlarken işletmelerin faaliyet göstermesine olanak sağlamaktadır.

Dijital bölünme (the digital divide), BİT'in toplumdaki eşit olmayan dağılımını tanımlar. Türkçe literatürde, dijital bölünme kavramına karşılık gelen, sayısal bölünme, dijital uçurum, sayısal uçurum, dijital eşitsizlik gibi kavramlar da ayni olguyu ifade etmek için kullanılmaktadır. Tanımı bağlamında, dijital bölünme, internete erişimi olan ve olmayanlar arasındaki uçurumu ifade eder. Ancak, dijital bölünme tanımının ötesinde ikili değil çok yüzeyli bir problemdir; bağlantı, ekipmana erişim, satın alınabilirlik, hizmet kalitesi, teknolojiyi kullanma motivasyonu, dijital beceriler vb. gibi birçok faktörü içerir. Bu nedenle, dijital bölünme, farklı dijital 'eşitsizlik' türleri (seviyeleri) ile sonuçlanan internet ile ilgili çeşitli zorlukları kapsar. Dijital bölünme literatürü, bu zorlukları şu şekilde sınıflandırmaktadır: erişimdeki farklılıklar (birinci seviye dijital bölünme), kullanım ve dijital beceriler (ikinci seviye dijital bölünme) ve İnternet kullanımının sonuçları (üçüncü seviye dijital bölünme). Bu zorluklara bağlı dijital uçurumlar, uluslararası düzeyde mevcut olduğu gibi bir ülke içinde de gözlemlenebilmektedir. Dijital uçurumlar, genellikle, bir ülkedeki diğer sosyal eşitsizliklerle birlikte ortaya çıkar – öyle ki, yukarıda sıralanan dijital bölünme türleri (seviyeleri), farklı demografik ve sosyoekonomik özelliklere sahip bireyler arasındaki, BİT'e erişme ve bunları kullanma fırsatları ve becerilerine ilişkin farklılıkları ve eşitsizlikleri yansıtmaktadır.

Bu tez, Türkiye'de dijital bölünmenin farklı yönlerini ampirik olarak incelemektedir. Türkiye'deki birinci düzey ve ikinci düzey dijital bölünmenin demografik ve

sosyoekonomik belirleyicilerini araştırmakta ve 2008-2020 yılları arasındaki sayısal eşitsizlikleri ortaya koyan ampirik bulguları sunmaktadır. Literatürde yalnızca bir veya az sayıda değişkene odaklanan ya da Türkiye özelinde ekonometrik modellere dayanmayan diğer birçok çalışmanın aksine verinin olanak sağladığı ölçüde çok sayıda değişkeni, sosyal grupların cihaza erişim, İnternete erişim ve İnternet kullanım davranışları ve bu bağlamda İnternet servislerinden yararlanmalarını hesaba katarak kapsamlı ve ayrıntılı bir analiz yapılmıştır. Yıllara göre yapılan analiz sonuçları cihaza erişim ve İnternete erişimde ilerlemeye işaret etse de özellikle Internet kullanımındaki eşitsizliklerin devam ettiği görülmektedir.

Bilgi ve iletişim teknolojilerindeki dijital dönüşüm ve teknolojik gelişmeler, başta gelişmekte olan ekonomiler olmak üzere ülkeler için çok büyük fırsatlar sunmaktadır. Ancak, dijital gelişmelerin tam potansiyeline, altyapı dağıtımına yatırım yapmak gibi sadece arz yönlü politikalara odaklanarak ulaşılması mümkün değildir. Son donemde artan İnternet penetrasyon oranlarına rağmen, Türkiye'nin dijital olarak kapsayıcı bir toplum yaratmayı tam anlamıyla başardığı söylenememektedir ve bu nedenle, dijitalleşmenin faydalarını kaçırma riskini altında olduğu düşünülmektedir. Bu soruna katkıda bulunan başlıca faktörlerden biri, dijital bölünmeyi azaltan etkili, talep yönlü çözümlerin olmamasıdır. Bu tez çalışmasındaki bulguları, Türkiye'de farklı sosyal gruplar arasında İnternet erişimi ve İnternet kullanım davranışları açısından önemli eşitsizliklerin devam ettiğini göstermekte, gerekli politikaların ivedilikle uygulanmaması halinde bazı dijital eşitsizliklerin kapanmasının yakın gelecekte mümkün olmayacağına dikkat çekmektedir.

Bu tezin bulguları, Türkiye'deki birinci düzey ve ikinci düzey dijital bölünmesinin talep yönlü politikaların gerçekleştirilmesi noktasında öncelikli olarak ele alınması gereken hedef grupları ortaya koymaktadır. Öte yandan, İnternet erişim ve kullanımındaki bölgesel eşitsizlikler de ampirik bulgularla ortaya konmaktadır. Tezin son bölümünde Türkiye'nin dijital bölünmeye yönelik girişimleri ve potansiyel dijital eşitsizlikleri azaltma stratejileri tartışılmaktadır. Toplumun her kesiminin bilgi ve iletişim teknolojilerinden eşit derecede faydalanabilmesi için uygulanan politikaları ifade eden 'dijital kapsayıcılığı' merkezine alan dijital donuşum projeleri, toplumun dezavantajlı gruplarının dijital yetkinliğinin artırılması ve dijital donuşum surecinde ekonomik ve sosyal faydanın artırılması açısından gereklidir. 'Kapsayıcılık' ilkesi doğrultusunda, dijital eşitsizliğe yönelik politikaların oluşturulmasında bu tezin bulguları önemli bir role sahip olacaktır.

Türkiye'de Internet penetrasyonunu artırmak için 'talep-yönlü politikalar' ile ilgili tutarlı bir politika vizyonu eksikliği gözlemlenmektedir. Regülasyonlar ve ilgili politikalar geliştirilirken Türkiye'nin demografik ve sosyoekonomik özellikleri genellikle göz ardı edilmektedir. Bu nedenle, internetin yaygınlaşmasını artırmak için özel programların gerekli olduğu sonucuna varılmaktadır. Bu programlar, katılımcı bir yaklaşımla, yüksek öncelikli grupları hedef alarak tasarlanmalı ve uygulanmalıdır. Kavramsal çerçevede, tezin bulgularına dayalı olarak dört ana politika alanını belirlenmiştir: (i) altyapı, (ii) kapsayıcılık, (iii) kurumlar, (iv) pazar yapısı ve (v) dijital yetkinlik. Bu politika alanları altında tezde tespit edilen İnternete erişim ve kullanım açısından dezavantajlı olduğu tespit edilen sosyal gruplara yönelik programlar uygulanmalıdır. Kadınlar, yaşlılar, hane geliri düşük vatandaşlar, eğitim düzeyi düşük vatandaşlar, maaşsız ev emekçileri ve

emekliler ile özellikle Kuzeydoğu Anadolu, Orta Doğu Anadolu, Güneydoğu Anadolu ve Batı Karadeniz bölgeleri internet erişim ve kullanım acısından dezavantajlı gruplar olarak öne çıkmaktadır. Bu gruplar, dijitalleşme ve dijital donuşum kapsamında oluşturulan politikalarda dijital bölünmeyi ortadan kaldırabilmek adına özellikle dikkate alınmalıdır. Talep yönlü faktörler odağında, yüksek hızlı sabit ve mobil bağlantıların yaygınlaştırılması, akıllı telefonların yani sıra diğer İnternet özellikli cihazların kullanımının yaygınlaştırılması, yeni nesil telekomünikasyon altyapısının konuşlandırılması, çeşitli internet servislerinden toplumun tamamının faydalanabilmesi için dijital yetkinliklerin geliştirilmesine yönelik eğitim ve programlar geliştirilmesi gibi uygulamalar dijital bölünmenin ortadan kaldırılması adına dijitalleşme politikaları kapsamına alınmalıdır.

1. INTRODUCTION

With the technological advancements and information revolution, information and communication-intensive activities have become an essential component of society and the economy. These activities form the basis for all areas of life and become basic needs. Accessing to and using Information and Communication Technologies (ICT) has eventually become very important than ever before. The technological and structural changes that show up in every sector in every country prove that ICT will continue to revolutionize societies and become one of the most impactful inputs to economic growth. The efficiency and widespread use of ICT will contribute to the international competitive power, advanced health and education systems (Çilan et al., 2009) as well as democratic freedoms (Qureshi, 2012; Shirazi et al., 2009).

Digital transformation offers tremendous economic and social opportunities especially for emerging economies. However, the full potential of the digital advancements can only be achieved with widespread adoption of digital technologies, which depends on country's capability to deliver ICTs and their practical and effective usability by mass populations under any circumstances. Although technology becomes more integrated into everyday life and digital-intensive activities become an increasingly important component of the economies, foundational access inequalities, unfortunately, continue to cause a gap between people who have access to ICT and privileges to take advantage of opportunities that ICT offer and who do not.

In a world where socioeconomic inequalities are already in place, digitalization has brought a different dimension of inequality, namely digital inequality or digital divide, which is defined as “the gap between individuals, households, businesses and geographic areas at different socioeconomic levels with regard to both their opportunities to access

information and communication technologies and to their use of the internet for a wide variety of activities" by OECD (2001). Various internet related challenges have resulted in different types (levels) of digital divide: (i) the first level digital divide which is based on the unequal access to internet connection and internet-enabled devices, (ii) the second level digital divide which is related to the level of online engagement and digital competence, and finally, (iii) the third level digital which mainly reflects the discussions about outcomes of internet use. The digital divide has become a topic of interest as internet access and use of personal computers increased and has been evolving since. The first-step approach to the digital divide is the study of uneven distribution of internet access, observed as binary distinction between connected to the internet those who are not (Mehra et al., 2004, Riggins and Dewan, 2005). Those who have an internet connection are perceived as being on the preferred side of the divide (Bucy and Newhagen, 2004). The relevance of digital divide based on internet access has been started to be questioned when broadband internet access and internet-enabled devices became more prevalent. Hargittai (2002) argued that a distinction should be made between internet access divide and a skills divide, the latter indicating the differences between groups of people in terms of skills considered required to effectively use the internet. Therefore, the focus of the digital divide discourse shifted to digital skills, as part of the second level digital divide (Hargittai, 2002), which is also associated with the differences in internet use (van Deursen and van Dijk, 2014). Several scholars have argued that the digital divide is a more complex phenomenon and should be approached more comprehensively. According to those arguments, the consequences of Internet use should also be addressed along with Internet access and digital skills (e.g., Fuchs, 2009; Selwyn, 2004; van Dijk, 2005). The digital divide discourse, eventually, has shifted from binary internet access to skills, to a focus on the beneficial outcomes of internet use. Consequently, the difference in how the internet is being utilized is labelled as the third level digital divide (Wei et al., 2011). The idea here is that being on the preferred side of the first and second level digital divide does not necessarily result in beneficial consequences. In other words, even when internet access is available, it does not always translate into beneficial outcomes from its use which creates another form of inequality of outcomes and productivity. It can thus persist even after the first and second level have

been attained. The approach has emerged from the observation of reciprocal effects that social and digital inequalities have on each other, in particular, digital inequalities' tendency to reinforce the social inequalities (Ragnedda, 2016). Although the concept moves beyond access inequalities and relates more to the tangible outcomes of adoption of ICTs and online engagement, it actually is a more complex phenomenon. The measurement of third level digital divide goes beyond the scope of this study, albeit discussions on the potential policy measures to address the first and second level digital divide presented in the final chapter indeed redounds to the utmost advantage from the ICT access and usage.

Digital divide is a universal problem, but the situation is even more dramatic for the developing countries, especially after the recent global pandemic as digital technology has become more integrated to people's lives when employment, schooling, and social interaction have all shifted online, which altered perceptions of what can be done in digital format by reducing cost and saving time at the same time. The COVID-19 pandemic recently revealed the depth of the digital divide. Reliable and affordable Internet access has become a basic need amid the pandemic, when employment, schooling, and social interaction have all shifted online. People started to look to ICTs to adapt to the evolving uncertainty and operate with minimal disruption under the new circumstances. Although fixed and mobile broadbands are nearly ubiquitous in many countries, these extraordinary circumstances were an unease experience for the disadvantaged segments of societies. Even before the pandemic broke out, inequality in accessing digital technologies existed, however, the digital divide has reinforced inequalities as the use of ICT has become indispensable in everyday activities.

Despite the increased Internet penetration rates in recent years, disparities in ICT adoption continue to persist in Turkey as well. While the country is undergoing digital transformation and morphing into more innovative and technologically advanced organizations and systems, given the relationship between social connectivity and digital connectivity (Chen, 2013), the disadvantaged groups of the population would become more vulnerable to remain socially and digitally excluded, which in turn would cause the digital inequality to become a more structural problem.

Scholars claimed that ICT access and use are associated with socioeconomic and demographic characteristics such as economic class, gender, race and ethnicity, aging, disability, education, rural residency, occupational status, networks, and geographies (e.g. Bonfadelli, 2002; van Deursen and van Dijk, 2014; van Dijk, 2005; Witte and Mannon, 2010).

In this thesis, I empirically examine the digital divide in Turkey by focusing on the disparities in ICT access and use, and the scope of the online activities and digital skills in particular, namely the first level and second level digital divide. There are only a few studies dealing with this phenomenon in the Turkish context, which I consider less sophisticated in terms of methodological approach and unrepresentative of the present-day. Therefore, this thesis contributes to the literature by proposing a methodological and comprehensive analysis of digital divide in Turkey by focusing on the disparities in ICT access and use as well as differences in Internet service adoption and disparities in digital competencies. The thesis particularly investigates whether or to what extent key demographic and socioeconomic factors such as gender, age, education, household income, employment and geographical regions affect ICT access and use. Hence, it provides a useful body of knowledge which can facilitate further academic research as well as debates and structural decisions among policy-makers and regulators, by emphasizing the high-priority target groups.

The thesis is structured as follows: Chapter 2 provides a quantitative examination of first level digital divide from three perspectives: device access, internet access, and internet use; Chapter 3 examines whether Internet usage and digital skills differentiate according to certain demographic and socioeconomic factors; Chapter 4 provides a yearly analysis and an overview on the evolution of the digital divide in Turkey; and finally, based on the findings of previous chapters, Chapter 5 discusses Turkey's initiatives toward digital equity and potential mitigation strategies for digital inequalities.

2. THE FIRST LEVEL DIGITAL DIVIDE IN TURKEY: DETERMINANTS OF INTERNET ADOPTION

2.1 Introduction

Information and communication technologies (ICT), which broadly include telecommunications, mobile telephony, the Internet, and various Internet-enabled devices, have permeated most aspects of life by offering new and more efficient ways for people to communicate, access information, and learn. With applications in education, banking, e-commerce, health, and government services, among other areas, ICT are a major force behind economic growth and productivity, connecting people to essential services and jobs while enabling businesses to operate. International institutions have been supporting ICT implementation by urging developing nations to deregulate and massively invest in ICT infrastructure since the early 1990s as a means of accelerating socioeconomic development (Ngwenyama and Morawczynski, 2009). However, despite continuous investments in ICT infrastructure, many developing nations have not yet achieved the desired outcomes.

Digital transformation and technological advancements in ICT offer tremendous opportunities for countries, especially for emerging economies. However, the full potential of digital advancements cannot be achieved by focusing solely on supply-side policies such as investing in infrastructure deployment. For example, fiber-based Internet access has been regarded as a leading technology for broadband access in recent years. The development of fiber Internet and its adoption by society have been the subject of national goals, strategies, and action plans. However, despite increased Internet penetration rates, many countries have failed to create a digitally inclusive society and risk missing out on the benefits of digitization.

One of the leading factors contributing to this problem is the lack of effective solutions mitigating the uneven distribution of Internet access and use between different social groups: this fundamental problem is called the digital divide. The term digital divide refers to the gap between individuals from different demographic backgrounds and at different socioeconomic levels with regard to their opportunity and ability to access and utilize ICTs. The digital divide is a major impediment to reaping the benefits of digitalization (ITU, 2020) and exacerbates inequalities in society as the Internet has become indispensable in everyday activities. Reliable and affordable Internet access has become a basic need amid the COVID-19 pandemic in particular, when employment, schooling, and social interaction have shifted online substantially.

The International Telecommunications Union (ITU) recently called for empirical studies to assess the effectiveness of ICT expansion in developing countries, pointing at the digital gaps that exist despite technological developments. To this end, my goal has been to study the relationship between demographic and socioeconomic characteristics and the disparities in ICT adoption in Turkey. My hypothesis is that the key demographic and socioeconomic characteristics predict Internet access and use in Turkey such that the groups that are socially and economically at the margins of society are more disadvantageous in the digital realm. Thus, I pose the following research questions: What are the main determining factors explaining Internet access and usage in Turkey? Do key demographic and socioeconomic factors such as gender, age, education level, income level, employment status, and geographical regions predict Internet access and use in Turkey and, if so, to what extent? Which social groups are the most vulnerable in terms of accessing and/or using the digital technologies? Are there significant disparities among society that indicate the need for demand-side policies to address the digital divide?

I empirically examine the digital divide in Turkey, focusing particularly on the disparities in Internet access and use, the so-called first-level digital divide. Connectivity depends on having access to an Internet-enabled device, having access to an Internet connection, and having the opportunity and the capability of using the Internet. Therefore, we examine the first-level digital divide in Turkey from three perspectives: device access, which refers to the problem of having or not having physical access to an Internet-enabled device; Internet access, which refers to the services and/or infrastructure needed for

connectivity; and Internet use, which takes into account whether an individual with Internet access actually uses the Internet. We investigate whether and to what extent these three aspects of the first-level digital divide are associated with the key demographic and socioeconomic factors. The analysis of first level digital divide in the Turkish context will form the basis of further examinations on the current situation of digital divide in Turkey.

This chapter is structured as follows: Section 2.2 presents a literature review on the first level digital divide. Section 2.3 describes the data used in this study and provides explanations for selected variables. Section 2.4 presents some stylized facts about the first level digital divide in Turkey in terms of device access, internet access and internet use. More details about the breakdown of device ownership, internet access and internet use by age, gender, employment status, income, education level and region are discussed in this section. Section 2.5 explains the research methodology and Section 2.6 presents the findings of the empirical study. Section 2.7 concludes the chapter.

2.2 Literature Review

The adoption of Internet or ICT in general depends on various factors other than infrastructure availability. Although technology becomes more integrated into everyday life and digital-intensive activities become an increasingly important component of the economy, disparities remain in the use of digital technology across different social groups. There is a plethora of research proving that Internet access and use are associated with socioeconomic and demographic characteristics such as economic class, gender, race and ethnicity, age, disability, education, rural residency, occupational status, networks, and geographies.

The digital divide literature categorized various Internet-related challenges, which results in different types (levels) of the digital divide: the first level (Internet access), the second level (Internet skills and use), and the third level (outcomes of Internet use). The first level digital divide refers to the common observation of the uneven distribution of Internet access and use (Riggins and Dewan, 2005; DiMaggio et al., 2004; Mehra et al., 2004), and shows that disparities in Internet access and use usually correlate with demographics

and socioeconomic factors such as gender (Antonio and Tuffley, 2014; Gray et al., 2017; Korupp and Szydlik, 2005; Mumporeze and Prieler, 2017), age (Grishchenko, 2020; Loges and Jung, 2001; Peacock and Künemund, 2007; Selwyn et al., 2003), race (Mossberger et al., 2006; Wilson et al., 2003), education (Bonfadelli, 2002; Chaudhuri et al., 2005; Talukdar and Gauri, 2011), income (Chaudhuri et al., 2005; Fuchs, 2009; Grishchenko, 2020; Korupp and Szydlik, 2005; Talukdar and Gauri, 2011), employment (van Dijk and Hacker, 2011), region of residence (Lucendo-Monedero et al., 2019, Ruiz-Rodriguez et al., 2017), and rural/urban distinction (Grishchenko, 2020; Salemink et al., 2017). People with an Internet connection are perceived as being on the preferred side of the digital divide (Bucy and Newhagen, 2004). The lack of physical access to necessary technologies, poor connection quality, unfavorable access location would make a difference in terms of time extension and availability for its usage, and these are the potential reasons for not having an Internet connection (Khan et al., 2020). Issues concerning time availability, cost, quality of the technology, and the environment where the technology is used, as well as privacy concerns and ease of use are critical mediating factors in people's access to ICT (Davis, 1993; Selwyn, 2004). Moreover, the costs of owning and maintaining technologies can be burdensome, hence may discourage the adoption of the technologies (Gonzales, 2016). According to European Commission's Digital Economy and Society Index (DESI) 2020, the top reasons for not having Internet access are the lack of need or interest (46%), insufficient skills (44%), equipment costs (26%), and high-cost barriers (24%). These factors would vary in strength across countries with different development levels. Although ICT access and usage have become more widespread over the years (Scheerder et al., 2017), the first level digital divide persists, and remains a problem even in developed countries (Hargittai, 1999; Robinson et al., 2015), the first-level digital divide remains a problem, even in developed countries (Robinson et al., 2015).

Physical access to Internet-enabled devices is another aspect of the digital divide. Van Deursen and van Dijk (2019) took physical access and material access into consideration separately when dealing with the first-level digital divide. Material access refers to the means required to connect to the Internet (van Dijk, 2005) and incorporates aspects such as device ownership, peripheral diversity, and maintenance expenses (van Deursen and

van Dijk, 2019). In this study, the term Internet access refers to physical access to the infrastructure and necessary tools and services for connection (modem, Internet service provider (ISP), etc.), and device access refers to access to any Internet-enabled device. Along with device and Internet access, we also consider whether a person with access actually uses the Internet.

Only a few studies have investigated the digital divide in the Turkish context, which is less sophisticated and/or unrepresentative of the present-day: Acilar (2011) discussed gender, age, education and geographic location aspects of the digital divide in Turkey based on a summary of 2010 data; Yildiz (2011) provided a general insight to the subject and examined various initiatives in Turkey to combat the digital divide; Polat (2012) examined Turkey's digital divide policies and argued that although it has been found to be interwoven with other social inequalities, the digital divide is not a priority in the Turkish government's agenda. Existing policy initiatives fail to address the most disadvantaged groups, as indicated by the lack of a national strategy on digital exclusion. Therefore, Polat emphasized "the need for more sophisticated multivariate regression analysis that goes beyond descriptive statistics to uncover the most important predictors of internet use". Unlike previous work, I address the issue from a broad perspective of first-level digital divide and base my arguments on well-established econometric models instead of solely descriptive statistics. Köksal and Anil (2015) examined the determinants of the broadband access and broadband usage in Turkey in 2012 and found that education, age, gender, employment, region and availability of fixed and mobile telephony are significant determinants. To the best of my knowledge, that is the only study conducted in Turkey based on an econometric (probit) model prediction. However, despite providing valuable discussion, the data used in that study are also outdated. The explanatory variables are not as detailed as in the present study, and the device access aspect is not addressed at all. Also, since their regional approach is based on congregating 12 NUTS-1 statistical regions of Turkey into three as West-Central-East, Köksal and Anil (2015) provides limited information on the relative performance of each region in terms of Internet access and use, which is essential to implement region-specific policies.

Köksal (2021) underlined the lack of coherent vision on the demand side to increase Internet penetration in Turkey – that is, the demographic and socioeconomic factors have been disregarded while developing regulations and related policies. As reported in a large-scale study by the Berkman Center for Internet & Society (Benkler et al., 2010), supply-side policies are quite limited to increase the penetration and usage of the Internet in societies. Therefore, policymakers' attention should not be exclusively focused on the supply side. Instead, they should pay increasing attention to demand-side policies alongside supply-side policies if greatly expanded adoption of broadband is the policy goal (Hauge and Prieger, 2010).

Dalgic-Tetikol et al. (2022) present the findings of this chapter. That article is important as it provides useful pointers for policymakers to make structural decisions and mitigate digital inequalities in Turkey by identifying high-priority target groups. It draws attention to the fact that Turkey needs a more coherent vision on ICT policies, particularly concerning the demand side factors while developing regulations and related policies that are aimed at stimulating Internet access and use in the country.

2.3 Data and Variables

The study draws upon data collected in Turkey as part of the Turkish Statistical Institution's (TurkStat) "Information and Communication Technology (ICT) Usage Survey on Households and Individuals, 2020", which is prepared and carried out annually in accordance with EuroStat's survey on "ICT Usage in Households and by Individuals". The survey includes questions about demographics, Internet access and use, Internet activities, and presents the most recent reliable empirical data on this subject matter. The survey data includes 15,103 households and 32,955 individuals (16,535 female, 16,420 male). TurkStat's data selection process ensures the Turkish population's representativity in terms of its sociodemographic makeup, and adequate sampling methods to support national-level analysis.

The sampling universe is respondents aged 16–74, who are any type of Internet user from novice to experienced. Age, income, and level of education are included as categorical variables. We separated age into four categories: 16–35 (young/early working age), 36–

50 (prime working age), 51–65 (mature working age), and 66–74 (elderly). We also separated monthly household income into three categories: less than minimum wage (low income), more than minimum wage but less than twice the minimum wage (mid-income), and more than twice the minimum wage (high income).[1] To identify participants' level of education, they are asked about the highest level of education attained. We split education levels into three categories: below high school, high school, and tertiary degree.[2] We assessed individuals who are employed, unemployed, student, homemaker, and retired.[3] Finally, we include 12 geographical regions of Turkey to assess whether ICT access and use vary among different regions of Turkey. The geographical categorization of TurkStat for Turkey's regions is based on the European Nomenclature of Territorial Units for Statistics (NUTS). Table 2.1 shows the NUTS-1 statistical regions of Turkey with the corresponding codes.

Table 2.1 : NUTS-1 statistical regions of Turkey.

NUTS-1 code	Region
TR1	Istanbul
TR2	West Marmara
TR3	Aegean
TR4	East Marmara
TR5	West Anatolia
TR6	Mediterranean
TR7	Central Anatolia
TR8	West Black Sea
TR9	East Black Sea
TRA	Northeast Anatolia
TRB	Central East Anatolia
TRC	Southeast Anatolia

[1] The net monthly minimum wage in Turkey in 2020 is 2,324.71 Turkish Lira.
[2] The classification is based on International Standard Classification of Education (ISCED) 2011.
[3] The classification is based on International Classification of Status in Employment (ICSE) 1993.

2.3.1 First level digital divide indicators

In this chapter, I aim to demonstrate the demographic and socioeconomic predictors of first level digital divide in Turkey by providing a systematic examination to the literature and portraying a comprehensive picture of all important indicators that should be included in the analysis. The first level digital divide is related to Internet connectivity. Connectivity depends on having access to an Internet-enabled device and having access to Internet connection and opportunity to use it. In this section, I analyze each separately to determine at which of these states connection fails for some social groups.

2.3.1.1 Device access

Categorical differences in society lead to an uneven distribution of resources, which in turn, leads to unequal opportunities for internet access (Van Dijk, 2005). Internet access is only possible with necessary tools and technologies which enable connectivity. The distribution and diversity of the Internet-enabled devices in society would give an indication for different dimensions of the digital divide. The various types of access can be considered as layered, with device access at the bottom, implying that each type is required but not sufficient for the next (Fuchs, 2009). Therefore, I analyze the current state in Turkey in terms of device access as a first step to approach this issue. I consider typical devices used for accessing the internet and going online, namely, smartphone, desktop, laptop, tablet, smart TV and game console. I refer these devices as internet-capable devices.

2.3.1.2 Internet access

On a practical level, having device access does not guarantee Internet access (neither vice versa). Internet access refers to the state of having or not having an Internet connection. In order to access the Internet, a household should be provided with necessary infrastructure and have tools and services for required connection such as a modem, and an Internet service provider (ISP). Internet access measure includes access to the Internet from any device via fixed or mobile broadband or both. It will not be possible to acquire the necessary skills and attitudes to utilize from the Internet if one does not have physical access to connectivity. In this study, only individual and household access and use

opportunities have been considered; ICT access and use at work or public facilities are not within the scope of this study.

2.3.1.3 Internet use

Having access to ICTs is necessary but not sufficient for Internet usage. The measure for Internet use is based on the following questions: “When was the last time you used the Internet at home?” and “How often have you used the Internet in the last three months?” By looking for answers to these questions, my aim is to investigate whether Internet non-adoption, even when Internet connection is actually available, is linked to various demographic or socioeconomic variables. Therefore, this part of the analysis goes beyond the binary distinction of being connected or not, and provide a more meaningful body of knowledge in revealing the digital gaps in Turkey in terms of actual Internet usage.

2.3.2 Demographic and socioeconomic indicators

Six population characteristics have been considered in this study, as potential indicators of the digital divide: three of them are classified as demographic characteristics, namely gender, age and region; the other three characteristics are classified as socioeconomic, namely income level, education level and employment status. The first characteristics are obviously based on the demographic data and region data. The latter characteristics refer to social and economic standing of an individual. In this section, I explain why each of these indicators is relevant to the first level digital divide discussion in the Turkish context. The categorization of the demographic and socioeconomic characteristics and segmenting the population based on this categorization will allow us to identify the high-priority target groups so that the policymakers can tailor their efforts based on particular social segments to address the digital divide in Turkey.

2.3.2.1 Gender

Gender equality is a cornerstone of a prosperous society and intrinsically linked to sustainable growth and is vital to the realization of human rights for all. Numerous studies have shown that improving gender inequality would have significant economic and social advantages. Gender equality requires equal possession of goods, opportunities and resources by women and men. Where gender inequality exists, it is generally women who

are excluded or disadvantaged. Women are underrepresented in their use and ownership of computers compared with men (Cooper and Weaver, 2003). However, it is generally assumed equal access for all household members, ignoring some fundamental constraints to ICT use for many women (Hafkin, 2006). There is indeed evidence from the developed countries claiming that the gap between men and women has closed in terms of internet access (Blank and Groselj, 2014; Ono and Zavodny, 2003). However, the gender gap persists in many developing countries. Concerning digital inequalities, it is critical to differentiate between Internet access and Internet use and identify the rate of women who actually use it. Therefore, by making a distinction between access and usage, and analyzing Internet access and Internet use separately, it will be possible to analyze the actual users in the household where connection is available.

2.3.2.2 Age

Information and communication-intensive activities have become an essential component of society and the economy. On the other hand, ICT is continuously reforming and reshaping itself at a very fast pace. Thus, people need to adapt to the changes to be able to integrate Internet use into their lives and take advantage of information and communication opportunities and resources. These technologies possess cognitive characteristics that make learning and adapting them a non-trivial effort (Schneider, 2005). The frequent rapid change in ICT causes digital knowledge and competency obsolescence, especially for the elderly. Therefore, age is another important factor of digital divide. I categorized age into four: 16-35 (student/early working age), 36-50 (prime working age), 51-65 (mature working age), and 66-74 (elderly). The categorical division enables us to examine the relationship between accessing to and using of the technologies and identify whether there is a disparity between age groups. Scholars have shown age is a significant predictor of the digital divide and that the gap is widening due to the dynamic nature of the ICTs and the substantial variation in skills and motivation to use the technologies. For instance, the younger individuals are mainly students or employees at the early stages of their careers' who are expected to take up more tech-savvy positions compared to older people. I will analyze if this is the case for Turkey or any other significant disparities exist between age groups in terms of ICT access and use.

2.3.2.3 Region

Telecommunications is a key infrastructure to the economic development prospects of regions. Unequal regional distribution of telecommunications infrastructure and services would lead to unequal utilization from the Internet. Also, socioeconomic and cultural differences between regions can also affect the degree of Internet adoption. It is more likely to observe such disparities in countries with heterogeneous regional characteristics.

Interregional disparities have already been a concern for the Turkish economy. Köksal and Anıl (2015) show that interregional disparities exist with regard to broadband adoption in favor of the western regions. I attempt to investigate whether similar disparities still exist in terms of ICT access and use in 2020. I will explore whether there is differentiation among NUTS-1 regions to in terms of ICT access and use.

2.3.2.4 Education

Level of education is one of the key composites of socioeconomic indicators. A great number of research deals with the significant relationship between educational attainment and socioeconomic outcomes. Digital divide literature also proves the correlative relationship between "knowledge gap" and gap in Internet access, showing that the level of education is one of the crucial factors for Internet access gaps such that more-educated people use Internet more actively and their use is more information-oriented whereas less-educated use it mostly for entertainment (Bonfadelli, 2002).

The scholars highlight the significant influence of education on internet access such that the highest levels of penetration are found among the most-educated (Chaudhuri et al., 2005; Dewan and Riggins, 2005). Moreover, countries with lower educational attainment tend to present lower rates of ICT access and use (Chinn and Fairlie, 2007; Dewan et al., 2009). Low education levels are one of the major barriers to becoming a knowledge economy and a network society. In this chapter, I will first look into the relationship between educational attainment and Internet access in the Turkish context, then analyze the Internet use frequency. In the next chapter, I will further investigate variation in content-specific usage patterns and inspect how level of education relates to digital skills that are required to use the technology.

2.3.2.5 Household income

Household income is commonly used as an indicator of home possessions, resources and a socioeconomic status of a person. Income measure is a source of economic scrutiny providing and index of household's ability to obtain goods and resources. Uneven distribution of income within a country is already a concern for other types of inequalities. Therefore, income measure is highly relevant in inequality studies as well as in the analysis of digital divide. People with high income are much more likely to have access to ICTs, to have the competency to use them, and to benefit from their use than people with low economic capital (Fuchs, 2009).

Van Dijk (2005) presented the findings of a multivariate analysis of Internet access surveys conducted in the United States and the Netherlands, demonstrating the importance of income as a determining factor in physical computer access. Korupp and Szydlik (2005) used the same method to determine the impact of human capital on Internet and computer usage using data from the German socioeconomic panel. A more recent study, Grishchenko (2020), showed people who have lower income are the most vulnerable social groups when analyzing the dynamics of the digital divide in Russia. There are countless other studies which demonstrated the significant effect of income on digital inequalities. In this study, I attempt to show the degree of this relationship in Turkey. I separated monthly household income into three categories: less than minimum wage (low income), more than minimum wage but less than twice the minimum wage (mid-income), and more than twice the minimum wage (high income).

2.3.2.6 Employment status

Employment status is another key measure of socioeconomic status. It can provide information about job characteristics as well as environmental conditions of the person. I grouped survey participants' occupational status as employed, unemployed, students, homemaker, and retired. Each group has a distinct socioeconomic position. I will analyze whether the occupational status of a person is a predictor of their position concerning the digital divide.

2.4 Stylized Facts

Participants were asked if they had access to an Internet-enabled device and an Internet connection, and whether they had used the Internet in the past 12 months for various types of personal use. I named the state of having physical access to an Internet-enabled device as *device access*. The devices considered consist of desktop, laptop, tablet, smartphone, smart TV, and game consoles that enable connectivity. The *Internet access* measure includes access to the Internet from any Internet-enabled device via fixed or mobile broadband or both. *Internet use* indicates whether the individual used the Internet in the last 12 months. I only took individual and household access and use opportunities. the initial findings from the data on the relationship between the predictors and the indicators of first-level digital divide, namely, device access, Internet access and Internet use. The first column presents the share of each variable; for example, the highest education level attained by 61.5 percent of the survey participants is below the high school level, 20.5 percent have a high school degree, and 18 percent have a higher-education degree. The percentages of device access, Internet access, and Internet use for each variable are presented in the subsequent columns.

Table 2.2 : First level digital divide indicators (%).

	share within category	device access	Internet access	Internet use
Variable				
Gender				
Female	50.2	99.5	91.1	69.6
Male	49.8	99.9	92.9	81.9
Age				
16-35	37.9	100.0	97.7	92.5
36-50	31.1	99.9	97.2	84.5
51-65	23.1	99.6	86.6	53.9
66-74	7.9	97.7	60.5	24.6
Income				
Low	31.3	99.2	82.1	60.2
Middle	43.3	99.9	94.9	78.0
High	25.4	100.0	99.1	91.1
Education				
Below high school	61.5	99.5	87.8	62.7
High school	20.5	100.0	98.4	94.6
Tertiary degree	18.0	100.0	99.0	98.6
Employment status				
Employed	39.1	100.0	96.5	89.5
Unemployed	8.0	99.9	95.2	88.4
Retired	12.1	99.5	83.0	58.8
Homemaker	30.9	99.5	89.0	60.5
Student	10.0	100.0	99.1	94.7
Region				
TR1	13.4	99.9	97.7	88.1
TR2	6.1	99.7	89.5	75.6
TR3	9.7	99.6	92.2	78.5
TR4	9.8	99.8	94.6	81.7
TR5	9.6	99.8	94.6	84.5
TR6	9.9	99.6	92.8	75.7
TR7	6.5	99.5	90.7	75.7
TR8	6.5	99.4	85.0	67.8
TR9	6.8	99.6	89.0	69.9
TRA	4.7	99.5	89.4	65.4
TRB	7.2	99.6	91.7	65.8
TRC	9.8	99.9	88.8	63.1

As shown in Table 2.2, device access rates are close to 100 percent and do not vary significantly across variables. A significant difference is observed in the age category concerning the percentage of Internet access. Only 60.5 percent of the elderly have an Internet connection. The rates further differentiate in terms of Internet use. Older people

are again in the lowest group with respect to Internet use, with only 24.6 percent reporting having used the Internet in the past 12 months. Although women and men have similar rates in terms of device and Internet access, the technology is used mostly by men. Only around 60 percent of homemakers and retired people use the Internet. The unemployed are not disadvantaged compared to the employed in terms of Internet use, as the usage rates are the same. The percentage Internet use for the education category is the lowest for people who have less than a high school degree and the highest for individuals with a tertiary degree. The data also reveal the income effect on the percentage Internet use. Only 60 percent of people with the lowest income level use the Internet, compared to 91 percent for high-income individuals. Finally, despite similar device access rates, we see variations in Internet access and Internet use among regions. While almost 98 percent of the people in Istanbul have Internet access, only 85 percent of the people living in the West Black Sea region (TR8) do. South-East Anatolia (TRC), East Black Sea (TR9), North-East Anatolia (TRA), and West Marmara (TR2) are other regions with relatively low Internet access rates. Nevertheless, the usage rates show more variation. The rates drop by around 25 percent for the regions with relatively low access rates. Only about 65 percent of people in South-East Anatolia (TRC), North-East Anatolia (TRA), and Central-East Anatolia (TRB) reported having used the Internet in the last 12 months. These regions are located in the eastern part of Turkey. Thus, the data at first glance reveal regional disparities in ICT access and use. It should also be noted that despite the lowest access rates, the West Black Sea (TR8) region has higher Internet usage rates than the eastern regions.

2.4.1 Device ownership and device diversity

The number of respondents who reported having access to an Internet-enabled device was 32,854 out of 32,955 (99 percent of the sample). Thus, almost all of the population has a device with sufficient technology to go online. The high rate of device access among population appears to be a good result at first glance. I analyze the device ownership patterns and how devices owned diversify among society.

I look into the rate of owning each internet-capable device that is subject to this study. Figure 2.1 shows the distribution of device ownership, reflecting the device diversity

among the population. Smartphone ownership significantly dominates other Internet-enabled devices.

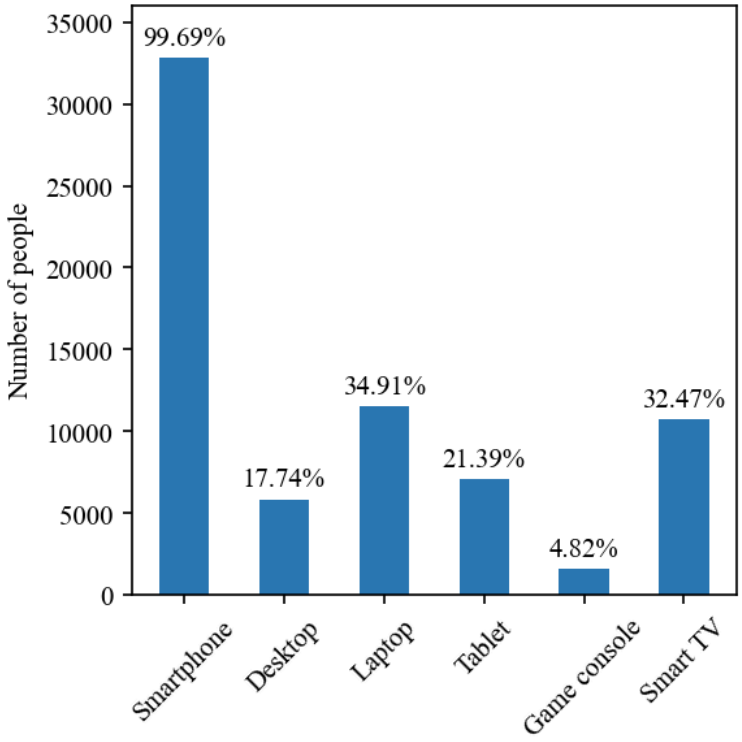

Figure 2.1 : Device ownership for each device type (%).

The uneven distribution of Internet-enabled devices could be related to economic and social inequalities. In a German context, Zillien and Hargittai (2009) showed that the pricing of technologies and the socioeconomic background of individuals affect device ownership. Economic resources are essential to acquire and sustain both the Internet and devices. Other than the price of broadband plans, consumers face the acquisition and maintenance costs of devices. These additional costs can significantly affect the affordability of overall ICT services, particularly in lower-income countries (ITU, 2020). On account of this, we expect to see that the distribution of device ownership in Turkey is concentrated towards devices that are considered essential; namely smartphones.

Both developed and developing countries have experienced rapid growth in mobile cellular penetration, but the growth of the average penetration rate has been faster in developing countries (Sicherl, 2019). Mobile phones have become promising new means

for Internet access in developing countries in Africa, Asia, and Latin America, such that Internet subscriptions per telephone mainline in those countries are as high as in developed countries (Dasgupta et al., 2005). Figure 1 indicates that the situation is similar in Turkey, as smartphones are available to a vast number of people. Even though smartphones offer mobility, convenience, and more continuous Internet use (Mossberger et al., 2012), they allow limited online activities and limited capacity for professional purposes. Knowing that one can diversify one's Internet experience by using different types of devices (van Deursen and van Dijk, 2019), groups that are on the undesirable side of the digital divide with only mobile access to the Internet cannot engage in a wide range of online activities, limiting the potential benefits of the Internet (Pearce and Rice, 2013). Figure 2.2 shows the number of different devices owned per person.

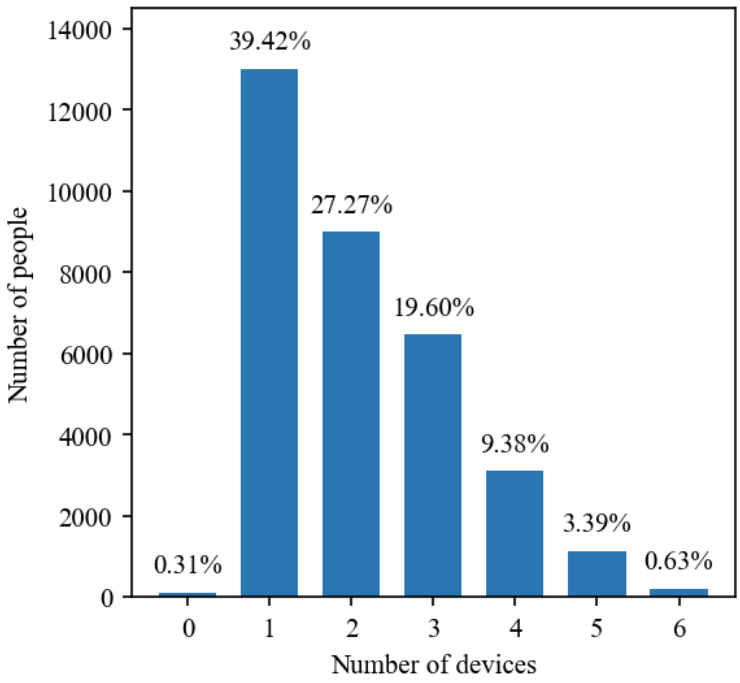

Figure 2.2 : Internet-enabled device ownership per person.

Given the vast smartphone availability for almost everyone, smartphone ownership can no longer be considered an indicator of the digital divide in Turkey in terms of device access. The majority of people own only one Internet-enabled device: a smartphone.

2.4.1.1 Smartphones as a mean of connectivity

Both developed and developing countries have experienced rapid growth of mobile cellular penetration, but the growth of the average penetration rate was faster rate in developing countries (Sicherl, 2019), where fixed and broadband connection and computer use are less widespread but instead smartphones are the key tool for connectivity (UNCTAD, 2021). Mobile phones have become promising new mean for Internet access in developing countries in Africa, Asia and Latin America such that the developing countries have Internet subscriptions per telephone mainline in those countries are as high as in developed countries (Dasgupta et al., 2005). Figure 2.1 indicates that the pattern is similar in Turkey. Given the vast smartphone availability for almost everyone, smartphone ownership can no longer be considered an indicator of the digital divide in Turkey in terms of device access. Even though smartphones offer mobility, convenience, and more continuous Internet use (Mossberger et al., 2012), and location services, game playing, and video streaming (van Deursen and van Dijk, 2019), they allow limited online activities and limited capacity for professional purposes. Hence, widespread use of smartphones may act as both "a bridge and a barrier for disadvantaged groups to overcome the digital divide" (Tsetsi and Rains, 2017). Nevertheless, effective use still needs to be promoted as widely as possible especially in poor developing countries (James, 2014). On the other hand, using only desktops results in relatively few opportunities for location-based activities as well as continuous communication. One can diversify their Internet experience by using different types of devices (van Deursen and van Dijk, 2019). The groups that are on the undesirable side of the digital divide with only mobile access to the Internet cannot engage in broad range of online activities, limiting the potential benefits of the Internet (Pearce and Rice, 2013).

Although smartphones are instrumentally useful, as discussed, especially after the pandemic outbreak, the transition to remote work and education was not an easy experience for smartphone-dependent users. Even though technological advancements in smartphone technology and digital platforms have started to provide an easier and more convenient user experience than before, relying on smartphones for online access today would not be sufficient to engage in more advanced online activities. Furthermore, previous research demonstrates the problematic relationship between smartphone

dependency and underprivileged demographic and socioeconomic groups. Tsetsi and Rains (2017) showed that smartphones are the only means of Internet access for minority groups, such as "younger, poorer and less educated users". Their findings also show that their online activity over smartphones remains limited to social activities. It appears that smartphone-only users cannot utilize all features of smartphones, indicating that the widespread use of smartphones cannot perfectly aid in the digital divide.

2.4.2 Internet access

Internet access refers to the state of having or not having an Internet connection. On a practical level, having device access does not guarantee Internet access (neither vice versa). Although Internet penetration rates have increased significantly in recent years in Turkey, differences in Internet access continue to persist. Approximately 42 percent of households had access to the Internet in Turkey in the early 2010s, and this rate rose to 90.7 percent as of April 2020 (TurkStat, 2020). The rate of households with internet access in Turkey is at the EU average access rate (ITU, 2018). Just over half (50.8 percent) of households have access to the Internet through a fixed broadband connection (ADSL, cable Internet, fiber, etc.), while 86.9 percent of them have access to the Internet through mobile broadband (3G, 4,5G through mobile phone/smartphone or modem) (TurkStat, 2020).

Differences in Internet access between different regions of Turkey are still observed. Albeit internet access in Turkey has been on an upward trend, access rates vary between Turkey's different geographic regions. The region with the highest penetration rate in 2019 was Istanbul with 95.6 percent, and interestingly, West Marmara, the nearest region to Istanbul has the lowest rate with 79. percent (TurkStat, 2019 and 2020).[4] The differences are also expected to be observed between urban-rural parts of the same region; however, our data do not reveal this distinction. For this reason, I only compare Turkey's NUTS-1 regions in terms of ICT access and use.

[4] 2020 data is more promising for West Marmara having the highest jump among other regions to 86 percent, leaving only West Black Sea region behind. TurkStat (2020). https://data.tuik.gov.tr/Bulten/Index?p=Hanehalki-Bilisim-Teknolojileri-(BT)-Kullanim-Arastirmasi-2020-33679, accessed on 8 December 2020.

Countries, particularly developing ones, have come a long way in improving their internet infrastructures. As a result, the number of people having Internet connection has increased rapidly, especially in recent years. However, according to the data, 30,322 out of 32,955 people have Internet access, which indicates that approximately 10 percent of the Turkish population aged 16–74 remain unconnected, which has critical implications and requires further assessment of the topic, and strategic policy interventions accordingly. The potential reasons behind this fact, along with demographic characteristics, are unaffordable costs of connection or equipment[5], limited digital literacy, lack of digital skills[6], and/or other motivational reasons.[7]

2.4.3 Internet use

Considering the digital divide as a dichotomous state of having or not having access to an Internet connection would be a simplistic approach to have a realistic understanding of digital inequalities. Even when Internet is available at home, some individuals do not use it, at least not effectively. Therefore, it is important not to conflate Internet access with Internet use in order to uncover actual inequalities. According to ITU (2018), the percentage of individuals in Turkey using the Internet is 64.7 percent. This rate is above the world average (48.6 percent) but below the EU average (77.2 percent).[8] The usage rate indicates that some individuals still do not use the Internet despite having necessary connection to use it. We therefore can say that having Internet access does not always lead to using it.

[5] 17 percent of the households without access to internet at home, have reported that they find access costs too high in 2019; 20% find access and equipment costs too high; percent find equipment costs too high (Eurostat, Digital Economy and Society Database, 2020, https://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do, accessed on Jan 16, 2021).
[6] 74 percent of the households without access to internet at home, have reported that they do not have access in 2019 because they are lack of skills (Eurostat, Digital Economy and Society Database 2020, https://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do, accessed on Jan 16, 2021).
[7] 61 percent of the households without access to internet at home in 2019, have reported that access is not needed (content is not useful, interesting, etc.); 6% have reported that they have privacy and security concerns (Eurostat, Digital Economy and Society Database, 2020, https://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do, accessed on Jan 16, 2021).
[8] Despite the relatively high rates of penetration, Turkey performs very poor in terms of internet speed. Turkey ranks 58 out of 139 countries in mobile broadband internet speed, and 102 out of 176 countries in fixed mobile internet speed (Speedtest Global Index, November 2020, https://www.speedtest.net/global-index, accessed on Jan 16, 2021).

2.4.3.1 Internet penetration level

Although society shows increased levels of Internet utilization in recent years, disparities in Internet use in terms of demographic, socioeconomic and regional characteristics persist, and the groups lagging are still causing concern. Internet usage is most common among Turkish young adults, with 79 percent usage rate in 2020. The 2019 rate was 75.3 percent (TurkStat 2019; TurkStat 2020).

The Internet is most commonly used in Istanbul with a rate of 86.6 percent, while the percentage of Internet use is the lowest in Southeastern Anatolia with 58.4 percent (TurkStat, 2020). The disparity between regions in Internet use is very alarming for Turkey. Furthermore, there is also a disparity among genders. While 81.8 percent of men were Internet users in 2019, this rate was 68.9 percent for women (TurkStat, 2020). Unlike Internet access, gender is expected to exert a more substantial effect on Internet use. Furthermore, students have the highest Internet usage rate, whereas homemakers have the lowest rate with 49.6 percent (TurkStat, 2020).

Approximately 90 percent (30,030 out of 32,854) of participants reported using the Internet in the past 12 months. The percentage of participants who have reported that they had used the Internet in the past three months is 75 percent (24,759 out of 32,854). The measure for Internet use is based on the following questions: 1- “When was the last time you used the internet at home, at work, or elsewhere?” and 2- “How often have you used the internet in the last three months?” I only consider the participants who have reported that they had used the internet in the past three months, $N = 24759$, in order to examine the amount and frequency of internet use. Table 2.3 shows the last time each participant used the Internet in percentages for each group. Regarding gender, men use the Internet more than women; 30 percent of women have never used the Internet. Students and young adults use the Internet the most. Individuals with higher income and with an above high school degree are on the advantageous side of the divide in terms of Internet use. They are also more frequent users of the Internet than the other groups in their category. Interestingly, there is no apparent difference between the employed and unemployed in terms of Internet use frequency. The eastern regions of the country (TRA, TRB, TRC) have higher rates of nonusers.

Table 2.3 : Last internet use (%).

	Never	Not used in the past 12 months	Used in 3-12 months	Used in the past three months
Variable				
Gender				
Female	29.7	0.7	0.6	69.0
Male	17.2	0.9	0.6	81.3
Age				
16-35	6.9	0.7	0.6	69.0
36-50	14.7	0.8	0.5	84.0
51-65	45.1	0.9	0.7	53.2
66-74	74.2	1.2	0.5	24.1
Income				
Low	38.7	1.1	0.9	59.4
Average	21.2	0.8	0.5	77.5
High	8.6	0.3	0.4	90.7
Education				
Below high school	36.3	1.0	0.8	61.9
High school	4.8	0.6	0.4	94.2
Any tertiary degree	1.1	0.4	0.1	98.5
Employment status				
Employed	10.0	0.5	0.3	89.2
Unemployed	10.4	1.2	1.3	87.2
Retired	39.6	1.6	0.8	58.0
Homemaker	38.5	0.9	0.7	59.9
Student	5.0	0.3	0.4	94.2
Region				
TR1	11.5	0.4	0.1	88.0
TR2	23.3	1.1	0.3	75.3
TR3	20.8	0.7	0.7	77.8
TR4	17.7	0.6	0.6	81.0
TR5	15.1	0.4	0.9	83.7
TR6	23.5	0.8	0.5	75.2
TR7	24.0	0.3	0.1	75.6
TR8	31.5	0.7	0.5	67.3
TR9	29.3	0.9	0.4	69.4
TRA	34.1	0.5	1.2	64.2
TRB	32.4	1.8	0.8	65.0
TRC	35.3	1.6	1.1	61.9

In the first stage of the analysis, we can infer that internet penetration level falls behind access rates in Turkey. This result leads us to question the meaningful connectivity in

Turkey because the gap between different social groups widens when it comes to internet penetration rates.

2.4.3.2 Internet use frequency

Table 2.4 shows Internet use frequency in the past three months. The frequency of use is lower for the elderly, less-educated, retired, and for those who have lower levels of household income. The data show a similar pattern for regions, such that people living in eastern Turkey uses the Internet less frequently.

Table 2.4 : Internet use frequency of people who used the Internet in the past three months (%).

	Less than once a week	More than once a week	Every day
Variable			
Gender			
Female	1.7	8.4	89.9
Male	1.6	7.8	90.6
Age			
16-35	1.2	5.1	93.7
36-50	1.5	7.7	90.8
51-65	2.6	15.4	82.0
66-74	5.2	21.8	73.0
Income			
Low	3.2	14.4	82.4
Average	1.5	7.8	90.6
High	0.6	3.3	96.1
Education			
Below high school	2.8	12.8	84.4
High school	0.6	4.5	95.0
Any tertiary degree	0.3	1.8	97.9
Employment status			
Employed	1.1	5.2	93.6
Unemployed	2.2	8.7	89.2
Retired	2.8	16.1	81.1
Homemaker	2.4	11.8	85.8
Student	0.9	4.2	94.9
Region			
TR1	1.4	5.2	93.3
TR2	0.7	8.0	91.4
TR3	1.4	7.4	91.3
TR4	0.8	7.5	91.7
TR5	1.4	4.7	94.0
TR6	1.6	8.0	90.4
TR7	1.3	6.4	92.3
TR8	1.2	8.2	90.6
TR9	1.9	15.4	82.6
TRA	4.3	11.1	84.5
TRB	3.1	11.0	85.9
TRC	2.7	11.6	85.6

The frequency of use is lower for the elderly, less educated, retired and for those who have lower levels of household income. The data shows similar pattern for regions such that people living in the eastern Turkey uses the Internet less frequently.

2.5 Methodology

Dependent variables represent a dichotomous state (presence or absence of Internet access and use). Explanatory variables are the key demographic and socioeconomic factors with the potential to affect Internet adoption patterns, namely, gender, age, employment status, level of education, income level, and geographical region. Due to the dichotomous characteristic of dependent variables, I employ a binomial logit model, which employs logistic distribution to estimate the parameters by maximum likelihood and allows for non-linearity between dependent and explanatory variables.

In addition to logit models, linear probability model has been also used in this context in the literature. However, linear probability model cannot take discreteness of the dependent variable into account. Logit model has the advantage of allowing for non-linearity between dependent and explanatory variables over linear probability model. Moreover, it should be noted that the logit model is sensitive to heteroskedasticity. A consistent estimate of standard errors and variance can be obtained by using White's heteroskedasticity consistent estimator (White, 1980). Therefore, we conducted a test for the absence of heteroskedasticity and correct heteroskedasticity by using White's consistent estimator whenever the null hypothesis is rejected for the regressions employed in the present study.

In addition to White's test for heteroskedasticity, we provided some goodness-of-fit measures such as the Wald test, pseudo R^2 (McFadden's R-squared) and receiver operating characteristics (ROC) curves. The ROC curve illustrates the fraction of the dependent variables taking the value one that is correctly classified against the fraction of dependent variables taking the value zero that is incorrectly classified at different classification thresholds. The area under curve (AUC) metric provided with ROC curves indicates the predictive power of the model. The higher the AUC, the more predictive the model is. The ROC curves are shown to be sufficiently bowed. The associated AUCs are 0.88 and 0.89, which supports the predictive power of the models. A statistically significant Wald test is also indicative of the significance of the model. The test results show that the models are statistically significant. The Pseudo R^2 shows the predictive

power of the model and is calculated as 0.30 and 0.37. A pseudo R^2 in the range of 0.20–0.40 is considered satisfactory in the literature (McFadden, 1979).

It is worth noting that the survey results do not reveal a divide in device access in Turkey along critical demographic and socioeconomic factors. Therefore, I conducted logistic regressions only for Internet access and Internet use.

The survey results do not reveal a divide in device access in Turkey along critical demographic and socioeconomic factors thanks to the widespread use of smartphones, as discussed in Section 2.4.1. Therefore, I performed logistic regressions only for Internet access and Internet use. I express the associated latent variable for Internet access as the linear predictor function and an additive random error variable:

$$Y^*_{access} = \alpha + \beta_1 \text{Gender}_i + \beta_2 \text{Age}_i + \beta_3 \text{Income}_i + \beta_4 \text{Education}_i + \beta_5 \text{Employment}_i + \beta_6 \text{Region}_i + u_i$$

where Y^*_{access} is the dependent variable representing Internet access and Gender, Age, Income, Education, Employment, and Region are independent variables that influence the latent variable along with the error term, u_i, which is distributed by the standard logistic distribution for each variable, such that $u_i \sim Logistic\ (0,1)$. Finally, α is the intercept term and βs are the coefficients of the respective independent variable.

The dependent variable, Y_{access}, can be viewed as an indicator for whether the latent variable is positive. Therefore, the binary variable Y_{access} is defined as:

$$Y_{access} = \begin{cases} 1, & Y^*_{access} > 0 \\ 0, & Y^*_{access} \leq 0 \end{cases}$$

By letting X_i denote the set of explanatory variables, the probability of observing the latent variable can be written as:

$$\begin{aligned} \Pr(Y^*_{access} > 0 \mid X_i) &= \Pr(u_i > -(\alpha + X_i\beta) \mid X_i) \\ &= \Pr(u_i < (\alpha + X_i\beta) \mid X_i) \\ &= \Pr(Y_{access} = 1 \mid X_i) \\ &= \psi(Y^*_{access}) \end{aligned}$$

where Y_{access} is a binary variable takes the value 1 if the individual *i* has Internet access in the past 12 months, or 0 otherwise, and $\psi(.)$ is the cumulative distribution function of the standard logistic distribution and equals the inverse of the logit (log-odds) function:

$$\psi(Y^*_{access}) = logit^{-1}(\alpha + X_i\beta) = \frac{1}{1 + e^{-(\alpha + X_i\beta)}}$$

which can also be written as probability distribution:

$$\Pr(Y_{access} = 1|\, X_i) = \frac{e^{\alpha + X_i\beta}}{1 + e^{\alpha + X_i\beta}} = p_i$$

The model becomes:

$$\log\left(\frac{p_i}{1 - p_i}\right) = \alpha + X_i\beta$$

The estimated parameters are in the log-odds scale, which, other than sign, do not have any useful interpretation. The raw coefficients, β, give the effect of an independent variable on the log-odds of the dependent variable. Since we are interested in finding out the effect of the independent variables on the probability of Internet access and Internet use, I calculated marginal effects to describe the effect of an explanatory variable on the conditional probability of the dependent variable taking on the value of one. I computed the average effect of X_i on the probability, p_i as:

$$\frac{\partial \Pr(Y_{access} = 1|\, X_i)}{\partial X_i} = \frac{\partial \Pr(Y_{access} = 1|\, X_i)}{\partial \boldsymbol{X}} \times \frac{\partial \boldsymbol{X}}{\partial X_i} = \psi'(Y^*_{access})$$

where $\frac{\partial \Pr(Y_{access}=1|\, X_i)}{\partial X_i}$ gives the incremental change effect of X_i.

Average marginal effects (AME) refer to the impact of a case picked at random from the sample of all observed values. The measure provides substantive information about the

influence of the independent variables on a dependent variable along with the regression results.

I employ the same methodology for predicting Internet use, where Y_{use} is the dependent variable that takes the value 1 if the individual *i* used the Internet in the last 12 months, or 0 otherwise.

2.6 Results

In this section, I present the results of the econometric models predicting the key demographic and socioeconomic factors that are associated with Internet access and Internet use in Turkey. I interpret the regression results in detail by AME calculations. I focus particularly on interregional differences in terms of both internet access and internet use with matrix tables which would help the reader better visualize the direction and significance of the relation between 12 regions. I also present the goodness-of-fit measures to prove the reliability of the results.

2.6.1 Demographic and socioeconomic predictors of internet access in Turkey

Internet access is measured by asking participants whether or not they had accessed the internet for various types of personal use in the past 12 months. This measure includes access to the Internet from any Internet-enabled device.

2.6.1.1 Regression results predicting internet access

Table 2.5 shows the log-odds from the logit model predicting Internet access in the past 12 months. The baseline findings for the case of Turkey are in line with the previous studies. According to White test results, the model suffers from heteroscedasticity. Therefore, the standard errors of the models are corrected by using White's heteroscedasticity-consistent standard errors. The test results show that both models are statistically significant as a whole. The Pseudo R^2 is 0.30 for the models, which is considered satisfactory.

Table 2.5 : Logistic regression predicting Internet access in the past 12 months (N= 23,742).

		Logit	
Variable			
constant		8.5078 (0.382)***	
Gender			
Female		-0.0780 (0.100)	
Age			
36-50		0.1086 (0.109)	
51-65		-1.4897 (0.092)***	
66-74		-2.8452 (0.106)***	
Income			
Average		-1.3121 (0.148)***	
Low		-2.4868 (0.145)***	
Education			
High school		-0.0169 (0.204)	
Below high school		-1.1168 (0.169)***	
Employment status			
Employed		-1.3320 (0.276)***	
Unemployed		-1.4094 (0.290)***	
Retired		-1.3594 (0.282)***	
Homemaker		-1.3620 (0.269)***	
Region			
TR2		-1.2002 (0.160)***	
TR3		-0.8870 (0.153)***	
TR4		-0.7112 (0.165)***	
TR5		-0.9375 (0.163)***	
TR6		-0.7036 (0.156)***	
TR7		-1.0472 (0.160)***	
TR8		-1.6002 (0.154)***	
TR9		-1.1508 (0.161)***	
TRA		-1.1435 (0.173)***	
TRB		-1.1229 (0.165)***	
TRC		-1.4178 (0.153)***	
Wald χ^2	2330.39	Df: 23	p-value=0.0
Pseudo R^2	0.3048		
White-test (LM-Stat)	4401.77		p-value=0.0
Note: Standard errors are reported in parentheses.			
*p=<.05; **p=<.01; ***p=<.001			

According to the results while there is a significant negative relationship between age and Internet access for the 51–65 and 66–74 age groups, this relationship is insignificant for the 36–50 age group with reference to the youngest age group, indicating that elderly people cannot fully engage themselves in the digital realm (Haight et al., 2014) as young

people and students do. The gender gap seems to disappear in terms of Internet access as the results show a weak effect. Unlike some earlier studies, we found that Internet access does not appear to be patterned on gender. There is a significant positive relationship between income level and Internet access. The reference group is people with high family income. People with lower family income are unlikely to access the Internet compared to the reference group, revealing a significant relationship between Internet access and economic gaps. Individuals with higher education levels are also more likely to access the Internet than people with low education levels. The difference is weak and not significant between high school and tertiary school graduates. Compared to Istanbul (TR1), all regions reveal significant results, which means that, regardless of whether someone is located in the west or east of Turkey, the probability of having an Internet connection is lower for those who do not live in Istanbul. Köksal and Anıl (2015) argued that interregional disparities exist with regard to broadband adoption in favor of western regions. It is worth checking whether this argument still holds true today, given infrastructural developments over time.[9] Therefore, I ran regressions repeatedly, each time taking a different region as a reference and controlling for all other variables. The matrix table (Figure 2.3) shows the digital divide from a regional perspective. The sign of the log-odds from the regression gives the direction of the relationship relative to the reference group (presented in the vertical axis). Figure 2.3 provides useful information for interregional comparison. For example, Istanbul (TR1) demonstrates all positive signs when compared to other regions, indicating that it is superior in Internet access to other regions of Turkey. The positive signs all shown in green also indicate that the results are statistically significant at 1% level of significance. The signs that are presented in red indicate that there is no significant relationship between respective regions. For example, despite West Black Sea region demonstrates a negative effect in terms of Internet access when compared to other regions, this effect is insignificant for South East Anatolia (TRC), meaning that those regions are not significantly better or worse off than each other in terms of Internet access.

[9] The length of fiber optic cable throughout Turkey has increased by 58 percent and reached 425.000 km from 2015 to 2020 (ICTA, 2021).

	TR1	TR2	TR3	TR4	TR5	TR6	TR7	TR8	TR9	TRA	TRB	TRC
TR1	N/A	+	+	+	+	+	+	+	+	+	+	+
TR2	-	N/A	-	-	-	-	-	+	-	-	-	+
TR3	-	+	N/A	-	+	-	+	+	+	+	+	+
TR4	-	+	+	N/A	+	-	+	+	+	+	+	+
TR5	-	+	-	-	N/A	-	+	+	+	+	+	+
TR6	-	+	+	+	+	N/A	+	+	+	+	+	+
TR7	-	+	-	-	-	-	N/A	+	+	+	+	+
TR8	-	-	-	-	-	-	-	N/A	-	-	-	-
TR9	-	+	-	-	-	-	-	+	N/A	-	-	+
TRA	-	+	-	-	-	-	-	+	+	N/A	-	+
TRB	-	+	-	-	-	-	-	+	+	+	N/A	+
TRC	-	-	-	-	-	-	-	+	-	-	-	N/A

green: p<=.001; yellow: p<=.01; orange: p<=.05; red: p>.05 (insignificant)

Figure 2.3 : Logistic regression results summarized to present interregional disparities in terms of Internet access.

According to Figure 2.3, Istanbul (TR1) is superior to all other regions in terms of access. Unlike Köksal and Anıl (2015), we cannot see a significant diminishing pattern from the west of Turkey to the east in terms of access rates in 2020. However, West Black Sea (TR8) and South East Anatolia (TRC) reveal significant results compared to other regions. The access rate in TRC is significantly lower than in western regions (TR3, TR4, TR5, TR6), except West Marmara (TR2). TR8 performs poorly compared to all regions except TRC, which reveals an insignificant result. The lower access rates in TR8 could be due to issues related to infrastructure, as ICTA (2021) reports shorter fiber optic cable lengths for the region.

2.6.1.2 Assessment of the overall model fit by ROC curve

Along with the aforementioned model evaluation metrics measured to test the models' performance towards multi-class classification problem, I also measured ROC curve and the associated AUCs. The ROC curve tells us how much the model is capable of distinguishing between classes. In other words, ROC is a probability measurement and visualizes the distribution of probabilities of class separation. The AUC represent the degree of separability. The higher values of AUC represent a greater degree of

separability such that the higher the AUC, the better the model is at predicting 0 classes as 0 and 1 classes as 1. Hence, an excellent model is expected to have AUC closer to 1.

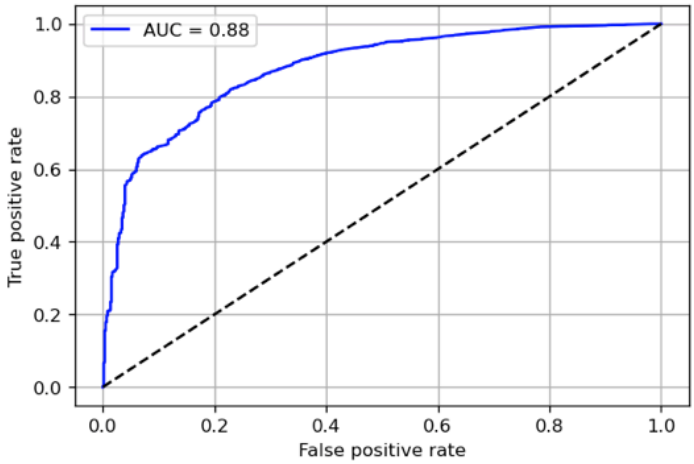

Figure 2.4 : Receiver Operating Characteristics (ROC) curve for the logit model predicting Internet access.

The ROC curve illustrated in Figure 2.4 is significantly bowed. The associated AUCs are 0.88 for the logit model predicting Internet access, which is considered a very good measure of separability, supporting the predictive power of both models. Therefore, I can conclude that the test result for Internet access is statistically reliable.

2.6.1.3 Interpretation of findings by average marginal effects of the predictors

Notice that the coefficients obtained from logit models is less intuitive and not directly comparable. In order to get more descriptive and intuitive results and more quantitative information concerning the effects of independent variables on the dependent variable from the logit analysis, I calculated the average marginal effects (AMEs) of the independents variables. Marginal effects measure the effect that a discrete change in a specific explanatory variable has on the outcome variable while all other variables are held constant. This measures thus provide substantive information on the influence of independent variables on a dependent variable along with the regression results. The AMEs refers to the impact for a case picked at random from the sample of all observed values. Hence, it reflects the full distribution of the particular independent variable.

Table 2.6 shows the AMEs of the logistic regression predicting Internet access. The derivatives (dy/dx) in Table 2.6 represent the impact of each category on the probability of having Internet access, holding the other covariates constant.

Table 2.6 : Average marginal effects of the logit model predicting Internet access (N= 23,742).

	dy/dx (Logit)
Variable	
Gender	
Female	-0.0040 (0.005)
Age	
36-50	0.0056 (0.006)
51-65	-0.0762 (0.005)***
66-74	-0.1456 (0.005)***
Income	
Average	-0.0671 (0.008)***
Low	-0.1273 (0.007)***
Education	
High school	-0.0009 (0.010)
Below high school	-0.0572 (0.009)***
Employment status	
Employed	-0.0682 (0.014)***
Unemployed	-0.0721 (0.015)***
Retired	-0.0696 (0.014)***
Homemaker	-0.0697 (0.014)***
Region	
TR2	-0.0614 (0.008)***
TR3	-0.0454 (0.008)***
TR4	-0.0364 (0.008)***
TR5	-0.0480 (0.008)***
TR6	-0.0360 (0.008)***
TR7	-0.0536 (0.008)***
TR8	-0.0819 (0.008)***
TR9	-0.0589 (0.008)***
TRA	-0.0585 (0.009)***
TRB	-0.0575 (0.008)***
TRC	-0.0726 (0.008)***
Note: Standard errors are reported in parentheses.	
*p=<.05; **p=<.01; ***p=<.001	

According to the results presented in Table 2.6, a discrete change for the 51–65 and 66–74 age groups decreases the probability of having Internet access as age increases; that

is, the probability decreases by 0.076 for a person at mature working age and drops by 0.15 for the elderly. Having a lower household income also decreases the probability of having Internet access. Households with less than twice the minimum wage income are 0.07 less likely to have Internet access, whereas those earning less than the minimum wage are 0.13 less likely. As to the education category, high school degree has no significant effect on Internet access. However, low-educated individuals who did not attain at least a high school degree are disadvantaged in having Internet access. A discrete change for the retired and homemaker within the employment category decreases the likelihood of having Internet access by 0.07. The impact of the region category on the probability of having Internet access varies. West Black Sea (TR8) and Southeast Anatolia (TRC) have a higher negative impact. These two regions reveal almost two-fold negative impact than East Marmara (TR4) and Mediterranean (TR6), disclosing the disparities between Istanbul and different regions of Turkey.

2.6.2 Demographic and socioeconomic predictors of internet use in Turkey

Conceptualization of the digital divide only as a dichotomous state as being either connected or disconnected would be a simplistic approach to have a realistic understanding of digital inequalities. Our results support the fact that some individuals do not use the Internet, even when a connection is available.

According to ITU (2018), the percentage of individuals in Turkey using the Internet is 64.7 percent. This rate is above the world average (48.6 percent) but below the EU average (77.2 percent). Although having the necessary infrastructure and tools for connection, the results show that some individuals still do not use the Internet effectively.

Although society shows increased levels of Internet utilization in recent years, disparities in Internet use in terms of demographic, socioeconomic and regional characteristics persist, and the groups lagging are still causing concern. Internet usage is most common among Turkish young adults, with 79 percent usage rate in 2020. The Internet is most commonly used in Istanbul with a rate of 86.6 percent, while the percentage of Internet use is the lowest in Southeastern Anatolia with 58.4 percent (TurkStat, 2020). The disparity between regions in Internet use is very alarming for Turkey. Furthermore, there is also a disparity among genders. While 81.8 percent of men were Internet users in 2019,

this ratio was 68.9 percent for women (TurkStat, 2020). Unlike Internet access, gender is expected to exert a more substantial effect on Internet use. Furthermore, students have the highest Internet usage rate, whereas homemakers have the lowest rate with 49.6 percent (TurkStat, 2020).

2.6.2.1 Logit model predicting internet use in Turkey

Conceptualization of the digital divide only as a dichotomous state as being either connected or disconnected would be a simplistic approach to have a realistic understanding of digital inequalities. Our results support the fact that some individuals do not use the Internet, even when a connection is available.

Internet use is measured by asking participants who had Internet access at home in the past 12 months, whether or not they had used the internet during this period. This measure refers to Internet usage from any Internet-enabled device at home. Table 2.7 presents the results from logistic regression predicting internet use in the past 12 months.

Table 2.7 : Logistic regression predicting Internet use in the past 12 months (N= 23,766)

		Logit	
Variable			
constant		7.1794 (0.186)***	
Gender			
Female		-0.5036 (0.064)***	
Age			
36-50		-0.7602 (0.061)***	
51-65		-2.3246 (0.064)***	
66-74		-3.5741 (0.093)***	
Income			
Average		-0.6032 (0.064)***	
Low		-1.0966 (0.066)***	
Education			
High school		-1.1426 (0.148)***	
Below high school		-2.7115 (0.135)***	
Employment status			
Employed		-0.2531 (0.113)*	
Unemployed		-0.3107 (0.132)*	
Retired		-0.5445 (0.124)***	
Homemaker		-0.8103 (0.109)***	
Region			
TR2		-0.6256 (0.105)***	
TR3		-0.4917 (0.095)***	
TR4		-0.3733 (0.095)***	
TR5		-0.3860 (0.099)***	
TR6		-0.7422 (0.092)***	
TR7		-0.6645 (0.102)***	
TR8		-1.0702 (0.099)***	
TR9		-0.9909 (0.101)***	
TRA		-1.5881 (0.110)***	
TRB		-1.6288 (0.094)***	
TRC		-1.9024 (0.091)***	
Wald χ^2	5039.11	Df: 23	p-value=0.0
Pseudo R^2	0.3733		
White-test (LM-Stat)	5305.12		p-value=0.0

Note: Standard errors are reported in parentheses.
*p=<.05; **p=<.01; ***p=<.001

The regression results in Table 2.7 show that nonusers are predicted to be disproportionately female, older, less-educated, low income, retired, and homemakers. Unlike the Internet access case, all the demographic and socioeconomic factors, even gender and mid-level education, have significant effects on Internet use. Age is negatively

associated with the likelihood of Internet use. Elderly people are less likely to use the Internet than young adults. Students are the most advantageous within the employment category. Furthermore, level of education is a significant predictor of Internet use, such that the probability that a person with a high school or below high school degree uses the Internet is lower than a person with a tertiary degree (the reference group). The geographical region of residence is a strong predictor of Internet use, such that the likelihood of Internet use is significantly lower for eastern regions compared to Istanbul (TR1). Figure 2.5 shows that there are interregional disparities in terms of usage. The intuition is the same as for Figure 2.3 in Section 2.6.1.1. The greater number of signs presented in green shade in Figure 2.5 indicates more significant results, meaning that there are more significant interregional differences in Internet use.

	TR1	TR2	TR3	TR4	TR5	TR6	TR7	TR8	TR9	TRA	TRB	TRC
TR1	N/A	+	+	+	+	+	+	+	+	+	+	+
TR2	-	N/A	-	-	-	+	+	+	+	+	+	+
TR3	-	+	N/A	-	-	+	+	+	+	+	+	+
TR4	-	+	+	N/A	+	+	+	+	+	+	+	+
TR5	-	+	+	-	N/A	+	+	+	+	+	+	+
TR6	-	-	-	-	-	N/A	-	+	+	+	+	+
TR7	-	-	-	-	-	+	N/A	+	+	+	+	+
TR8	-	-	-	-	-	-	-	N/A	-	+	+	+
TR9	-	-	-	-	-	-	-	+	N/A	+	+	+
TRA	-	-	-	-	-	-	-	-	-	N/A	+	+
TRB	-	-	-	-	-	-	-	-	-	-	N/A	+
TRC	-	-	-	-	-	-	-	-	-	-	-	N/A

green: $p<=.001$; yellow: $p<=.01$; orange: $p<=.05$; red: $p>.05$ (insignificant)

Figure 2.5 : Logistic regression results summarized to present interregional disparities in terms of Internet use.

From Figure 2.5, we deduce that the rate of Internet use decreases from the west to the east of Turkey. The disparities between western regions are either weak or insignificant. Therefore, Internet use appears to be differentiated within Turkey toward more economically prosperous regions (TurkStat, 2018). A similar result was previously argued by Köksal and Anıl (2015). My results show that gaps in Internet use persist

between regions of Turkey, indicating that the interregional divide has endured over time. The AMEs of the predictors of Internet use are shown in Table 2.8.

2.6.2.2 Assessment of the overall model fit by ROC curve

The AUC measure is 0.89, and the shapes of the ROC curve (see Figure 2.6) conforms acceptable values. The associated AUC is considered a very good measure of separability, supporting the predictive power of both models. Hence, the test results for internet use are statistically reliable.

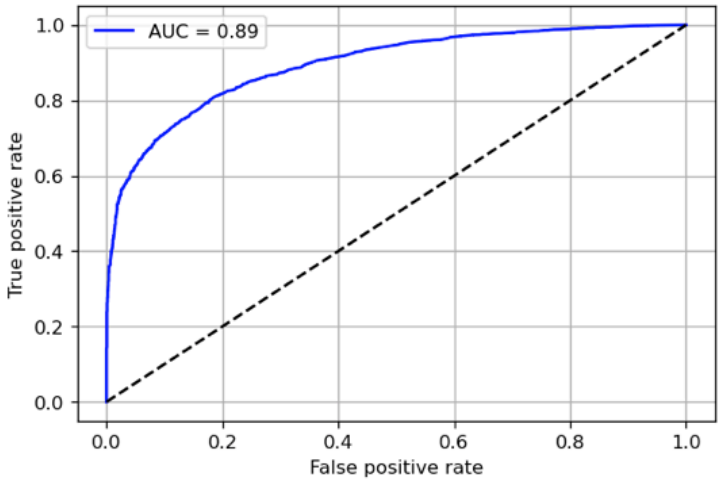

Figure 2.6 : Receiver Operating Characteristics (ROC) curve for the logit model predicting Internet use.

2.6.2.3 Interpretation of findings by average marginal effects of the predictors

In order to get a more intuitive understanding of the regression results, I again calculated the AMEs of the predictors and present them in Table 2.8.

Table 2.8 : Average marginal effects from logit model predicting Internet use (N= 23,766).

	dy/dx (Logit)
Variable	
Gender	
Female	-0.0536 (0.007)***
Age	
36-50	-0.0809 (0.006)***
51-65	-0.2473 (0.006)***
66-74	-0.3801 (0.008)***
Income	
Average	-0.0642 (0.007)***
Low	-0.1166 (0.007)***
Education	
High school	-0.1215 (0.016)***
Below high school	-0.2884 (0.014)***
Employment status	
Employed	-0.0269 (0.012)*
Unemployed	-0.0330 (0.014)*
Retired	-0.0579 (0.013)***
Homemaker	-0.0862 (0.012)***
Region	
TR2	-0.0665 (0.011)***
TR3	-0.0523 (0.010)***
TR4	-0.0397 (0.010)***
TR5	-0.0411 (0.010)***
TR6	-0.0789 (0.010)***
TR7	-0.0707 (0.011)***
TR8	-0.1138 (0.010)***
TR9	-0.1054 (0.011)***
TRA	-0.1689 (0.012)***
TRB	-0.1732 (0.010)***
TRC	-0.2023 (0.009)***
Note: Standard errors are reported in parentheses.	
*p=<.05; **p=<.01; ***p=<.001	

The results for Internet use are mostly in line with the results for Internet access. In fact, we draw some further implications when we compare both results. For example, the findings show that gender effect on Internet use is statistically negative and significant, with an average marginal effect of -0.05 for women. Similar to the results obtained for Internet access, the higher age categories and lower income and education level categories reveal a higher negative impact on the probability of Internet use. Homemaker reveals higher AME in absolute terms than retired, with a coefficient of -0.09. The region with

the highest negative AME on the probability of Internet use is again Southeast Anatolia (TRC). However, West Black Sea (TR8) region performs better in terms of Internet use compared to Internet access. Other regions with significantly higher negative AMEs are Northeast Anatolia (TRA) and Central East Anatolia (TRB). The most prominent common feature of these three regions is that they form the eastern part of the country. On the other hand, the regions with smaller AME in absolute values are East Marmara (TR4), West Anatolia (TR5), and Aegean (TR3), all of which are located in the western part of Turkey.

2.7 Analysis of the Results

In the present chapter, I have explored the adoption of ICTs by mainly focusing on Internet access and use from the perspective of the digital divide in Turkey. The results of the econometric analyses reveal that there are significant disparities in the likelihood of having access to an Internet connection and using the Internet between certain demographic and socioeconomic groups. We can conclude from the results that demographic and socioeconomic characteristics are the predictors of Internet access and Internet use in Turkey. The significant disparities among society point to the problem of the digital divide and indicate the need for a more coherent vision on the ICT policies, demand-side policies in particular, to address the digital divide in the country.

Before moving to the detailed analysis of Internet access and Internet use, we first analyzed the problem of having physical access to an Internet-enabled device, which we call the device access aspect of the first-level digital divide. According to the TurkStat survey data, the vast majority of the population have access to an Internet-enabled device. Smartphone ownership significantly dominates other Internet-enabled devices. On top of smartphones' dominance, they are the only means of connectivity for the considerable majority of the population. Since other Internet-enabled devices are not widely used, people are constrained by what smartphones provide them. The uniformity of device preferences in Turkey reveals the lack of multimodality of Internet use, which is another critical indicator of the digital divide (Wei, 2012).

We observe more significant results when we analyze the relationship between demographic and socioeconomic factors and Internet access. Although Internet access in Turkey has been on an upward trend, there are still "disconnected" people. The results show that the people with the least Internet access are older people, those with lower household incomes or low level of education. Moreover, we observe significant gaps between Istanbul and other regions. On the other hand, there is no significant difference between genders in terms of Internet access.

I take Internet use into consideration separately because equal access at home is not sufficient to lead to equal use for each household member. Internet use presumes access, but the reverse is not true. The findings reveal even more significant and stronger relationships between predictors and Internet use. Although there is no difference between men and women in terms of ICT access, the results show that most Internet users are men. Internet users in Turkey are predominantly young people. The variation in Internet adoption across different age groups might be due to significant variations in technology adoption and initial learning (Czaja et al., 2006; Selwyn, 2004), web accessibility (Brajnik et al., 2011; Cavender and Bigham, 2011), digital abilities (van Deursen et al., 2011), and level of online activity and social networking (Haight et al., 2014). On the other hand, income and education are positively associated with Internet use. Considering the majority of the population with lower levels of education, we expect the average utility from ICT use will be low due to the high "knowledge gap" (Bonfadelli, 2002) in Turkey. Bearing in mind that low education level is one of the major barriers to becoming a knowledge economy and network society, education is an important factor in addressing the digital divide. Retired people and homemakers are both considered in the literature as inactive groups by working situation (van Deursen and van Dijk, 2011). My results show that these groups are also more likely to be digitally excluded. In addition to the aforementioned factors, regional differences also reveal a noteworthy effect on Internet usage. The level of digital development of a region is inextricably linked to that of its neighbors; therefore, geographical vicinity is considered an important factor for the digital divide (Lucendo-Monedero et al., 2019). The regions with higher negative average marginal effect on Internet usage are mainly clustered in the eastern part of Turkey, providing evidence for this claim.

While the country is undergoing digital transformation and morphing into more innovative and technologically advanced organizations and systems, given the relationship between social connectivity and digital connectivity (Chen, 2013), disadvantaged groups of the population would become more vulnerable to remaining socially and digitally excluded. The advantageous position of the younger, well-educated, and higher income groups in ICT access and use reinforces their already privileged social position, while the socially vulnerable groups experience challenges using the ICTs and gaining benefits from them, leading to further marginalization of their position, deepening the inequalities (Ragnedda et al., 2022), and causing the digital inequality to become a more structural problem.

2.8 Conclusion

In this chapter, a number of significant differences within certain groups in terms of first level of digital divide in Turkey have been observed and supported by reliable survey and statistics. Although I have seen some significant differences in some categories in terms of Internet access, the challenges regarding the digital divide in Turkey go beyond lack of Internet access and become more apparent when I examine Internet use patterns in detail.

I considered device access, Internet access and Internet use as indicators of first level digital divide. Then, I examined if and to what extent the key demographic and socioeconomic factors relate to each of these indicators of first level digital divide in Turkey. I used the latest data collected as part of the TurkStat's 2020 Survey on "Information and Communication Technology (ICT) Usage in Households and by Individuals". The vast majority of respondents have said they had access to an Internet-enabled device. Smartphone ownership significantly dominates other Internet-enabled devices. On top of smartphones' dominance, they are the only means for connectivity for the considerable majority of the population. Given vast smartphone availability for almost everyone, device access itself is not an indicator for first level digital divide in Turkey. The results of the econometric analyses reveal that there are significant disparities in the

likelihood of having access to an Internet connection and using the Internet between certain demographic and socioeconomic groups. We can conclude from the results that demographic and socioeconomic predictors of Internet access and Internet use in Turkey.

Countries, particularly developing ones, have come a long way in improving their Internet infrastructures. Turkey has been investing in basic physical and digital infrastructure, too. As a result, the number of people having Internet connection has increased rapidly, especially in recent years. However, according to our data, 30,322 out of 32,955 people have Internet access, which indicates that approximately 10 percent of the Turkish population aged 16–74 remain unconnected, which has critical implications and requires further assessment of the topic and strategic policy interventions. Turkish policymakers appear to be looking for simple and immediate solutions. There is a lack of coherent vision concerning 'the demand-side policies' to increase Internet penetration in the country. Strictly speaking, Turkey's demographic and socioeconomic characteristics have been mostly disregarded while developing regulations and related policies (Köksal, 2021). Government policies were limited to projects that target issues related to access in the first place. The idea of access to the Internet as a social imperative usually manifests itself in news featuring a politician distributing tablets to students from economically disadvantaged families or granting computers to public schools and libraries in recent years. However, supply-side policies are only moderately effective at increasing Internet penetration and Internet usage in societies (Benkler et al., 2010). In fact, demographic and social factors are the major determinants of both Internet access and usage. As Köksal and Anil (2015) showed – and I have validated to the fullest extent with an in-depth analysis and up-to-date data – demographic, socioeconomic, and geographic factors significantly affect Internet adoption in Turkey. Turkey has made some progress in becoming an information society in recent years, and gaps in physical access are being addressed to some extent, but demographic, socioeconomic and regional gaps persist, as we have shown.

Along with demographic characteristics, possible reasons for this rate are unaffordable costs of connection or equipment, limited digital literacy, lack of digital skills, and/or other motivational reasons (EuroStat, 2020). According to the International Telecommunications Union's (ITU) "2018 Measuring the Information Society Report",

Turkey has one of the world's most affordable fixed-broadband services, with fixed prices corresponding to less than 1 percent of its gross national income (below USD 8/month). Nevertheless, despite the efforts of the Information Communication Technologies Authority (ICTA), which is responsible for regulating the sector in Turkey, a significant competitive environment could not be achieved in the sector until 2010. However, as of 2010, with the spread of third-generation mobile communication technologies and the emergence of alternative operators in fixed infrastructure, the transition to a competitive environment in the sector finally started. It was only after 2010 that it was possible to obtain a better-quality Internet access service at more reasonable prices in this competitive environment (Köksal and Ardıyok, 2015). The uptake in subscription rates has become impressive since then and individuals have started to enjoy relatively cheap broadband.

A number of factors make it still difficult for some groups to obtain access to the Internet or to use it effectively. These include factors such as poverty, high device, data, and telecommunications costs, infrastructure barriers, digital literacy challenges, cultural barriers, and policy and operational barriers.

The findings in this chapter point out the target groups of first priority to address inequalities. For example, there is no significant difference in the percentage of Internet access between genders; however, when it comes to Internet use, women use the Internet significantly less than men do. Hilbert (2011) explained this fact with women's unfavorable circumstances with respect to education, employment, and income. Nevertheless, they found that women are more active users when these variables are controlled for. I anticipate that the findings in this study are related to the difference in social roles, interests, and expectations between the genders in Turkey, which are associated with educational background and socioeconomic opportunities. Other priority groups are senior citizens, economically disadvantaged groups, people with below high-school educational attainment, homemakers, and retired people. Also, there are discrepancies with sharp regional differences in terms of Internet access and use. Therefore, region-specific studies need to be conducted where ICT access and use are low, especially in the eastern regions and West Black Sea region, where access rates are unexpectedly low.

We can conclude from the results that special initiatives and programs are required to increase widespread adoption of the Internet. Those initiatives and programs should be designed and implemented with a participatory approach, targeting the high priority groups: women, older citizens, citizens with lower household income, citizens with low educational background, homemakers, and retired people, as well as citizens of the Northeast Anatolia, Central East Anatolia, Southeast Anatolia and West Black Sea regions of Turkey, while considering the factors that make Internet access and use difficult.

The regional differences that are shown in this paper in terms of Internet access and use are indications of disparities in the socio-spatial structure of the country. Therefore, Turkey must seek to fortify every citizen with stable Internet access in order to address digital inequalities, and for that, rapidly scale the investment in infrastructure in order to ensure everyone can have a meaningful connection from any place. Lowering tariffs on digital products, encouraging the adoption of low-tech and disruptive applications, and reducing product market regulations are some of the policy priorities that the government should also consider (World Development Report, 2016). Moreover, financial mechanisms, such as universal service funds, can be directed towards disadvantaged geographical areas to increase access and Internet literacy.

Public policy should endeavor to make sure the ICTs are distributed equally among societies to be able to transform the use of digital technologies into economic and social benefits. Intensive use of ICTs in professional and personal lives would allow people to realize their potential and improve their quality of life. Internet access and use are vital in the digitization process of Turkey to be able to keep up with contemporary developments, make rapid decisions and effective actions, build the capacity to produce innovative technological solutions, and eventually ensure a digitally inclusive society. By pointing out the high-priority target groups, this study has drawn attention to the matter and provides essential knowledge that can facilitate further academic research, as well as debates and structural decisions among Turkish policy-makers and regulators. The policy implication will further be discussed in Chapter 5.

3. SECOND LEVEL DIGITAL DIVIDE IN TURKEY: ADOPTION OF INTERNET SERVICES

3.1 Introduction

The focus of this chapter is on Internet use inequalities in Turkey. The International Telecommunication Union (ITU)'s "2018 Measuring the Information Society Report" points to the general upward trend in ICT access and use. According to the Report, by the end of 2018, 51.2 percent of the population were using the Internet; mobile-cellular phone subscriptions continue to grow; fixed-broadband subscriptions are continuously increasing; majority of people can access the Internet through a 3G or higher-quality network; almost 60 percent of the population have internet access at home. Penetration rates gradually increase worldwide following the technological advancements in the telecommunications sector and increasing customer demand, and as a result, reduce the gap between social groups at different ends of the demographic or socioeconomic categories to a certain extent. However, not only the first level digital divide remains an unsolved problem, but societies are also exposed to digital skills divide or financial and cultural barriers which affect individuals' level of online engagement. Those who are on the disadvantageous side of the divide usually cannot diversify their Internet experience due to limited online engagement with more sophisticated Internet activities. Internet use cannot be discussed as a general phenomenon; instead, it is vital to specifically examine different types of uses as typology of Internet users are based on set of online activities they engaged with (Blank and Groselj, 2014).

As the Internet becomes increasingly embedded in the lives of individuals, it is critical to ensure digital literacy and digital skills for everyone. The 2020 issue of "Digital Skills Insights" by The International Telecommunication Union (ITU) features different aspects of capacity development and skills requirements in the digital era and calls for an urgent

need to develop the global skills needed towards new risks and technological developments in the digital economy and society. The need for capacity development is crucial at individual-level, and also essential for country's successful transition to a digital economy. The lack of essential skills to be able to use information and communication technologies (ICT) is a barrier to benefit the technology at full potential. Examining the issue of inequality in online engagement and digital skills can promise to deliver a better understanding of opportunities and challenges which can provide an outlook on countries' infrastructure developments and government policies to improve the utilization from ICT. The uneven knowledge levels and capacities to use ICT are generally associated with people's demographic and socioeconomic background and considered a cause for exacerbation of the digital gaps.

In this chapter, I focus on the differences in the use of Internet services across individuals of different demographic and socioeconomic backgrounds and from different regions of Turkey as another aspect of digital inequality. This aspect of the digital divide is called second-level digital divide in the literature and is concerned with the degree of relationships individuals develop with ICT and how much they can make use of the digital resources (Selwyn, 2004). In this chapter, I investigate the nexus between demographic and socioeconomic characteristics and adoption of various Internet activities in Turkey and to determine the groups that are the most vulnerable in terms of engaging in online activities. A selected group of Internet activities are considered to analyze disparities in online engagement in society. These activities are online communication, social media usage, online entertainment, online information-seeking, e-health, e-commerce, e-government, e-banking, and e-learning. The research questions I pose in this chapter are as follows: "How is online engagement structured along demographic and socioeconomic characteristics? Which demographic and socioeconomic factors significantly predict the adoption of various Internet services?" In light of these research questions, my main goal is to examine if and to what extent the key demographic and socioeconomic factors predict the use of these Internet services and to analyze whether certain demographic and socioeconomic factors such as age, gender, level of household income, level of education, employment status, and region are associated with the degree of engagement with different online tasks in a way that it demonstrates inequality among society in terms of

online engagement. I will use econometrical models, mainly logistic regression, to examine the main determining factors explaining the adoption of various types of Internet services.

In Chapter 2, I showed that disparities in Internet access and Internet use are significantly associated with certain demographic and socioeconomic factors. Age, education, household income, occupation, and region are all significant predictors of Internet access. Gender, alongside all these factors, are also significantly associated with Internet use. In the present chapter, I expect to observe disparities among society in terms of online engagement. My hypothesis is that the demographic and socioeconomic predictors of Internet access and Internet use are again on the disadvantageous side of the second-level digital divide – that is, they are less likely to adopt various Internet services. Moreover, they mostly engage with less sophisticated online activities such as online communication and social media usage. Since I incorporate nine types of Internet activities, the analysis will yield further results which allow comparisons between Internet services as well as between social groups.

This chapter takes the binary view of Internet use and non-use forward and deals with the gradations in Internet use. Therefore, the results of this approach will allow for comparing the categories of Internet users, distinguishing low Internet users from broad users. Moreover, the results drawn from regressions will be basis for discussing public policies and private strategies to promote the use of various Internet services and narrowing the digital divide by specifically targeting those groups with lower adoption rates of Internet services.

Broadband access at home allows individuals to perform many daily tasks that previously needed personal touch. It has become vital in strengthening economic and social resiliency especially during the recent pandemic crisis when people are required to continue their job or studies at home. However, individuals' internet usage practices may impede their ability to continue in the same way as before. The online activity types vary considerably among internet users (UNCTAD, 2021b). For example, in most developing countries, the internet is mostly used for communication via social networks, rather than engaging in more complex tasks such as online shopping or using online government

services and online banking services, which are critical for economic resiliency. In terms of economic development, it is important to know what types of activities people utilize the Internet for. The online activities that the individuals undertake is an indication of their capacity as certain type of activities require more sophisticated digital skills. Individuals in every segment of society were required to do more than searching the web for content. However, without essential digital skills, or due to financial and social barriers, it has been difficult for many to fully benefit from such online services.

Specific knowledge about Internet use inequalities in society is useful for policymakers. The empirical analysis conducted in this chapter points to digitally excluded social groups. Therefore, the results presented in this chapter provide useful pointers to the policymakers when considering adopting a digital divide mitigation policy.

The present chapter is structured as follows: Section 3.2 reviews the literature dealing with the nexus between the demographic and socioeconomic factors and Internet use. The literature review is mostly based on the studies on the second level digital divide which are mainly focused on Internet use inequalities and digital skills. The data and methodology used in this chapter is the same with those in Chapter 2. They are briefly described in Section 3.3 and 3.4. A more detailed description of the data and methodology can be found in Section 2.3 and 2.5, respectively. In Section 3.5, I provide a conceptual approach to the analysis of Internet services. In this section, the selected Internet activities are analyzed as they reflect core usage types. In Section 3.6, I present the results of the econometric analysis. In Section 3.7, I discuss the analyze the results. Finally, Section 3.8 concludes the chapter.

3.2 Literature Review

3.2.1 General background

The second level digital divide refers to the disparities in Internet use and digital skills that are necessary to use ICTs. Research shows that the digital divide is more than just an issue of access, and it cannot be solved simply by supplying the necessary equipment (Jones and Flannigan, 2006; Selwyn, 2004; Van Deursen and van Dijk, 2010; Van Deursen and van Dijk, 2017). It can persist even after the first level digital access has

been detained (Hargittai, 2002). In fact, as access diffuses to parts of the society who were initially excluded, quality of use becomes a critical issue to be considered (DiMaggio and Hargittai, 2001). Hence, although broadband Internet access has become widespread over the years, even populations with ubiquitous access are riven with digital knowledge and skill inequalities and differentiated usage. Jones and Flannigan (2006) define the second level digital divide as "a person's ability to perform tasks effectively in a digital environment". From another perspective, the second level refers to the range and diversity of Internet activities or services in which individuals engage when they are online. Previous studies argue that socioeconomically advantaged groups are more likely to engage more frequently and more broadly with the Internet (Reisdorf and Groselj, 2017; Zillien and Hargittai, 2009). Shifting away from the view of binary Internet use and non-use, Internet users are categorized according to the variety of Internet use (Blank and Groselj, 2014) and type of online activities they engage with (Blank and Groselj, 2014; Zillien and Hargittai, 2009). The range of online activities that individuals perform is worth studying in order to observe how much they take advantage of the internet.

3.2.2 Digital skills

Individuals can engage with ICT as much as their capability allow (Selwyn, 2004). People can only engage with various internet activities to the extent their digital skills enable them (Hargittai, 2002). Digital skills are a significant factor to ensure individual-level ICT acceptance (Goncalves et al., 2018; Helsper and Eynon, 2012). The digital skills that gain importance over time are not equally present in every person in society. In fact, skills divides tend to grow and become bigger than access divides (Van Dijk, 2005).

Van Deursen and van Dijk (2009, 2010) elaborated a range of skills by proposing operational, formal, information, and strategic Internet skills. Operational skills indicate the basic skills in using the technology. Formal Internet skills refer the skills of navigation and orientation. Information Internet skills relate to the skills required to fulfill the information needs. Finally, strategic skills refer to the capacity to efficiently use the Internet as a meaning of reaching particular goals (Van Deursen and van Dijk, 2011). Lower levels of education and aging found to contribute to operational and formal skill related issues. Higher levels of education perform best in terms of information skills.

Aging does not have significant negative effect in executing information skills. Also, there is no significant difference between different age groups in terms of strategic skills (Van Deursen and van Dijk, 2011). Our knowledge is limited to the effect of age and education since the other demographic and socioeconomic variables were not considered in Van Deursen and van Dijk (2011).

Van Deursen and van Dijk (2017) have classified the digital skills and 21st-century digital skills into categories according to the knowledge and capability levels that are essential to engage with various online activities by conducting a systematic literature review. Those skills are conceptually different than the technological skills which primarily indicate a basic set of skills in using computers or Internet technology such as turning off the computer, opening a folder and saving a file (Van Deursen and Van Dijk, 2017). 21st-century skills are broadly categorized according to learning skills, literacy skills and life skills, or based on the ways of thinking (creativity, critical thinking, problem solving, etc.), ways of working (communication, collaboration, teamwork, etc.), tools for working (information literacy, ICT literacy, etc.), and living (life and career, and personal and social responsibility) (Binkley et al. 2012; Van Deursen and Van Dijk, 2017). 21st-century digital skills is an integration of digital and 21st-century skills, involving digital competence and digital literacy along with 21st century skills. Those skills are considered essential to cope and thrive in the changing society. Internet users who are capable to use the Internet independently, without soliciting help or support from others, benefit more from Internet use (Van Deursen et al., 2014).

3.2.3 Online engagement

The previous section summarizes the digital skills considered necessary to be able to use ICTs and types of resources that are available online effectively. Insufficient digital skills might play a role in limiting efficiency in trying to undertake an Internet activity. There are many Internet activities comprise the necessary activities to be engaged in today's social and professional life. The internet has the potential to improve the quality in most aspects; however, those who are on the disadvantaged side of the divide can be further worsen off due not being able to engage in various Internet activities sufficiently, which

as a result exacerbates more inequalities as the need for and dependence of ICT will ultimately become vital than before.

Digital inequality is undoubtedly a part of the social system, the macro level, yet its explication as an emergent outcome of individual usage patterns requires theoretical and empirical analysis at the micro level (Büchi, 2017). There are various sources of online activity variation among groups of people. By examining the differences in internet usage types for five countries with narrowing access gaps, Büchi et al. (2015) argued the shift in the digital divide from access to usage in those countries despite considerably high internet penetration rates. They further showed that age being the strongest predictor of the variation in internet use, sociodemographic factors account for up to half of the variation.

There is a substantial body of literature that try to explain the factors affecting the adoption of different types of Internet services: Monsuwé et al. (2004) found that consumer attitudes toward online shopping, which requires more skill than online searching (Hoffman et al., 2000), are influenced by age, gender, education, and income. Serrano-Cinca et al. (2015) argued that age, education level and income are significant factors explaining the digital divide in Spain. They also found that unemployed people are the most frequent users of internet. However, the most digitally excluded groups are homeworkers who are mainly woman (Serrano-Cinca et al., 2018). Garín-Muñoz et al. (2019) found that socioeconomic characteristics are significantly associated with the adoption of internet services such as e-commerce, e-banking and e-government in Spain. Pérez-Amaral et al. (2020) found that age, gender, income, education, region, and digital skills have a significant effect on the adoption of e-commerce service.

3.2.4 Studies in the Turkish context

There are a number of studies which deal with the subject in the Turkish context. These studies focus mainly on a single Internet service. For example, Alkan and Unver (2020) showed that gender, education level, income, occupation, and region are among the factors that affect e-government use in Turkey. Specifically focusing on gender aspect, Acilar (2020) argued that there is a significant gap between females and males in Turkey in terms of e-government service use such that females do not benefit the potential

advantages of the e-government services. Likewise, there remains a significant gap between females and males in online shopping, females being on the disadvantageous side of the gap (Acilar, 2022). In a recent study, Unver and Alkan (2021) show that age, gender, income level, occupation and region are among the factors that affect e-commerce use. Kuzu-Yildirim and Aricigil-Cilan (2020) also examined the relationship between demographic factors and the use of e-commerce service and found that the likelihood of adopting e-commerce service is affected predominantly by education level. There are opposing views in terms of gender effect on e-commerce adoption. Unlike other studies (Acilar, 2022; Unver and Alkan, 2020), they found no significant relation between gender and e-commerce use. Empirical results by Tekin and Güleryüz (2020) indicate that women are less likely to use e-banking service compared to men. Also, education, being employed, and household income have significantly positive effect on the likelihood of using e-banking services, but age demonstrates a non-linear association with the use of e-banking such that middle-aged people are more likely to utilize e-banking than the younger and older age groups. There is a little consistency over the effect of some variables, gender in particular, on the use of Internet services. Also, there is a lack of a thorough study of the effect of all demographic and socioeconomic variables on various Internet services to allow for comparison of the results. Many studies tend to focus on a few activities, mainly e-banking, e-government and e-commerce, instead of considering a wide range of activities to obtain a broader understanding of Internet engagement. It is particularly vital to explore the relationship between demographic and socioeconomic variables and Internet use patterns and determine Internet usage differences in society since such differences can potentially translate into further inequalities (Helsper, 2012; Witte and Mannon, 2010). Therefore, the present chapter will contribute to the literature in the Turkish context by empirically investigating the unexplored or underexplored areas of the issue.

3.3 Data

The study draws upon data collected as part of the Turkish Statistical Institution's (TurkStat) 2020 Survey on "Information and Communication Technology (ICT) Usage in Households and by Individuals", which draws on a sample collected in Turkey in 2020.

The analysis in this Chapter is based on the same dataset used in Chapter 2 and the survey covers 18,233 individuals for this part of the study. The explanatory variables (gender, age, education, income, occupational status and region) are defined and categorized in the same way as in Chapter 2. In line with the research question that this chapter tries to answer, we identified the dependent variables as different types of online activities. The participants were asked about various types of online activities. It is such a robust approach, asking survey participants, who had used the Internet in the past 12 months, directly about the activities that they had performed when online. I classified those activities in nine clusters namely, online communication, online education, online entertainment, online information-seeking, social media, e-health, e-commerce, e-government, and e-banking. Those are main groups of Internet activities which I refer them as 'Internet services.'

3.4 Methodology

In the present chapter, shifting away from the view of binary Internet use and non-use, I examine the variety and type of activities that individuals perform online. In the first part of the analysis, I identify which demographic and socioeconomic variables tend to adopt greater number of Internet services. For that, I employed the multiple correspondence analysis (MCA) which is a generalization of correspondence analysis (CA) when there are more than two categorical variables. These analyses are described as analogous to principal component analysis (PCA) for categorical variables. When testing each variable for association with an outcome, there are several challenges with such a high-dimensional data that those methodologies mitigate, including computational expense and an increased error rate due to multiple test correction. These methodologies are appropriate methods simplifying the complexity in high-dimensional data while retraining trends and patterns (Lever et al., 2017). Hence, in this part of the analysis, MCA provides a typology of the social groups in terms of the number of Internet services they adopt. Also, we can assess the nexus between the variables.

In the second part of the analysis, I employed logistic regression to identify the demographic and socioeconomic predictors of each Internet activity. Regression analysis is a reliable method of determining the independent variables' impact on a dependent variable. It allows us to examine the nexus between the multiple variables of interest. Taking each Internet activity as a dependent variable, in this chapter, I conducted total of nine regression analyses for nine Internet activities. The demographic and socioeconomic variables are treated as independent variables as in the Chapter 2. The reason for adopting logit model for this analysis is due to the dichotomous characteristic of dependent variables. The logit model employs logistic distribution to estimate the parameters by maximum likelihood and allows for non-linearity between dependent and independent variables.

$$Y^*_{activitytype} = \alpha + \beta_1 \text{Gender}_i + \beta_2 \text{Age}_i + \beta_3 \text{Income}_i + \beta_4 \text{Education}_i + \beta_5 \text{Employment}_i + \beta_6 \text{Region}_i + u_i$$

$Y^*_{activitytype}$ represents the dependent variable for each Internet activity, where *activitytype* signifies online communication, online education, online entertainment, online information-seeking, social media, e-health, e-commerce, e-government or e-banking for the respective regression model, and takes the value 1 if the individual *i* used the particular Internet service in the last 12 months, or 0 otherwise. The survey participants were asked if they had used particular Internet service. As this is a yes/no question, the dependent variable can either be 1 or 0. Gender, Age, Income, Education, Employment and Region are independent variables that influence the latent variable along with the error term, u_i, which is distributed by the standard logistic distribution for each variable, such that $u_i \sim Logistic\ (0,1)$. Finally, α is the intercept term and βs are the coefficients of the respective independent variable.

The logistic regression model estimates the probability that a person engages with the certain Internet activity as a function of their gender, age, education level, income level, occupational status, and region. One of the advantages of the logit model is that the impact of each explanatory variable can be singled out. This feature has obvious policy

implications since it enables policymakers to identify the most significant factors and prioritize policy objectives accordingly (Montagnier and Wirthmann, 2011).

The estimated parameters are in the log-odds scale, which, other than sign, do not have any useful interpretation. The raw coefficients, β, give the effect of an independent variable on the log-odds of the dependent variable. Since we are interested in finding out the effect of the independent variables on the probability of the use of Internet activities, we calculated marginal effects to describe the effect of an explanatory variable on the conditional probability of the dependent variable taking on the value of one. Average marginal effects (AME) refer to the impact of a case picked at random from the sample of all observed values. The measure provides substantive information about the influence of the independent variables on a dependent variable along with the regression results. White's test for heteroscedasticity as well as all necessary goodness-of-fit measures such as the Wald test and pseudo R^2 (McFadden's R-squared) have been employed in order to validate the predictive power and significance of the model as in the Chapter 2. I checked and visualized the performance of the multi-class classification problem of my method by using the receiver operating characteristics (ROC) curves. The ROC curves and the area under the ROC curve (AUC), both are already discussed in Chapter 2. The ROC curve is created by plotting the true-positive rate against the false-positive rate and can be thought of as a plot of the power as a function of the Type-I error, indicating the sensitivity/or recall as a function of false-positive rate. When given one randomly selected positive instance and one randomly selected negative instance, the AUC gives the probability that the classifier will be able to tell which one is which. Higher the AUC, the better the model is at distinguishing between adopters and non-adopter in our case. The ROC curves and the respective AUCs, all showing acceptable rates that are above 0.70 (Hosmer et al., 2013), are provided in the Appendix.

Before moving into a detailed analysis of the regression results, I present the rate of adoption of each Internet service to analyze the level of participation in each Internet activity in the following section.

3.5 Classification of Online Activities

Numerous daily activities that have previously been carried out offline are now available as online services on the Internet. There are a wide range of online activities performed by internet users. The most popular internet activities are using text/instant messaging, using email, watching video online, using online social networks, shopping, making reservations or using other consumer services online, using online financial services, streaming/downloading music/radio/podcasts, and participating online video calls/conferences, among many others (Statista, 2020).

In Table 3.1, I present the types of Internet activities that are considered in this study. This table demonstrates different types of Internet activities classified in nine Internet services. For example, if a person used email, video call, or other messaging services, they are considered having adopted online communication.

Table 3.1 : Classification of different types of Internet activities.

Internet service	Activity
Online communication	Email, video call (Skype, Messenger, Whatsapp, BİP, Facetime, Viber, etc.), messaging (Skype, Messenger, Whatsapp, BİP, Facetime, Viber, etc.)
Social media usage	Having a social media account (Facebook, Twitter, Instagram, etc.), sending messages or photos, sharing content on social media
Online entertainment	Listening/downloading music, watching TV, watching paid video (Netflix, Puhu TV, Blu TV, etc.), watching video on video sharing platforms (YouTube, Daily Motion, Twitch, etc.), play/download games
Online information-seeking	Online news, searching for information about goods and services, seeking health information
e-Health	Making doctor appointment, accessing personal health information (prescription, test results, etc.)
e-Commerce	Shopping/selling goods and services
e-Government	Using online government services
e-Banking	Online banking
e-Learning	Taking an online course, using online learning materials (audio-visual materials, online learning software, electronic textbooks), communicating with instructors and students via the website/portal

The Internet activity types vary considerably among Internet users (UNCTAD, 2021b). People need to engage in various distinct Internet activities in order to address their specific needs. Internet activities can be conceptualized as a form of 'digital (online) engagement'. The range of online activities that an individual can perform indicates the extent to which they take the advantage of online resources. In other words, the total number of distinct activities performed online indicates wider engagement in Internet and hence possibly broader benefit (Helsper and Eynon, 2010). Nevertheless, it is worth to note that performing an online activity does not imply that the respondent is extremely skilled at it, and not performing an activity does not imply that the respondent lacks the expertise to perform it. There are many dimensions to be considered when analyzing the second level digital divide. The distribution of variety of Internet use is plotted in Figure 3.1.

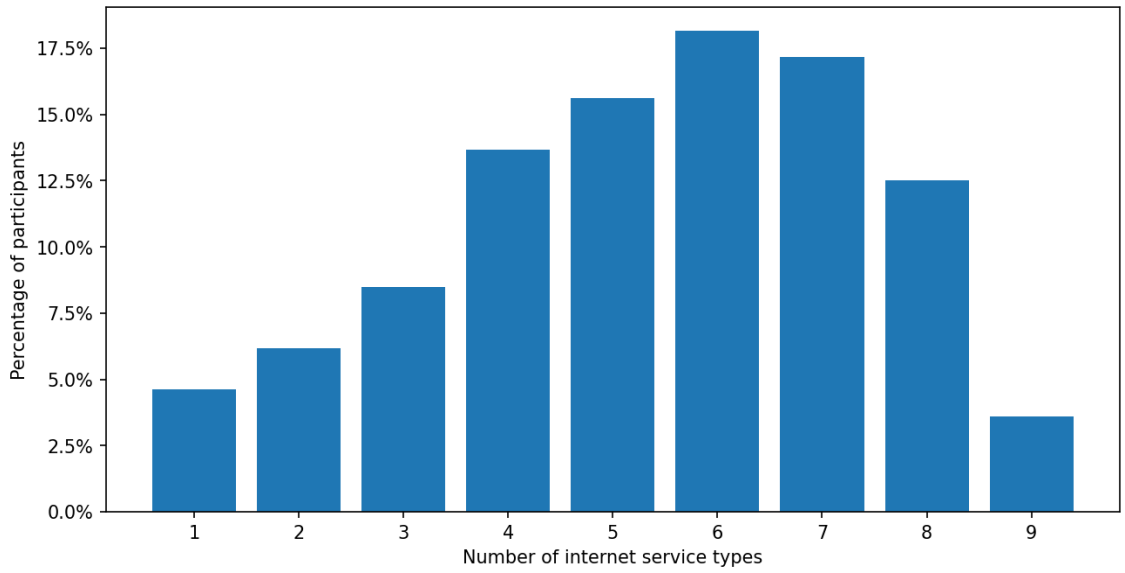

Figure 3.1 : The distribution of the number of Internet services adopted by the survey participants in the last 12 months.

Figure 3.1 illustrates the rate of adoption of the number of Internet services in the last 12 months. The figure demonstrates that around 17 percent of the population has engaged only six of the main Internet services. Only around 3 percent of the population has used all Internet services. We cannot infer the types of Internet services that are widely adopted

by society from this figure, but we can get an idea of to what extent Turkish population diversify their Internet experience by engaging in different online activities.

Figure 3.2 illustrates the adoption rate of each Internet service. The Internet activities are discrete categories. Since people can engage in many different activities, they can be involved in more than one category. As the figure demonstrates, online communication services are widely adopted by the Internet users in Turkey. Other internet services such as online search for information and news, online information-seeking, social media usage and online entertainment activities come after online communication, all with more than 80 percent adoption rate. There is a considerable drop in the adoption rate of the remaining Internet services such as e-government, e-banking, e-commerce, and e-learning. Only around 70 percent of the users use e-government services. The adoption rate is less than 50 percent for the remaining four services, e-learning being the least-adopted Internet service with below 20 percent adoption rate.

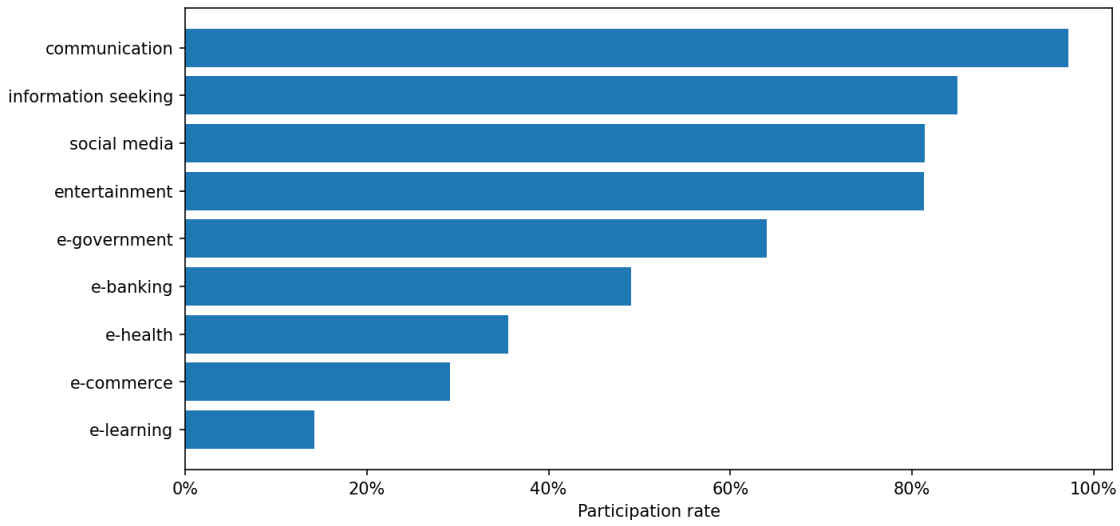

Figure 3.2 : Participation rate of each Internet service.

Figure 3.3 illustrates the MCA score plot of the first two principal components of the dataset showing the diversity of Internet service adoption by different demographic and socioeconomic groups. The figure demonstrates which social groups can diversify their Internet experience by using a broader range of Internet services. The MCA plots shows clusters of samples based on their similarity. The color of data points indicates the number

of Internet services adopted by a particular survey participant. The location of the individuals in the figure provides a valuable information contained in data. The number of Internet services increases from darker to lighter shades. The red boxes denote the categories of a particular social group. The category is an average point of the individuals in that are in that category.

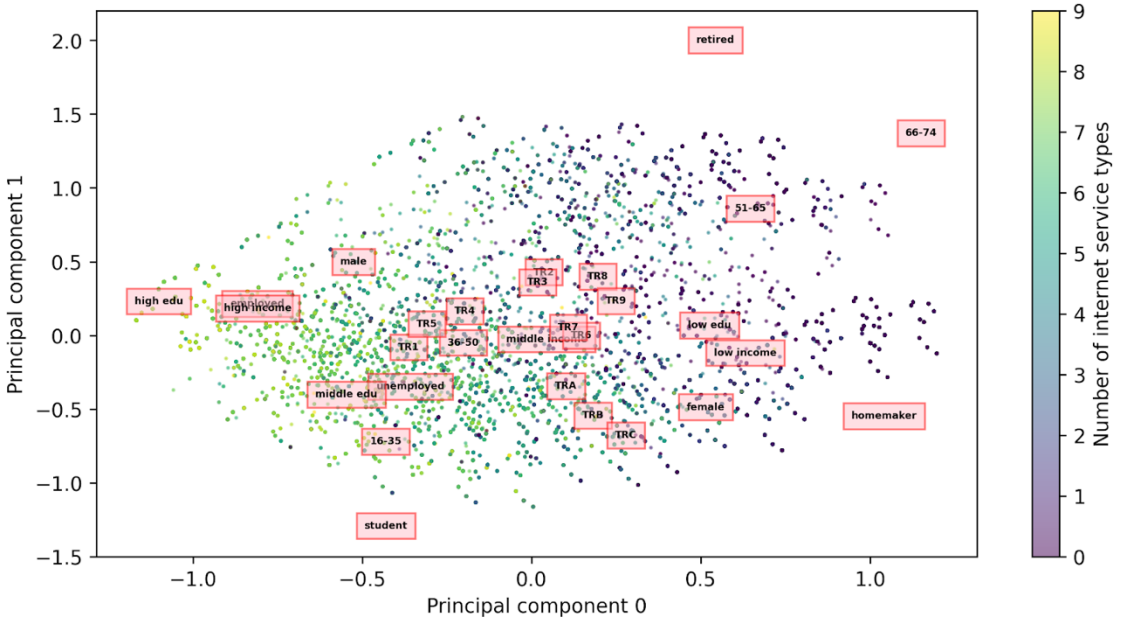

Figure 3.3 : The MCA scatterplot of the first two PCs of the dataset showing diversity of Internet service adoption by different demographic and socioeconomic groups.

The social groups that are clustered around lighter shades (green, yellow) are those who adopt greater number of Internet services. The proximity between different variables means that these variables tend to appear together in the observations. The categories appear close to each other if the individuals in that categories have answered in a similar way to the questions about online activity use – that is, the categories that are close to each other indicate that they tend to adopt similar number of Internet services. The figure demonstrates that high education, high income, employed, and men are clustered around lighter shades, suggesting that they tend to use greater number Internet services whereas elderly, retired, homemaker, low education, low income, and women are clustered around darker shades and hence, they tend to adopt fewer number of activities.

In the following section, I will look into the disparity in adoption of each service by different social groups. The regression results presented in the that section will uncover which social groups are most likely to be among those who do not use these services. These results will serve as evidence to reveal whether the distribution of adoption of any service is disproportionate among social groups.

3.6 Results

In this section, I present the results of the econometric models predicting the key demographic and socioeconomic factors that are associated with adoption of Internet services in Turkey. I interpret the regression results in detail by AME calculations. The goodness-of-fit measures to prove the reliability of the results are provided in the Appendix.

3.6.1 Results of regressions predicting adoption of each internet service

It is only possible to understand the dynamics of digital inequality in a country by looking at its distinctive structural characteristics. In order to uncover the underlying structural factors, which are mainly demographic and socioeconomic factors, it is necessary to apply well-established scientific methods and meticulously analyze the results. In this section, I present the results of the logistic regression models predicting the key demographic and socioeconomic factors that affect the likelihood of adopting various Internet services in Turkey.

Demographic and socioeconomic predictors of Internet service adoption are shown in Table 3.2, Table 3.3, and Table 3.4. Nine Internet services are grouped into three for the ease of presentation, but not grouped in a particular order. Table 3.2 presents a group of three Internet services, including communication, social media, and entertainment.

Table 3.2 : Logistic regressions predicting online communication, social media, and online entertainment adoption (N=18,233).

	Communication	Social media	Entertainment
Variable			
constant	5.5836 (0.267)***	2.7604 (0.106)***	4.8735 (0.137)***
Gender			
Female	0.5246 (0.137)***	-0.1458 (0.056)**	-0.0444 (0.063)
Age			
36-50	-0.5497 (0.137)***	-0.5304 (0.051)***	-1.0300 (0.057)***
51-65	-1.2681 (0.155)***	-0.9998 (0.065)***	-1.7559 (0.070)***
66-74	-1.5906 (0.237)***	-1.6077 (0.120)***	-2.3878 (0.129)***
Income			
Average	-0.2512 (0.134)	-0.1704 (0.051)***	-0.2901 (0.057)***
Low	-0.5394 (0.147)***	-0.2720 (0.060)***	-0.6458 (0.065)***
Education			
High school	-0.7499 (0.214)***	-0.0270 (0.068)	-0.5178 (0.081)***
Below high school	-1.3742 (0.199)***	-0.4500 (0.061)***	-1.2522 (0.073)***
Employment			
Employed	0.3577 (0.183)*	0.0369 (0.082)	-0.6053 (0113)***
Unemployed	0.2925 (0.221)	0.1383 (0.104)	-0.4717 (0.133)***
Retired	0.1282 (0.227)	-0.2240 (0.108)*	-1.0451 (0.133)***
Homemaker	0.4369 (0.247)	-0.4927 (0.087)	-1.1450 (0.120)***
Region			
TR2	-1.0786 (0.217)***	0.1393 (0.104)	-0.4907 (0.101)***
TR3	-0.8748 (0.201)***	-0.1197 (0.083)	-0.5209 (0.089)***
TR4	-0.4665 (0.219)*	-0.0187 (0.084)	-0.1662 (0.093)
TR5	-0.2760 (0.234)	-0.4471 (0.078)***	-0.3025 (0.091)***
TR6	-0.6655 (0.212)**	-0.4049 (0.081)***	-0.3406 (0.092)***
TR7	-0.5623 (0.245)**	-0.4129 (0.091)***	-0.8150 (0.099)***
TR8	-0.8118 (0.233)***	0.0360 (0.102)	-0.7567 (0.104)***
TR9	-0.0222 (0.284)	0.3061 (0.104)**	-1.3010 (0.096)***
TRA	-1.1427 (0.242)***	-0.6867 (0.104)***	-0.8967 (0.120)***
TRB	-1.0435 (0.226)***	-0.6495 (0.091)***	-0.9212 (0.104)***
TRC	-0.7737 (0.222)***	-0.4087 (0.088)***	-0.8762 (0.095)***
Wald χ^2 Df: 23 p-value = 0.0	454.5	1182.7	2637.7
Pseudo R^2	0.093	0.073	0.189
White-test (LM-Stat) p-value = 0.0	806.5	1341.0	2999.3

Note: Standard errors are reported in parentheses.
*p=<.05; **p=<.01; ***p=<.001

Gender is a significant predictor of communication such that being female positively likely affects adoption of online compunction. The effect of gender is less significant or insignificant for social media use and entertainment activities, respectively. Age significantly affects adoption of all three activities presented in Table 3.2. Aging has a negative effect on the adoption of those Internet services. Education and household income have similar effects. Being in the lowest category in those socioeconomic groups significantly less likely to engage in those activities compared to the reference categories. Employment status does not have significant role in using online communication services and social media. However, all employment groups are less likely to engage in online entertainment activities compared to students. The effect of region varies between services. TR2, TR3, and TR4 are not significantly better or worse off compared to Istanbul. In fact, TR4 does not significantly different than TR1 in terms of online communication, social media, and entertainment adoption. However, TR6, TR7, TR8 (except social media), TR9 (except communication), TRA, TRB, and TRC are significantly less likely to engage in those activities compared to Istanbul. Table 3.3 presents the second group of Internet services namely, information-seeking, e-learning, and e-commerce.

Table 3.3 : Logistic regressions predicting online information-seeking, online education, and e-commerce adoption (N=18,233).

	Info-seeking	e-Learning	e-Commerce
Variable			
constant	4.6183 (0.149)***	1.6487 (0.102)***	1.4464 (0.083)***
Gender			
Female	-0.1064 (0.068)	0.3061 (0.055)***	0.1447 (0.045)***
Age			
36-50	-0.3425 (0.059)***	-0.2473 (0.064)***	-0.4911 (0.045)***
51-65	-1.0404 (0.070)***	-0.4896 (0.111)***	-1.3375 (0.079)***
66-74	-1.7325 (0.137)***	-1.3306 (0.375)***	-2.1852 (0.207)***
Income			
Average	-0.2800 (0.064)***	-0.4544 (0.058)***	-0.4375 (0.044)***
Low	-0.6503 (0.070)***	-0.6424 (0.077)***	-0.7394 (0.058)***
Education			
High school	-1.0240 (0.117)***	-1.1251 (0.074)***	-0.8026 (0.049)***
Below high school	-2.1649 (0.108)***	-1.4122 (0.069)***	-1.9696 (0.051)***
Employment			
Employed	0.0658 (0.094)	-2.6376 (0.078)***	-0.1208 (0.062)*
Unemployed	0.0133 (0.116)	-2.8270 (0.116)***	-0.6035 (0.085)***
Retired	0.0191 (0.122)	-3.6162 (0.193)***	-0.4809 (0.117)***
Homemaker	-0.5341 (0.093)***	-3.1901 (0.097)***	-0.8283 (0.072)***
Region			
TR2	-0.2493 (0.109)*	0.0119 (0.111)	-0.1948 (0.091)*
TR3	-0.2703 (0.095)**	-0.1331 (0.101)	-0.0641 (0.073)
TR4	-0.1560 (0.096)	0.6916 (0.090)***	-0.0696 (0.071)
TR5	-0.3966 (0.094)***	0.0021 (0.090)	-0.1473 (0.070)*
TR6	-0.3078 (0.093)***	-0.3819 (0.104)***	-0.2570 (0.075)***
TR7	-0.4152 (0.105)***	0.1090 (0.120)	-0.3609 (0.088)***
TR8	-0.2161 (0.114)*	0.0007 (0.121)	-0.2409 (0.087)**
TR9	-0.2607 (0.111)*	-0.6976 (0.137)***	-0.9223 (0.093)***
TRA	-0.6826 (0.119)***	-0.0317 (0.132)	-0.4341 (0.100)***
TRB	-0.7076 (0.103)***	-0.3120 (0.118)**	-0.9839 (0.095)***
TRC	-0.5659 (0.097)***	-0.4743 (0.120)***	-0.9799 (0.090)***
Wald χ^2 Df: 23 p-value = 0.0	1856.4	2839.6	3373.1
Pseudo R^2	0.158	0.251	0.214
White-test (LM-Stat) p-value = 0.0	2594.3	3539.7	2434.9

Note: Standard errors are reported in parentheses.
*p=<.05; **p=<.01; ***p=<.001

According to the results presented in Table 4, women are significantly more likely to use e-learning and e-commerce. Age, household income, and education are significant predictors of adoption of all three services. Aging negatively affects whereas income and education positively affects the adoption. Homemaker is the only category of employment that is disadvantaged for all service types presented in Table 3.3. Other employment groups are less likely to use e-learning and e-commerce but not information-seeking. The effect of regions again varies depending on the type of service. The results are similar for information-seeking and e-commerce in terms of region; the results for TR5, TR6, TR7, TR8, TR9, TRA, TRB, and TRC indicate lower probability of adoption of these services compared to Istanbul. TR4 yields an interesting outcome such that the probability of using e-learning service is significantly higher in the region than it is in Istanbul. On the other hand, we observe higher number of regions with insignificant results. I argue that this outcome is associated with very low participation levels in online learning activities (see Figure 3.2) – that is, a few number of e-learning adopters that are distributed among 12 regions leave a very low number of observations to give accurate regression results for that particular variable. Table 3.4 presents the final group of Internet services namely, e-government, e-health, and e-banking.

Table 3.4 : Logistic regressions predicting e-government, e-health, and e-bankings adoption (N=18,233).

	e-Government	e-Health	e-Banking
Variable			
constant	3.4405 (0.099)***	0.7451 (0.078)***	1.7239 (0.085)***
Gender			
Female	-0.4573 (0.049)***	0.0728 (0.043)	-0.5548 (0.046)***
Age			
36-50	-0.1567 (0.046)***	-0.1254 (0.040)**	-0.2350 (0.047)***
51-65	-0.8594 (0.063)***	-0.5833 (0.063)***	-0.7923 (0.071)***
66-74	-2.0022 (0.146)***	-1.0916 (0.144)***	-1.8358 (0.165)***
Income			
Average	-0.2067 (0.046)***	-0.1222 (0.040)**	-0.4263 (0.045)***
Low	-0. 3865 (0.054)***	-0.3620 (0.051)***	-0.6436 (0.055)***
Education			
High school	-1.1281 (0.067)***	-0.6541 (0.047)***	-0.7693 (0.057)***
Below high school	-2.1072 (0.063)***	-1.4800 (0.046)***	-2.0559 (0.054)***
Employment			
Employed	0.2281 (0.065)***	0.2882 (0.060)***	1.4295 (0.061)***
Unemployed	0.0308 (0.083)	0.1361 (0.077)	0.7009 (0.079)***
Retired	-0.2546 (0.099)**	0.3638 (0.098)***	0.8983 (0.104)***
Homemaker	-0.9608 (0.068)***	-0.0071 (0.067)	-0.5537 (0.072)***
Region			
TR2	-0.3381 (0.087)***	-0.6287 (0.079)***	-0.0782 (0.089)
TR3	-0.5733 (0.075)***	-0.2579 (0.066)***	-0.3456 (0.074)***
TR4	-0.4689 (0.073)***	-0.2579 (0.065)***	-0.1392 (0.072)*
TR5	-0.3545 (0.075)***	-0.6044 (0.066)***	-0.2175 (0.072)**
TR6	-0.2136 (0.076)**	-0.8308 (0.070)***	-0.3012 (0.076)***
TR7	-0.6840 (0.087)***	-0.2227 (0.078)**	-0.3654 (0.088)***
TR8	-0.8033 (0.088)***	-0.0969 (0.076)	-0.4085 (0.088)***
TR9	-1.1461 (0.090)***	-0.8021 (0.081)***	-0.5551 (0.090)***
TRA	-0.9818 (0.098)***	-0.5938 (0.092)***	-0.6219 (0.099)***
TRB	-0.8441 (0.083)***	-0.9217 (0.083)***	-0.8178 (0.088)***
TRC	-0.7761 (0.080)***	-0.2705 (0.071)***	-0.8197 (0.081)***
Wald χ^2 Df: 23 p-value = 0.0	3660.1	2181.8	4612.5
Pseudo R^2	0.222	0.106	0.293
White-test (LM-Stat) p-value = 0.0	2576.3	1418.5	2779.7

Note: Standard errors are reported in parentheses.
*p=<.05; **p=<.01; ***p=<.001

There are only few variables that do not significantly affect e-government, e-health and e-banking adoption: Being unemployed does not affect the probability of e-government and e-health adoption. It is however, a significant variable predicting e-banking adoption. Along with unemployed, homemaker is not a significant predictor of e-health adoption. However, employed and retired are significant predictors of all three services, yet the direction of the effect is reverse e-health adoption than the other two services – that is, retired people are significantly more likely to use e-health services whereas less likely to use e-government and e-banking compared to the students. The significant effects of age, household income, and education also prevail such that aging, lower household income, and lower education decreases e-government, e-health, and e-banking adoption. As for gender, women are less likely use e-government and e-banking; however, gender does not play a significant role in the probability of using e-health services. Lastly, region all regions are less likely to adopt these online services compared to Istanbul, except for TR8 and TR2 does not demonstrate significant differences in e-health and e-banking adoption, respectively.

3.6.2 Interpretation of findings by average marginal effects of the predictors

The AMEs of the predictors of usage of Internet services are presented in Table 3.5, Table 3.6, and Table 3.7.

Table 3.5 : Average marginal effects (dy/dx) of the logit model predicting online communication, social media, and online entertainment adoption (N=18,233).

	Communication	Social media	Entertainment
Variable			
Gender			
Female	0.0137 (0.004)***	-0.0205 (0.008)**	-0.0055 (0.008)
Age			
36-50	-0.0144 (0.004)***	-0.0746 (0.007)***	-0.1272 (0.007)***
51-65	-0.0331 (0.004)***	-0.1406 (0.009)***	-0.2169 (0.008)***
66-74	-0.0415 (0.006)***	-0.2260 (0.017)***	-0.2950 (0.015)***
Income			
Average	-0.0066 (0.004)	-0.0240 (0.007)***	-0.0358 (0.007)***
Low	-0.0141 (0.147)***	-0.0382 (0.008)***	-0.0798 (0.008)***
Education			
High school	-0.0196 (0.006)***	-0.0038 (0.010)	-0.0640 (0.010)***
Below high school	-0.0359 (0.005)***	-0.0633 (0.008)***	-0.1547 (0.009)***
Employment			
Employed	0.0093 (0.005)*	0.0052 (0.012)	-0.0748 (0.014)***
Unemployed	0.0076 (0.006)	0.0194 (0.015)	-0.0583 (0.016)***
Retired	0.0033 (0.006)	-0.0315 (0.015)*	-0.1291 (0.016)***
Homemaker	0.0114 (0.006)	-0.0693 (0.012)	-0.1415 (0.015)***
Region			
TR2	-0.0282 (0.006)***	0.0196 (0.015)	-0.0606 (0.012)***
TR3	-0.0228 (0.005)***	-0.0168 (0.012)	-0.0644 (0.011)***
TR4	-0.0122 (0.006)*	-0.0026 (0.012)	-0.0205 (0.011)
TR5	-0.072 (0.006)	-0.0629 (0.011)***	-0.0374 (0.011)***
TR6	-0.0174 (0.006)**	-0.0569 (0.011)***	-0.0421 (0.011)***
TR7	-0.0147 (0.006)**	-0.0580 (0.013)***	-0.1007 (0.012)***
TR8	-0.0212 (0.006)***	0.0051 (0.014)	-0.0935 (0.013)***
TR9	-0.0006 (0.007)	0.0430 (0.015)**	-0.1607 (0.012)***
TRA	-0.0298 (0.006)***	-0.0966 (0.015)***	-0.1108 (0.015)***
TRB	-0.0272 (0.006)***	-0.0913 (0.013)***	-0.1138 (0.013)***
TRC	-0.0202 (0.006)***	-0.0575 (0.012)***	-0.1082 (0.012)***

Note: Standard errors are reported in parentheses.
*p=<.05; **p=<.01; ***p=<.001

According to the results presented in Table 3.5, being female increases the probability of using online communication activities by 0.014, but decreases the probability of using social media by 0.0205 (p=<.01). A discrete change for the 36-50, 51-65, and 66-74 age groups decreases the probability of using online communication. Having an average household income does not significantly influence online communication; however, having a much lower income decreases the likelihood of using online communication.

The similar relationship is observed between education level and social media usage such that only the lowest education level is significantly disadvantageous than the reference category. Occupational status does not significantly affect neither communication nor social media usage: however, as for online entertainment, students are significantly dominate all other categories in terms of probability of engaging with online entertainment activities such as listening to music, watching videos, and playing games online. As to the region, the only region that does not differentiate from Istanbul in terms of communication, social media, and entertainment adoption is East Marmara (TR4). All other regions are significantly less likely to engage in online entertainment, TR9 has the highest negative effect with 0.167. For other two Internet services, the effects vary depending on the region. TR6, TR7, TR8, TRA, TRB, and TRC are all less likely to use all those online services.

Table 3.6 : Average marginal effects (dy/dx) of the logit model predicting online information-seeking, online education, and e-commerce adoption (N=18,233).

	Info-seeking	e-Learning	e-Commerce
Variable			
Gender			
Female	-0.0118 (0.008)	0.0282 (0.005)***	0.0226 (0.007)***
Age			
36-50	-0.0380 (0.007)***	-0.0228 (0.006)***	-0.0768 (0.007)***
51-65	-0.1153 (0.008)***	-0.0452 (0.010)***	-0.2092 (0.012)***
66-74	-0.1921 (0.015)***	-0.1227 (0.035)***	-0.3419 (0.032)***
Income			
Average	-0.0310 (0.007)***	-0.0419 (0.005)***	-0.0684 (0.007)***
Low	-0.0721 (0.008)***	-0.0593 (0.007)***	-0.1157 (0.009)***
Education			
High school	-0.1135 (0.013)***	-0.1038 (0.007)***	-0.1256 (0.007)***
Below high school	-0.0721 (0.012)***	-0.1303 (0.006)***	-0.3081 (0.007)***
Employment			
Employed	0.0073 (0.010)	-0.2433 (0.006)***	-0.0189 (0.010)*
Unemployed	0.0015 (0.013)	-0.2608 (0.010)***	-0.0944 (0.013)***
Retired	0.0021 (0.013)	-0.3336 (0.017)***	-0.0752 (0.018)***
Homemaker	-0.0592 (0.010)***	-0.2942 (0.008)***	-0.1296 (0.011)***
Region			
TR2	-0.0276 (0.012)*	0.0011 (0.010)	-0.0305 (0.014)*
TR3	-0.0300 (0.011)**	-0.0123 (0.009)	-0.0100 (0.011)
TR4	-0.0173 (0.011)	0.0638 (0.008)***	-0.0109 (0.011)
TR5	-0.0440 (0.010)***	0.0002 (0.008)	-0.0230 (0.011)*
TR6	-0.0341 (0.010)***	-0.0352 (0.010)***	-0.0402 (0.012)***
TR7	-0.0460 (0.012)***	0.0101 (0.011)	-0.0565 (0.014)***
TR8	-0.0240 (0.013)*	0.0001 (0.011)	-0.0377 (0.014)**
TR9	-0.0289 (0.012)*	-0.0643 (0.013)***	-0.1443 (0.0014)***
TRA	-0.0757 (0.013)***	-0.0029 (0.012)	-0.0679 (0.016)***
TRB	-0.0784 (0.011)***	-0.0288 (0.011)**	-0.1539 (0.015)***
TRC	-0.0627 (0.011)***	-0.0438 (0.011)***	-0.1533 (0.014)***

Note: Standard errors are reported in parentheses.
*p=<.05; **p=<.01; ***p=<.001

The AMEs of the logit models predicting e-learning and e-commerce demonstrate a significant positive relationship between women and e-learning and e-commerce such that women are by around 0.03 more likely to use these services. With aging, adoption of these three services drops. The AME of the elderly is considerably high for e-commerce such they are 0.34 less likely to use e-commerce than the young adults. People who

attained low education are similarly disadvantaged within their group, with AME of -0.31. Homemaker is again the only category revealing significantly negative outcome. Although other employment groups do not reveal a significant effect in online information seeking, they are also less likely to use e-learning and e-commerce then students. Regions have varying effects: the regions with the highest negative AMEs on the probability of using the services are TRA and TRB for information seeking, TR9 and TR4 for e-learning, and TR9, TRB, and TRC for e-commerce.

Table 3.7 : Average marginal effects (dy/dx) of the logit model predicting e-government, e-health, and e-banking adoption (N=18,233).

	e-Government	e-Health	e-Banking
Variable			
Gender			
Female	-0.0774 (0.008)***	0.0144 (0.008)	-0.0894 (0.007)***
Age			
36-50	-0.0265 (0.008)***	-0.0248 (0.008)**	-0.0379 (0.007)***
51-65	-0.1454 (0.011)***	-0.1154 (0.012)***	-0.1277 (0.011)***
66-74	-0.3388 (0.024)***	-0.2160 (0.028)***	-0.2958 (0.026)***
Income			
Average	-0.0350 (0.008)***	-0.0242 (0.008)**	-0.0687 (0.007)***
Low	-0. 0654 (0.009)***	-0.0716 (0.010)***	-0.1037 (0.009)***
Education			
High school	-0.1909 (0.011)***	-0.1294 (0.009)***	-0.1239 (0.009)***
Below high school	-0.3566 (0.011)***	-0.2929 (0.008)***	-0.3312 (0.008)***
Employment			
Employed	0.0386 (0.011)***	0.0570 (0.012)***	0.2303 (0.009)***
Unemployed	0.0052 (0.014)	0.0269 (0.015)	0.1129 (0.013)***
Retired	-0.0431 (0.017)**	0.0720 (0.019)***	0.1447 (0.017)***
Homemaker	-0.1626 (0.011)***	-0.0014 (0.067)	-0.0892 (0.012)***
Region			
TR2	-0.0572 (0.015)***	-0.1244 (0.016)***	-0.0126 (0.014)
TR3	-0.0970 (0.013)***	-0.0510 (0.013)***	-0.0557 (0.012)***
TR4	-0.0794 (0.012)***	-0.0524 (0.013)***	-0.0224 (0.012)*
TR5	-0.0600 (0.013)***	-0.1196 (0.013)***	-0.0350 (0.012)**
TR6	-0.0361 (0.013)**	-0.1644 (0.014)***	-0.0485 (0.012)***
TR7	-0.1157 (0.015)***	-0.0441 (0.015)**	-0.0589 (0.014)***
TR8	-0.1359 (0.015)***	-0.0192 (0.015)	-0.0658 (0.014)***
TR9	-0.1940 (0.015)***	-0.1587 (0.0016)***	-0.0894 (0.014)***
TRA	-0.1661 (0.016)***	-0.1175 (0.018)***	-0.1002 (0.016)***
TRB	-0.1428 (0.014)***	-0.1824 (0.016)***	-0.1318 (0.014)***
TRC	-0.1313 (0.013)***	-0.0535 (0.014)***	-0.1321 (0.013)***

Note: Standard errors are reported in parentheses.
*p=<.05; **p=<.01; ***p=<.001

Women are 0.08 and 0.09 less likely to use e-government and e-banking, respectively. A discrete change for any age group decreases the probability of using all services. Lower income and education groups are again disadvantaged in adopting these services. In particular, the lowest education level is the significant factor that negatively affects adoption of these Internet services by 0.30-0.35. Certain employment categories have a

reverse affect than it has been observed in the previous results. Employed people are more likely users of these three Internet services than students. E-government tend to be used more by the unemployed and retired along with the employed. Retired are also more likely to use e-health than students, however, they are still behind students in terms of e-government usage. Unfortunately, there is no case that homemaker has an advantageous position. As to the regions, unlike the previous cases, almost all regions have a significant negative effect in adopting e-government, e-health, and e-banking. In the following section, I will provide a more in-depth analysis of the results, particularly emphasizing the critical disparities that are indeed an indicative of the second level digital divide in Turkey.

3.7 Analysis of the Results

The regression results as well as the AMEs indeed provide substantial evidence concerning the digital disparities between different demographic and socioeconomic groups. By taking each Internet service, which are all considered essential to cope and thrive in the changing society, into consideration separately, it is possible not only to infer about the state of the digital divide in terms of different Internet services but also to precisely identify which social groups are excluded from which type of online activities. The disparities in online engagement with certain social groups being excluded from undertaking Internet activities that are indeed essential maintain and accrue social and economic capital, may exacerbate social inequalities, and cause the digital divide become a more structural problem. The differences in Internet utilization among survey participants of different social groups, subject to the variety and type of engagement, point to a social pattern in which those begin with advantage accumulate more advantage over time and vice versa: the problem known as *the Matthew Effect* (Merton, 1968). The Matthew Effect concerns not only about the gradual decline of the disadvantageous groups, but also about the widening gap between the disadvantageous and advantageous groups. Individuals' (dis)advantageous position in terms if ICT access and use is associated with their demographic characteristic, socioeconomic background, or region. On the other hand, Internet becomes increasingly imperative in the lives of individuals. Therefore, given the already existing gaps among society in terms of ICT access and use

as well as their level of online engagement, the gap between individuals who can take advantage of what Internet offers them and those who cannot, will keep widening unless the necessary actions are not taken today. The results presented in the present Chapter along with other evidence provided in the rest of this thesis essentially advise policymakers where to start by emphasizing the high-priority target groups.

The results undoubtedly have social, financial, and cultural implications that require sophisticated analyses and a broader discussion far beyond the subject of this thesis. Without delving deep into the underlying causes of the disparities in digital participation among society, yet feeling confident for having laid the foundation for further research, I will analyze the results obtained in the present Chapter from a digital inequality perspective: Which demographic and socioeconomic variables are the significant predictors of Internet services? What are the differences in digital engagement in society?

Table 3.8 summarizes the results obtained from the regression analyses and shows the significant demographic and socioeconomic determinants of each Internet service.

Table 3.8 : The significant demographic and socioeconomic determinants of Internet service adoption.

	Communication	Social media	Entertainment	Info-seeking	e-learning	e-commerce	e-government	e-health	e-banking
Female	✓ (+)	✓			✓ (+)	✓	✓		✓
Age	✓	✓	✓	✓	✓	✓	✓	✓	✓
Income	✓	✓	✓	✓	✓	✓	✓	✓	✓
Education	✓	✓	✓	✓	✓	✓	✓	✓	✓
Employment			✓	homemaker	✓	✓	✓ except unemployed	✓ except employed, unemployed	✓

Note: (+) indicates that the variable is significantly more likely to adopt the particular Internet service compared to the reference group.

Internet usage patterns differ significantly by most of the demographic and socioeconomic characteristics:

Gender is a significant predictor of online communication and social media usage as well as e-learning, e-commerce, e-government, e banking adoption, yet the results are only favorable in the case of communication and e-learning for women. The results are in line with the results obtained by Grazzi and Vergara (2014) reflecting seven Latin American countries, and indicate that women are likely to use the Internet for relatively less technically sophisticated online activities. Gender does not influence the likelihood of using the Internet for entertainment, searching the Web for content or e-health. They are also 0.08 and 0.09 less likely to use e-government and e-banking, respectively. Thus, Internet access inequality is no longer a concern about women, however, gender differences in diversity and type of Internet usage appear to remain. Further analysis and projections by using longitudinal data can better explain whether explain those differences show progress to disappear in the near future. Chapter 4 aims to investigate the evolution of those gaps.

Age is a significant factor for all Internet service types such that with aging the probability of engaging in a particular online activity decreases. Internet usage is much less prevalent among the senior age groups as shown in Chapter 2. When we take closer look at the Internet activities, we observe that older users have lower probability of practicing all Internet activities than the younger users even though the adoption of some Internet services such as e-health, e-government, e-banking are considered vital even for the elderly. As the Internet becomes a prominent source of information, communication and financial facilities, the widespread use of those Internet services among seniors will be beneficial in providing ease of satisfying their daily needs. Older-adult users can indeed gain multiple benefits of engaging with more diverse activities.

Both household income and education are significant predictors; higher levels of education and income are associated with partaking in more activities online. Both variables appear to be among the most influential, but in an unpreferred direction, factors that are associated with Internet service adoption. The results imply very low user rates of those who lack financial resources or those with low educational attainment compared

to the superior groups with respect to all Internet services. The relative engagement rates are particularly low in Internet services such e-commerce, e-government, e-health, and e-banking. The Internet appears to provide increasingly more capital-enhancing opportunities for those with higher education and income, which as a result reinforce their already advantageous positions in society (Van Deursen et al., 2015). Therefore, unless those groups start to widely and effectively use those Internet services, the digital gaps will further increase, deteriorating the disadvantageous position of low-income and low-education groups.

Research shows evidence that differentiated patterns of Internet usage are observed across employment groups. The scope of Internet use varies according to employment status. Specifically, employment has a significant positive effect on overall Internet use (Campos et al., 2017) such that employed individuals are overall more likely to adopt e-commerce, e-banking, and e-government, and less likely to engage in e-learning and online entertainment activities (Grazzi and Vergara, 2014). The results presented in the present chapter are mainly in line with the previous evidence. Other takeaways also include results regarding other Internet services that are not covered in those studies such as e-health, e-learning, online information seeking. For example, employed and retired are significant variables with respect to e-health services. They are more likely to use e-health than students are, suggesting that e-health activities are more associated with the needs of people. Furthermore, little attention has been paid to how being homemaker affects online engagement, which, in fact, requires a meticulous attention. Being homemaker significantly negatively effects Internet adoption such that except for communication and social media, they are in an unfavorable position in engaging in online activities that require relatively more sophisticated digital knowledge or skills. On the contrary, students usually have more advanced digital skills and greater motivation to use most of the services and hence, constitute the important part of the Internet adoption. They are only behind other groups (except homemaker) in e-banking adoption, which can also be explained with the minimal need or motivation to use the service. Internet adoption behavior of each occupation should be empirically evaluated by controlling other factors such as income, gender, and education to explore the dynamics that may underlie these differences in Internet usage and potentially go beyond motivation and needs.

Regional aspects of Internet use in Turkey vary depending on the Internet service type. The least variation is observed with respect to online communication, social media, and e-learning. However, although the calculations still give significant results for some regions, an empirical investigation by reflecting differences between rural and urban areas can yield more meaningful interpretation. Bearing in mind that the number of e-learning adopter is the lowest according to the data, and given the high number of region variables (12 regions), the regression results, the regression results tend to become unreliable. On the other hand, an assessment regarding the different online engagement patterns between rural and urban areas can provide more policy-oriented evidence.

3.8 Conclusion

In the present chapter, I examined the variety and types of Internet activities in which users engage as a means for understanding (i) what they do when they are online, (ii) the disparities between social groups in terms of the type of Internet service they are more likely to adopt. Understanding the range and type of Internet activities a person performs is important because the variety of online activities can help users take full advantage of the Internet. Logistic regression models were used to determine the demographic and socioeconomic factors that influence adopting various Internet services. The results demonstrate that gender, age, economic level, education, and in some cases employment status and region are significant determinants of their use of Internet. The body of knowledge provided in the present chapter provides empirical evidence to the differences in Internet usage pattern and hence, contributes to a discussion of academic literature on the second level digital divide, in the Turkish context in particular, by revealing the significant factors that explain individuals' Internet usage behaviors.

The results highlight the significant paradox that exists between substantial efforts to digitize many private and public sector services without sufficient attention directed towards ensuring digital inclusivity. People who do not have Internet access and those who engage in a limited number of Internet activities are not actually able to fully participate in a digital society and take full advantage of wide range of resources,

information and social contacts that Internet offers (Haight et al., 2014). In the current stage of Internet penetration in Turkey, it is vital to promote its different usages.

The results obtained in the present chapter indicate that a uniform demand-side policy across all individuals will not be the most effective in promoting the use of each Internet services. Given the observed differences in online engagement, policymakers should concentrate on demographic and socioeconomic strata specific measures. The policies and initiatives should therefore be implemented in diverse ways depending on the target group and application scope. Such policies may require the prioritization of certain groups such as women, elderly, low-income and low-education groups, homemakers, and certain regions with a particular focus and meticulous investigation of urban-rural distinction which requires a data at the micro-level.

As the Internet develops, the common activities in the Internet changes. The digital divide in terms of connectivity may not be as wide as it has historically been; however, significant disparities in online engagement persist. This suggests that longitudinal analysis of changes in common activities and how the digital gaps evolve over certain Internet services become a critical to measure changes in the Internet and the state of the digital divide in Turkey. Longitudinal study of changes in Internet access and use as well as the changes in Internet service adoption as a way to measure the evolution of the digital gaps will be the subject of the following chapter.

4. THE EVOLUTION OF THE DIGITAL DIVIDE IN TURKEY

4.1 Introduction

The digitalization potential and capacity of a country depend on the growth and penetration of ICTs in the region which is coupled with the concomitant rise in the even distribution of adoption of the technologies within society. According to the latest data provided by the International Telecommunications Union (ITU, 2020), there are 4.6 billion internet users worldwide, meaning that 59 percent of the population are internet users today which was only 16 percent in 2005. The ITU estimates that 4.9 billion people, or 63 percent of the world's population, will be online in 2021. This represents a 17 percent increase over 2019, with 782 million people estimated to have used the internet during that time. However, 2.9 billion people remain unconnected. Moreover, very few of those who are counted as Internet users can fully engage with all internet services. Also, there are strong differences either by social groups or by regions.

Turkey is undergoing digital transformation and morphing into more innovative and technologically advanced organizations and systems. However, given the relationship between social connectivity and digital connectivity (Chen, 2013), the disadvantaged groups of the population would become more vulnerable to remain socially and digitally excluded, which in turn would cause digital gaps between different social groups and regions. As shown in Chapter 2 and Chapter 3, there are digital gaps in terms of demographic and socioeconomic characteristics of the individuals in Turkey. Also, there are differences in internet access and use by geographical area. The main objective of this chapter is to examine the evolution of digital gaps in Turkey by using longitudinal data from TurkStat's "household ICT use and access" survey for the period 2008-2020. Having proved in the previous chapters that there are digital gaps for certain social groups in Turkey, I will investigate whether and for which groups these gaps have widen,

narrowed or disappeared over the years. I will look at almost all aspects concerning the digital divide from internet access to adoption of various internet services and present them by mostly using graphs to show the dynamics of the digital gaps and analyze how large are the gaps in each digital divide indicator along with different demographic and socioeconomic variables. This chapter will thus be the most comprehensive and detailed study to date examining the evolution of the digital divide in Turkey. For this reason, I believe that it will provide a useful body of knowledge in the design of policies to address the digital divide in Turkey.

In accordance with the objective to study the evolution of digital divide in Turkey, in this chapter, I particularly examine the change in broadband penetration in Turkey and digital gaps between different social groups over device access, internet access and internet use with respect to years. The analysis is done so by looking at how each variable that is the subject of Chapter 2 and Chapter 3 of this thesis has progressed over time.

4.2 Literature Review

The widespread growth of information and communication technologies (ICT) in recent decades has created incentives for individuals to widen their participation in social, political, and economic areas of life. Notwithstanding such incentives for individuals, using ICT entails having access to technology and infrastructure, as well as learning how to deal with new ICT concepts. As the internet reaches critical importance, some social scientists are starting to investigate the demographic and socioeconomic patterns of ICT access and use. It is widely acknowledged by scholars that the demographic and socioeconomic patterns of ICT access and use have critical policy implications. Thereof, there are a number of studies that give particular emphasis on how differences in ICT access and use in society changing over time. The digital divide literature is vast across individuals, regions, countries, disciplines and services (Pérez-Amaral et al., 2021). The summary of the literature in this section focuses on the studies which investigate the changes in ICT adoption along time.

Hoffman et al. (2000) is one of the early studies that give particular emphasis on how differences in ICT adoption are changing over time. They analyze the two of the key

variables like income and education that drive the policy questions surrounding the internet. The other aspect they look into in their study is the effect of racial difference in internet access and use over time. They conduct a systematic investigation of the differences between whites and African Americans in the United States with respect to ICT access and use. According to their results, the gaps in general Web access and use between the two races appear to be driven by whether there is a computer present at home. They also found significant differences in media use between the two races.

Polykalas (2014) analyzes the historic evolution of the digital divide across Member States of the European Union. This study does not deal with the issue at an individual level, but instead examines how Member States have progressed over time between 2004-2013. With the objective to assess the effectiveness of the policies in relation to the digital divide, the paper examines the existence of broadband infrastructure and the penetration of broadband services. The results show that a clear improvement has been achieved in terms of rural broadband coverage, however, the EU policies have not achieved quantitative targets to mitigate the digital divide across the Member States. Ragnedda and Kreitem (2018) sheds light into the digital inequalities in the particular setting of East EU by comparing and contrasting the differences and similarities between East EU countries in terms of internet access and online engagement by analyzing the period 2008-2017. Their analysis shows that internet penetration is rapidly rising across Europe, so that the number of people with no connectivity opportunities is significantly diminishing. However, despite the narrowing digital gaps, the first level digital divide has not been completely bridged. Indeed, there are still significant differences between North and East EU countries, even within East Europe itself. Furthermore, the disparities between the Baltic countries and Romania and Bulgaria, which are at the bottom of Europe's Internet penetration rankings, are particularly noteworthy (Ragnedda and Kreitem, 2018). Bearing in mind that the internet penetration is at similar rates in Turkey as in the East EU countries like Bulgaria and Romania according to ITU's World Telecommunication/ICT indicators database (2021), the discussion in Ragnedda and Kreitem (2018) is relevant to compare where Turkey stands and how it progresses in terms of ICT access and use compared to EU and East EU countries in particular.

Nishijima et al. (2017) analyze four nationally representative survey data (of years 2005, 2008, 2011 and 2013) on evolution and determinants of digital divide between 2005 and 2013 in Brazil. The study seeks to fill the gap in the literature on the digital divide in Latin American countries. The results show that the digital divide among individuals rapidly decreases from 2005 to 2013 in Brazil. However, digital illiteracy, evaluated by lack of education, poses challenges in access to ICT, especially among the elderly.

Jin et al. (2018) explore the trends of the digital divide in China between 2004 and 2016. They investigated regional and stratificational digital divides, including the access divide and the usage divide, and found that regional access and usage divides in China have decreased over time.

Garín-Muñoz et al. (2019, 2022) and Pérez-Amaral et al. (2020, 2021) examine the evolution of the use of ICT in Spain and analyze the internet adoption patterns of selected internet services. Garín-Muñoz et al. (2019) measure the effect of individuals' socioeconomic characteristics on the adoption of internet services such as e-commerce, e-banking and e-government by using logistic regression techniques. Pérez-Amaral et al. (2021) measure specific digital gaps which are mainly classified according to demographic and socioeconomic variables by using survey data for the period 2007-2019. The results show that most of the of the gaps are narrowing. In fact, in the case of gender, the gaps end up much smaller or even reversing in signs in some cases such that in the case of VoIP and social networks women become more likely users than men. However, some gaps concerning older groups persist. Also, for low-education levels digital divide remains high. The results further indicate that the gaps showing more stable evolutions coincide with internet activities that require more advanced digital skills to use. Pérez-Amaral et al. (2020) specifically measure the effect of socioeconomic and regional characteristics on digital e-commerce divides in Spain and their evolution over the period 2008-2016. They find that age, gender, income, education, region, and digital skills have a significant effect on the adoption of e-commerce service. Garín-Muñoz et al. (2022) examine whether the digital gender gap can be entirely examined by the socioeconomic differences between women and men. Their results confirm that the probability of using the internet is lower for women compared to men, ceteris paribus. After exploring the gender differences in the adoption of internet services for the period 2007-2020, they

found that women use more e-health, e-learning, e-tourism, social networks, chat, and VoIP whereas they use less e-banking, e-government, e-commerce, email, e-news and iCloud.

Mack et al. (2021) highlight the importance of meaningful longitudinal analyses of the digital divide and contribute to the literature by creating data infrastructure for investigating the evolution of digital divide. They develop a procedure for producing and integrating broadband time series (BITS) for the United States for the years 2008-2018.

Some of the contributions listed above use aggregate data, while others adopt different econometric approaches by using cross-section, pool, or panel data. Some of them are limited to only possible relevant dimension of digital divide such as connectivity or usage, or consider only one or a limited set of variables such as gender, income, race, etc. whereas in this chapter, I cover a large data set such that a variety of demographic and socioeconomic variables and a range of internet activities are included in the analysis.

4.3 Data

The study draws upon annual data collected in Turkey as part of the Turkish Statistical Institution's (TurkStat) "Information and Communication Technology (ICT) Usage Survey on Households and Individuals", which is prepared and carried out in accordance with EuroStat's survey on "ICT Usage in Households and by Individuals". The survey aims at collecting information about the information and communication technologies owned by households and individuals and their use every year since 2004 (except 2006). Due to missing and malformed data before 2008, this study covers the years from 2008 to 2020 and includes around 13,000-33,000 individuals of age 16-74 each year. Table 4.1 shows the number of individual and household participants each year with their gender distribution. The survey's questionnaire alters each year based on the evolving situation of ICT such that new variables emerge, and some variables are either renamed or omitted in some years. Therefore, the data underwent rigorous analysis, filtering and harmonization in order to standardize the information collected throughout the observation period.

Table 4.1 : Number of observations throughout the observation period 2008-2020.

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Number of participants	13314	12524	13236	26355	27394	23428	20150	19623	25058	29359	28888	28675	32955
Number of households	5161	4773	5094	10235	10605	11537	9814	9827	11268	12780	12822	12947	14498
Male	6380	6025	6392	12873	13255	10778	9259	8966	11699	13924	13719	13729	16420
Female	6934	6499	6844	13482	14139	12650	10891	10657	13359	15435	15169	14946	16535

4.4 Internet Penetration in Turkey Between 2008-2020

The internet penetration rate refers to the percentage of the total population of a given country or region that uses the Internet. An internet user is defined as anyone with the capacity to use the Internet, which requires the person to have access to an Internet connection and the basic knowledge to be able to use the technology. The TurkStat survey data confirm the upward trend in internet penetration in Turkey, validating the ITU's World Telecommunication/ICT Indicators Database (2021).

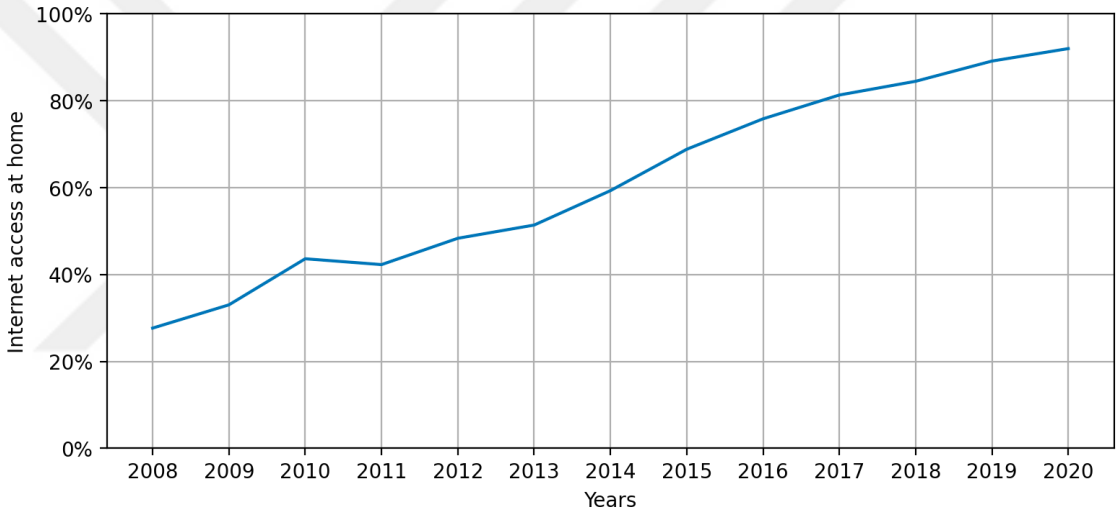

Figure 4.1 : Share of survey participants with Internet access between years 2008-2020.

Figure 4.1 shows the trend of the share of TurkStat survey participants who reported having Internet access. There is a clear upward trend in the share of people with internet access – that is, Internet penetration has increased in Turkey over years. As seen in the figure, the share was as low as below 30 percent back in 2008 but as of 2020 the share is over 90 percent. Except for the drop in 2011, the Internet penetration rate in Turkey has steadily increased.

As emphasized in the previous chapters, accessibility does not necessarily transform into usage. Therefore, I look into the usage trends separately to see whether access and usage perform differently in certain periods of years.

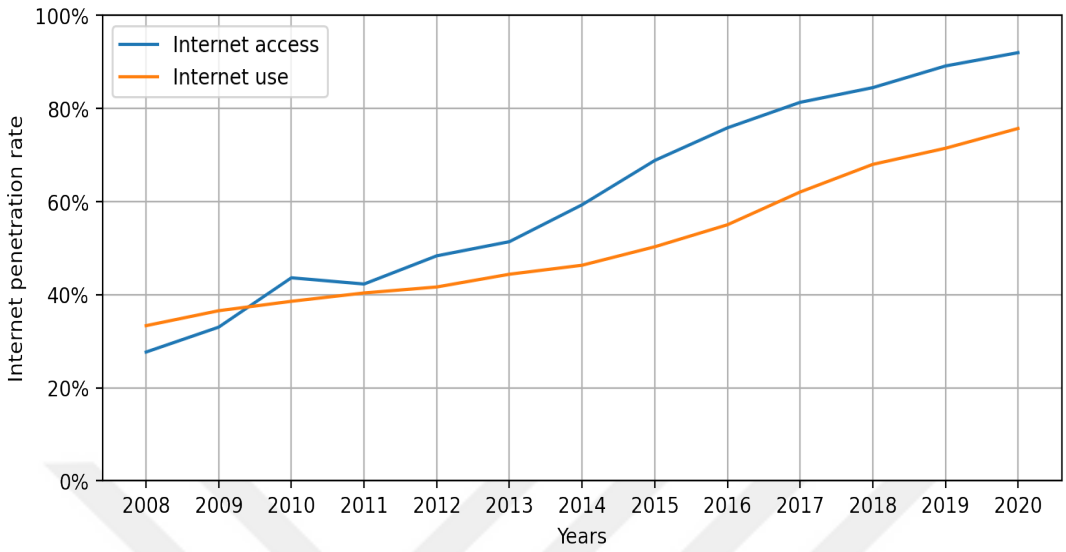

Figure 4.2 : Internet access and internet use trends between the years 2008-2020.

Figure 4.2 shows changes in the share of survey participants with Internet access and who actually use the Internet between the years 2008-2020 in separate trend curves. When we look at the Internet use curve in particular, we again see an upward trend starting from around 30 percent in 2008 up to almost 80 percent in 2020 with a constant increase. However, from the figure, we can deduce that access does not always transform into usage. Despite the continuous investments in infrastructure deployment and increasing infrastructure availability, there are other factors that limit actual usage.

4.5 Methodology

In Chapter 2 and Chapter 3, I concentrated on identifying the significant demographic and socioeconomic predictors of internet access and use and therefore employed logistic regression model to predict these predictors. I found that age, education, household income, employment status and region are significant predictors of internet access in Turkey and for internet use, gender is prepended to the list of predictors. I also showed the likely users of each internet service by regressing each online activity type on the demographic and socioeconomic variables.

In this chapter, I adopt a new approach to measure digital ‘gaps’ for each group of predictors that were identified in previous chapters and to understand at a high level

whether these gaps are narrowing or widening over time. In order to be able to analyze the evolution of the digital divide in Turkey, I measured the digital 'gaps' for each demographic and socioeconomic group. I adopted a similar method that is used in Pérez-Amaral (2021) which we believe enables us to understand whether the gaps are narrowing, widening or remain unchanged over time. Therefore, I used the following equation to measure the digital gaps:

$$Digital\ gap = (P_H - P_L)/P_H$$

where P is the percentage penetration of a given social group (gender, age, education, etc.). Each group may involve two, three, four, or more categories in the sample. H and L refer to the best and poor performing categories within the particular social group, respectively. Therefore, P_H refers to the rate of access or use of the most advantageous category in terms of internet access such that for each social group the most advantageous categories as the following: men, 16-35 age, high education, high household income, student, west, whereas P_L refers to the less advantageous categories compared to the abovementioned categories. The equation thus refers to the difference of penetrations relative to the penetration of the highest category. As also claimed by Pérez-Amaral et al. (2021), the formula admits a straightforward interpretation since the calculations yield a value bounded between zero and one, denoting the percentage difference in the penetration for the category L of a given digital divide indicator (internet access, internet use, online activity use) relative to the penetration in the highest category H. Based on these calculations, in the following sections I present a set of graphs illustrating the evolution of the digital gaps for each aspect of the digital divide in Turkey.

4.6 Results

In this section, I present the results of our analysis of the historic evolution of the digital divide. The results are presented in a set of graphs that illustrate the change of various aspects of the digital divide over time and how each demographic and socioeconomic predictor of the digital divide has evolved over time.

4.6.1 Device access

As a first step, I analyze the evolution of access to internet-enabled devices in Turkey over the years. The TurkStat dataset contains sufficiently diversified information about internet-enabled devices that allows for a comprehensive analysis about device ownership and device diversity among various social groups in Turkey over the years. Although access to an internet-enabled device is necessary for connectivity, it is not sufficient by itself to connect and maintain connectivity. Nevertheless, it is important to analyze the device access patterns in society to examine whether it has been a significant factor affecting connectivity. The analysis on device diversity, in particular, would also give an indication about the change in internet utilization by different social groups as one can diversify their Internet experience by using different types of devices (van Deursen and van Dijk, 2019). One of the important contributions of this chapter is to reveal whether the gaps between different social groups have widened, narrowed or remained unchanged in terms of device access. I first analyze the change in gaps in access to any internet-enabled device, namely smartphone (or mobile phone that enable internet connection), desktop, laptop/tablet, smart TV and game console.

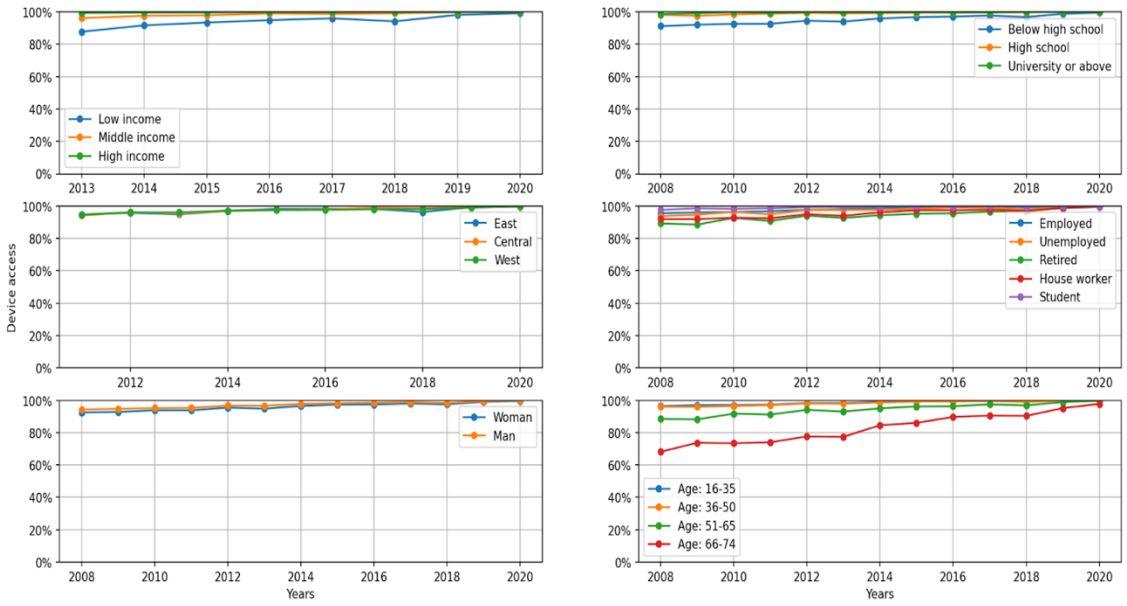

Figure 4.3 : Internet-enabled device access shares of different social groups in Turkey over the years.

Figure 4.3 involves six graphs showing the shares of individuals from different social groups with access to internet enabled devices in Turkey over the years. The horizontal axes present the years. The first two graphs illustrate gaps in terms of household income and region on the left-hand side cover the years starting 2013 and 2011, respectively, to 2020. Since the survey was not conducted in 2006, the data for that year are missing for all variables. However, there is more than sufficient historical data available to calculate trends. The vertical axes present the share of individuals with device access. The two common conclusions we draw from all graphs are that, first, there is an increasing trend in device access – that is, the share of people with device access has been increased; second, the vast majority of the population now has a device that can connect to the internet. The first step of the analysis yields promising results. I will now deepen the analysis further to draw clearer conclusions about the trends in digital gaps over the years.

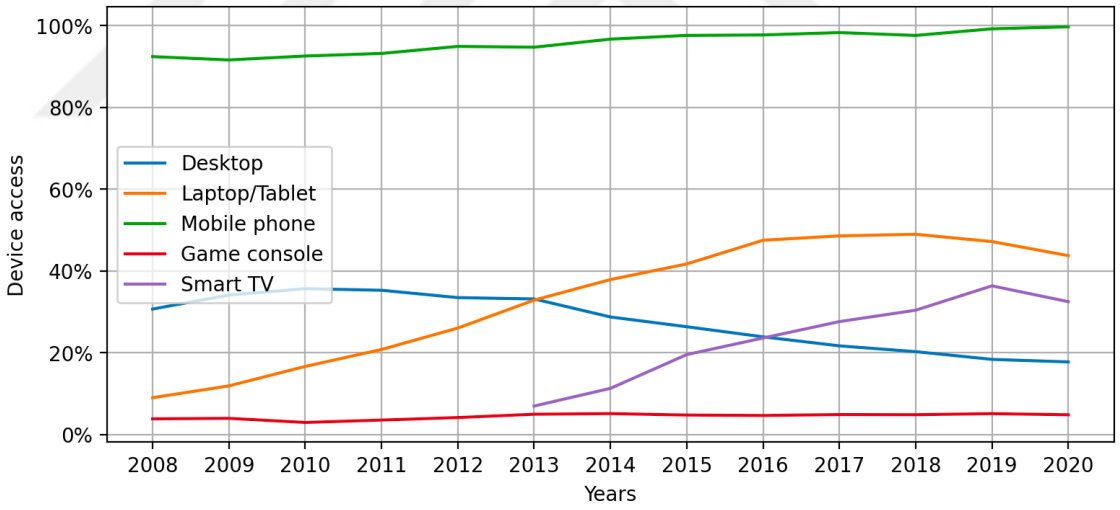

Figure 4.4 : Device ownership with respect to years (device types).

Figure 4.4 shows the share of the population using various Internet-enabled devices, throughout the years. This figure demonstrates that smartphones have been the most common type of device used to go online. As of 2020, almost everyone has a mobile phone that enables connectivity.

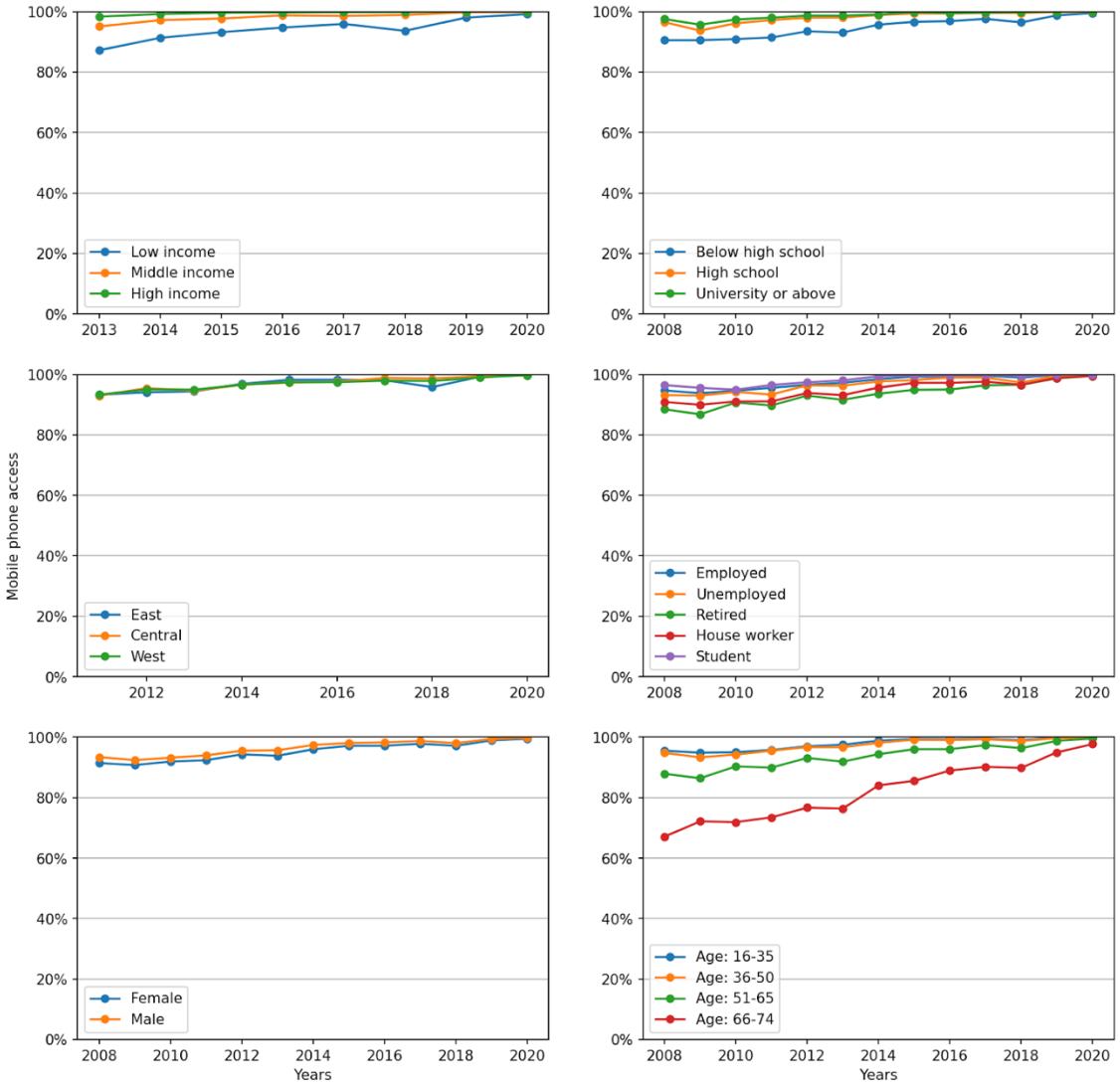

Figure 4.5 : Smartphone access rates of each social group over the years.

As shown in Figure 4.5, even the most disadvantageous groups such as older adults, individuals with low-income and low-education, have access to an internet-enabled phone. Moreover, smartphones have always been dominant over other devices enabled by the internet – that is, they have been central to the digital lives of users compared to other devices as Figure 4.4 demonstrates. In fact, the gap even between the second most used device (laptop/tablet) today is considerably huge. The vast majority of the population is reliant on smartphones and, therefore, constrained by what smartphones offer them, as discussed in Chapter 3. Smartphones being on top, all devices except the desktop in recent years reported an increase in use for online access. The trends in the

diversity of devices used to go online reveal the preference shifts towards portable devices.

On the other hand, device availability at home does not necessarily enable connectivity for every household member. Many households do not have enough devices for everyone or not everyone can use all devices to access the Internet. Therefore, although device availability gives an indication of how the country performs in terms of device opportunities itself, it is particularly critical to detect which household members can actually access those devices and which cannot. Therefore, I try to uncover the digital gaps between social groups of different demographic or socioeconomic characteristics on device access.

4.6.2 Digital gap over device access

Figure 4.6 includes six graphs that illustrate the gap between different social groups in terms of the share of people in each group that have access to an Internet-enabled device. Each curve represents the social group and demonstrates how each category of the representative social group has progressed over time relative to the most advantageous category in that social group. Therefore, the y-axis represents the percentage gap between the categories with the best-performing category. For example, the first graph on the top left-hand side illustrates the change in the device access gap between different low- and middle-income households (represented by blue and orange lines, respectively), and high-income households.

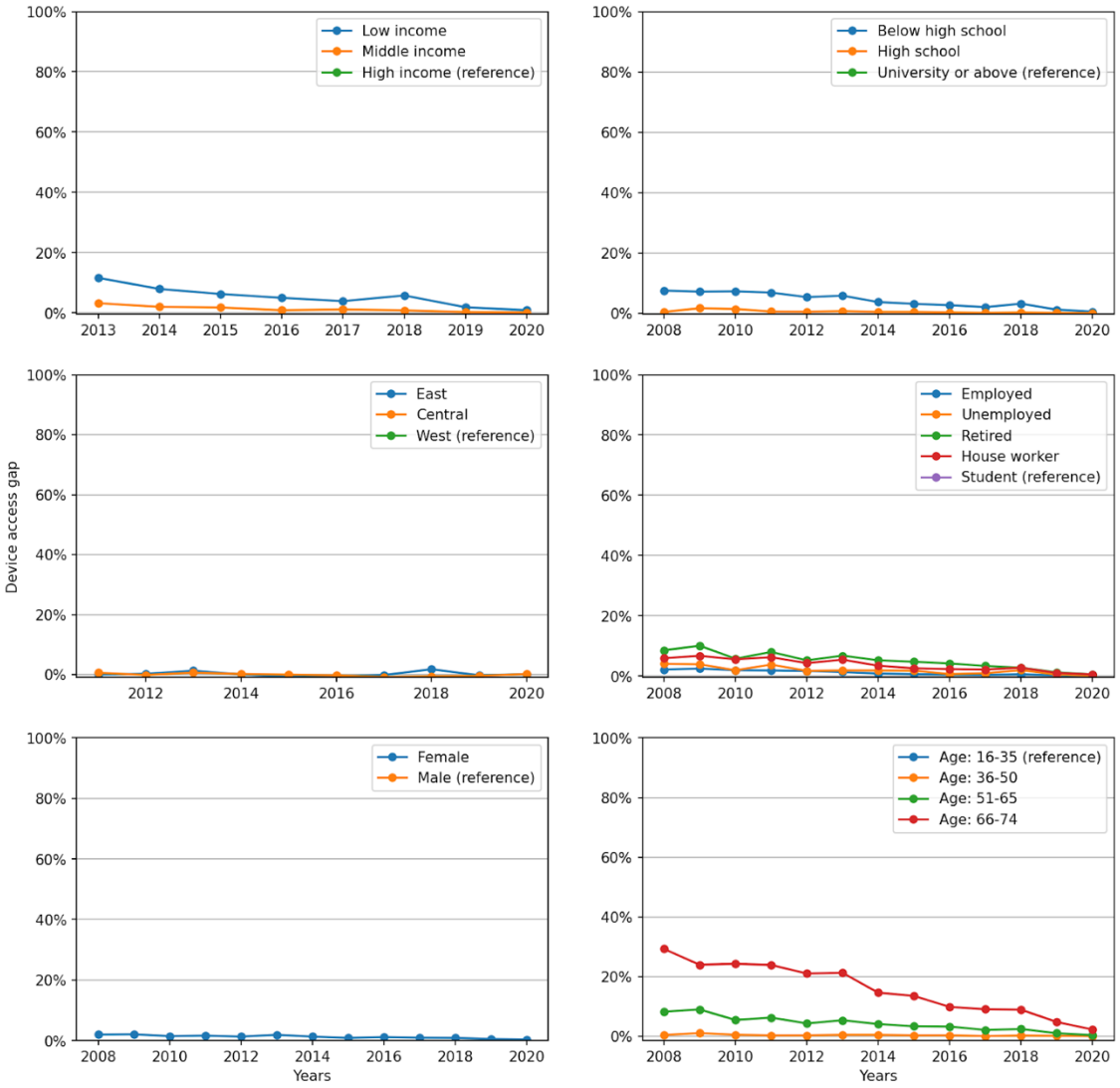

Figure 4.6 : Digital gap over device access.

As all graphs in Figure 4.6 show, the digital gap over device access has been nearly closed for all social groups, which appears to be a very promising outcome of the widespread use of Internet-enabled devices. However, it is worth mentioning that the measurement of device access here includes all Internet-enabled devices, namely smartphone (or mobile phone that enables Internet connection), desktop, laptop/tablet, smart TV and game console. From Figure 4.2, we deduce that today smartphone is a prevalent type of Internet-enabled device used to go online. So, we predict that the narrowed device divide between different social groups appears to be due to the widespread use of smartphones. Therefore, we specifically examine smartphone access gaps in Figure 4.7.

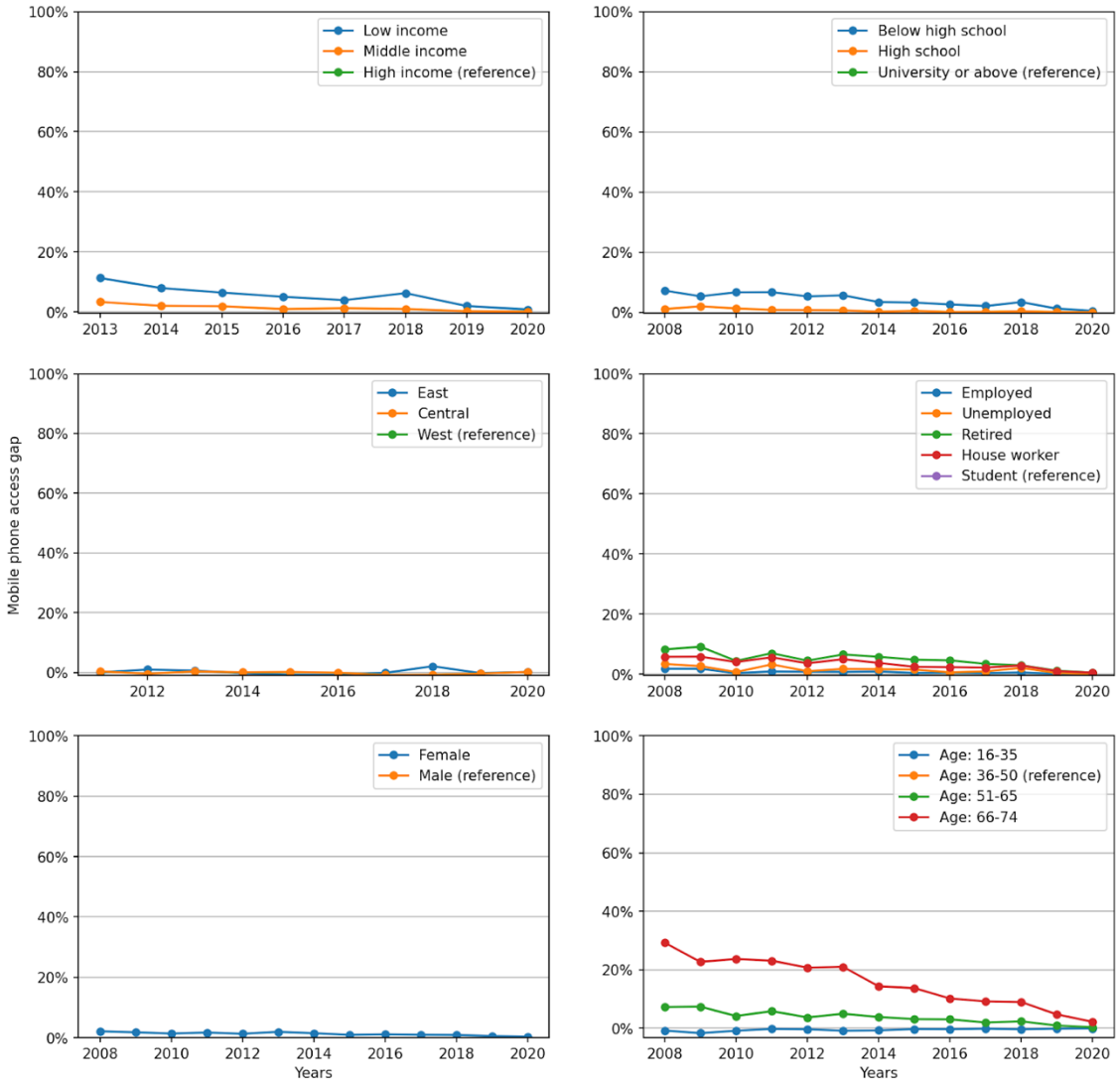

Figure 4.7 : Smartphone access gap.

In Figure 4.7, we see that smartphones are available to almost everyone, hence smartphone ownership can no longer be considered an indicator for the digital divide in Turkey in terms of device access. However, although smartphones are getting more powerful and functional each year, with larger screens, faster processors, and more memory and storage coupled with unlimited data plans offered more commonly by service providers and with relatively faster networks than before, they are still limited in convenience to perform some important and relatively more sophisticated tasks such as job applications and interviews, taking online courses, writing papers for school, etc. Furthermore, previous research shows smartphones are minority groups', such as

"younger, poorer and less educated users", only mean of Internet access and that their online activity over smartphones remains limited to social activities (Tsetsi and Rains, 2017). Given the evidence from the literature, I therefore find it important to analyze device divide in more detail. For such an analysis, we choose to particularly consider computers (such as desktops, laptops and tablets) because they offer a different Internet experience than that provided by smartphones, while at the same time, they can be considered a more imperative tool of today's social and professional life compared to other Internet-enabled devices like smart TV and game console. Figure 4.8 shows the evolution of computer access gaps between different social groups.

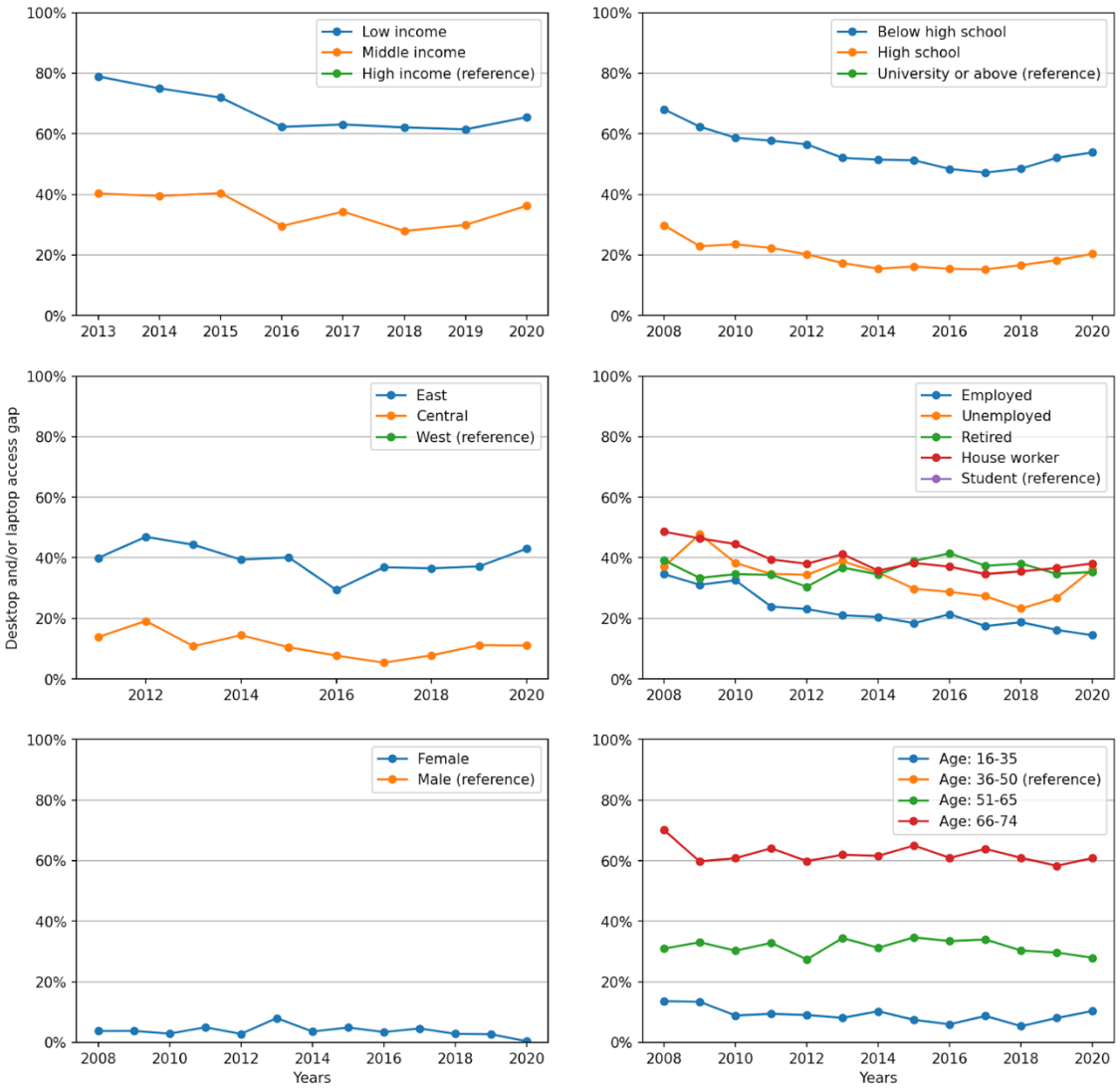

Figure 4.8 : Computer access gaps.

The evolution of the gaps and where the country stands with computer access divide is apparently not the same as with the smartphone access divide which has been nearly bridged. As Figure 4.8 clearly illustrates that the gaps over computer access persist, indicating that the majority of the population is indeed deprived of Internet activities that can be performed effectively solely on a reliable computer as they are the primary current prerequisite for performing certain activities. On the other hand, it is worth noting that although device availability has improved, devices are of limited use without a proper connection. Therefore, I extend the analysis in the following sections to assess the evolution of Internet access and Internet use in Turkey over the years.

4.6.3 Digital gap over Internet access

Internet access grows worldwide, and Turkey is no exception. Based on TurkStat data, I showed that internet penetration in Turkey has been an upward trend (see Section 4.4) such that today the share of the population who reported having an internet access has exceeded 90 percent. While this points to progress, the digital divide still persists among certain social groups.

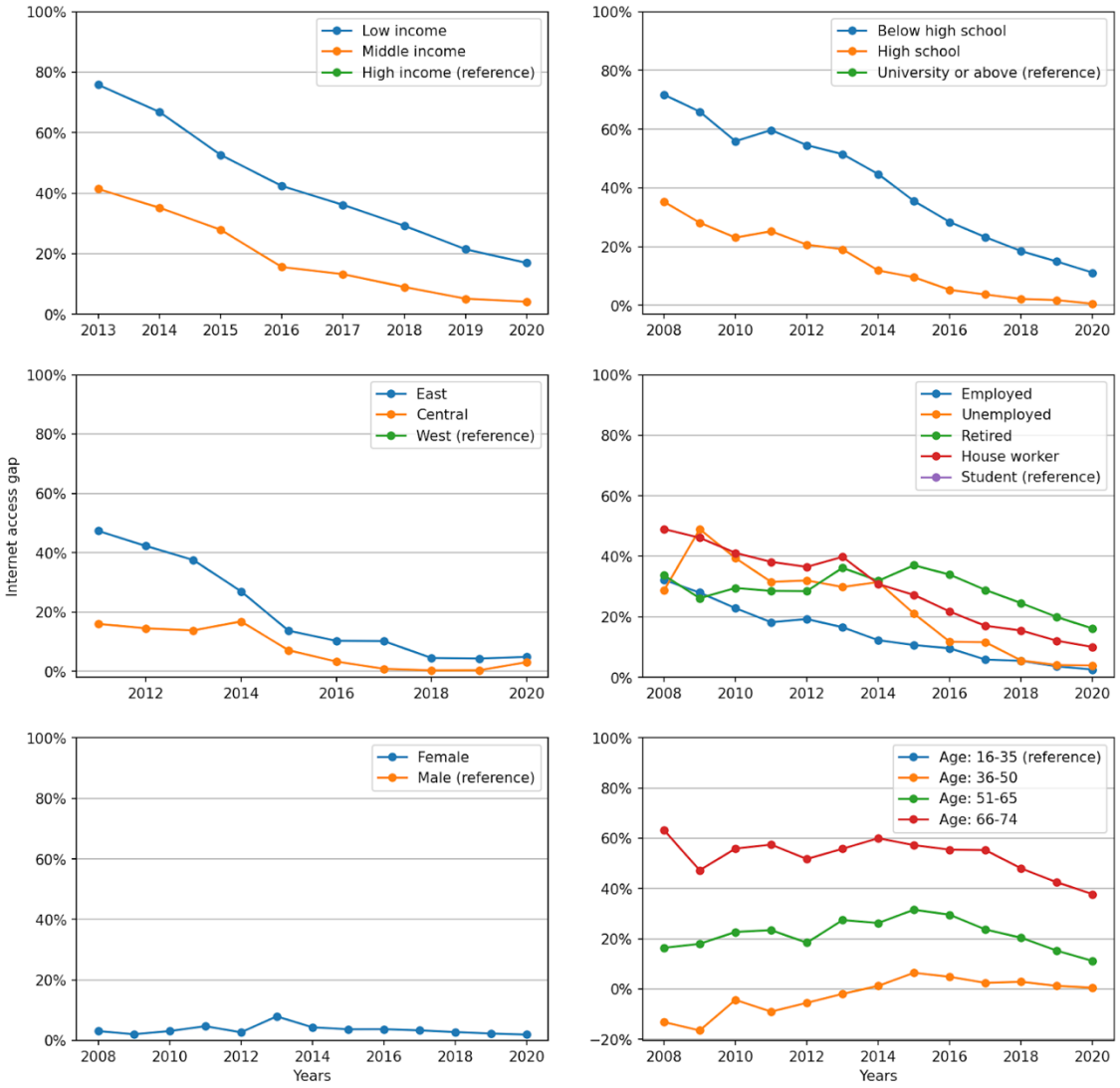

Figure 4.9 : The digital gap over Internet access.

Figure 4.9 illustrates the gaps observed in Internet access over the years concerning demographic and socioeconomic differences. The gaps are generally decreasing over time, insomuch that the gaps between some groups are nearly closed. For example, the gap between regions is considerably small towards the end of the period (2020) compared to 10 years ago. For different income and age groups, although the gaps have been substantial among the different categories earlier, today, only the second most advantageous categories, namely middle-income and middle-education categories, could catch up with the most advantageous categories whereas low-income and low-education, are still behind of others. On the other hand, older age groups have made much slower,

even stagnant, progress over the years. Despite the relative improvement in recent years, there is an almost 40 percent gap between the older and younger age groups in terms of Internet access. As for gender, there have often been small gaps between women and men, but they have always been unfavorable for women since 2008. Finally, for different employment statuses, homeworkers and retired have usually been at the margins among their group, yet homeworkers have made relatively better progress than the retired, who are now the least advantageous in terms of Internet access among other occupations.

4.6.4 Digital gap over Internet use

Access to an Internet connection is a necessary but not a sufficient condition for Internet use. It is therefore critical to analyze how the gaps over Internet use have progressed over time, given increased and improved Internet access and Internet use in general as well as narrowing gaps over Internet access.

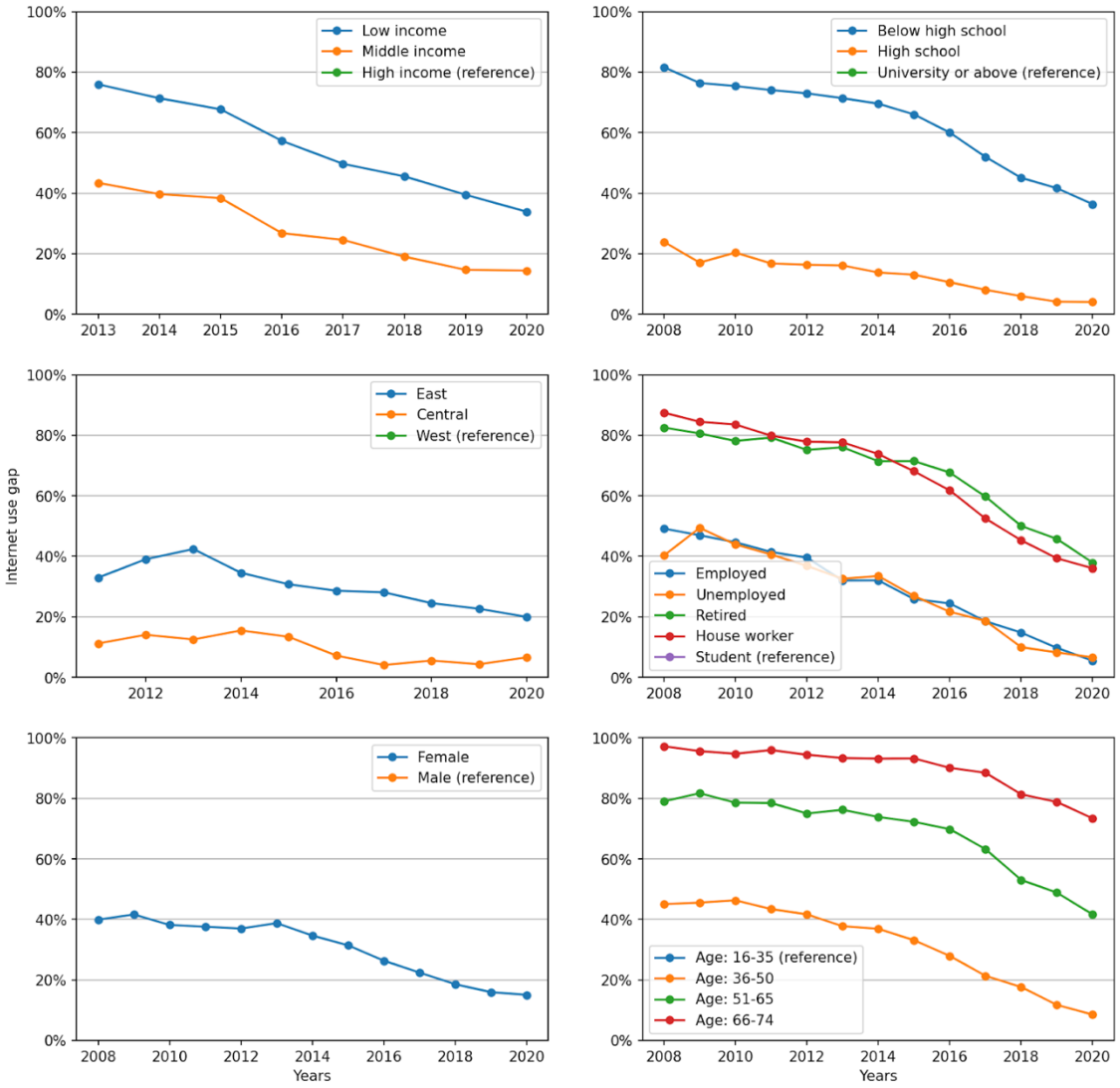

Figure 4.10 : Digital gap over internet use.

Figure 4.10 illustrates the evolution of digital gaps over Internet use and shows a more precise picture concerning the differences in Internet adoption in Turkey over the years. Although access divides have been mostly narrowed, high differences in usage remain for all social groups considered. Figure 4.10 presents a picture drastically different from Figure 4.9. Despite the overall increase in Internet access (Figure 4.1) and the decrease in access gaps for most social groups (Figure 4.8), in Figure 4.10, we see how terrible the usage gaps between certain groups still are. The increase in the number of individuals with Internet access has not been sufficient to close the digital divide. Despite a decline, especially in recent years, there is still a notable gap between the older and younger age

groups. Younger adults are usually more likely than their elders to be earlier adopters of innovation and digital technologies (Faverio, 2022), which explains the large gap of almost 100 percent in the initial year. However, the Internet adoption rate by those in the oldest age group, although it has been increasing for the last five years, is not at the desired pace to catch the younger adults up in a short time. A similar situation is also valid for education and income, particularly for those with the lowest education and income. In terms of regions, the gap between them appears to continue steadily. This might be due to region-specific factors like more rural areas where access to (high)connection is low or cultural dynamics that constrain certain social groups' linkage with the digital realm. In terms of occupational status, the gap between the students and employed and unemployed groups has been significantly narrowed. However, retired and homemakers still use the Internet much less than other employment groups. The gap indeed appears to need time to narrow if the adoption by these groups continues at similar rates. Our analysis regarding the gender gap in usage points to an interesting result. Unlike in the case of Internet access, the gender gap in terms of Internet usage, albeit has dropped compared to earlier persists – that is, female users are 20 percent less than men users despite having access opportunities alike. Moreover, the gender gap has barely improved since 2017, which is an indication of the presence of various barriers preventing a group of women from going online.

4.6.5 Adoption of internet services

The online activity types vary considerably among internet users (UNCTAD, 2021b). The online activities that people undertake are an indication of their ability to engage in activities that require more sophisticated digital skills, which can also be associated with their demographic and socioeconomic background. In Chapter 3, I regressed a selected group of internet activities namely, online communication, social media usage, online entertainment, online information-seeking, e-health, e-commerce, e-government, e-banking, and e-learning, on demographic and socioeconomic factors to test whether these factors significantly influence the type of internet service adopted. Based on 2020 data, the results demonstrate a significant relationship between age, gender, household income, education and region and online engagement. Before going into their relationship

between demographic and socioeconomic factors, I present the uptake of each internet activity over the years in Figure 4.11.

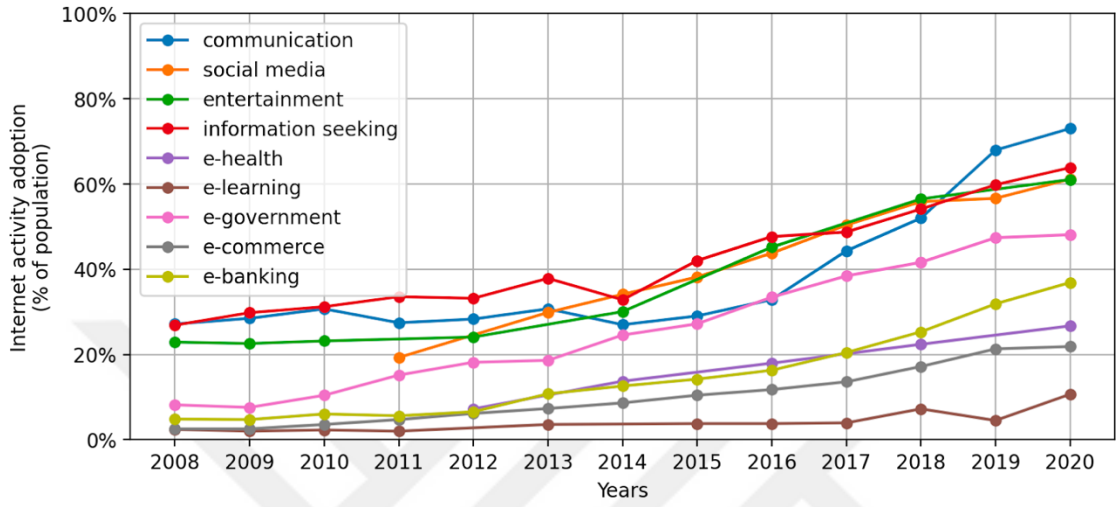

Figure 4.11 : The adoption of various internet activities.

The adoption of all nine online activities has increased over time. The rate of adoption, however, has been slower some services like e-learning, e-commerce and e-health compared to others. While e-government shows a more stable increase since earlier, e-banking has started to increase much rapidly in recent years. Additionally, we see a remarkable growth in the adoption of online communication. It is the most popular online activity since 2019 as voice over internet protocol (VoIP) has become more integrated into daily lives. There are three main reasons behind the rapid adoption of VoIP: first, given two endpoints are connected to the internet, the cost for communicating over VoIP is almost free or very cheap; second, they are useful because location is not an issue as long as an Internet connection is available, and they can be easily integrated with other services, enabling messaging, conference calls, file exchange, etc.; lastly, sophisticated digital skills are not actually required to use them. Nevertheless, it is commonly accepted that the use of a particular information and communication technology is determined by behavioral intention, which is jointly determined by the user's attitude toward using the system and perceived usefulness (Davis, 1989), meaning that usefulness have a greater correlation with technology adoption than do ease of use. The second most adopted online activity is online information seeking as the internet increasingly used to gain information

and understanding of a topic. The Internet has taken the role of books and libraries and has become the fastest way to acquire the greatest amount of information. Social media usage and online entertainment, which have been fueled by human impulse to communicate as well as sociological and commercial force since the launch of first social networking sites in the early 2000s, follow online information seeking.

To analyze the evolution of the adoption gaps of these internet services, I adopt a methodology similar to that employed by Pérez-Amaral et al. (2021). For each of the activities above, I measure the digital gaps according to demographic and socioeconomic characteristics and present the results in a set of graphs, clearly illustrating the evolution of gaps between different social groups over the adoption of each internet activity. The set of graphs in this section sheds light on the following research questions: How large are the gaps in each Internet services between different demographic and socioeconomic groups? Are the digital gaps for each Internet service have widened, narrowed or remained unchanged over time?

These two research questions lead us to analyze the gaps from two perspectives: first, for which of the Internet activities the gaps are still observed; second, which social groups are better or worse off in adopting various internet activities. The first perspective can be considered as a supply-side approach, focusing more on the evolution of the adoption of each activity in society while the latter perspective is more demand-centered, providing a more useful information as to the demographic and socioeconomic stratification of Internet use which is indeed a relevant issue for social science research. Bearing in mind that the network externality that the increased Internet adoption creates such that the usefulness of Internet use increases with each new adopter to the point where it has become not just useful but necessary (Büchi, 2017), the latter approach will expose the social groups which network externality of diverse Internet use become a disadvantage for. This is particularly an important issue considering that most information is exclusively online and numerous daily activities that have previously been carried out offline are now available as online services on the Internet.

I present a set of graphs in Appendix that show the evolution of gaps in adoption of each Internet service by different social groups. The analysis illustrated in Figures A1-A19 in

the Appendix demonstrate that social groups that are at the margins of society, e.g. low-income, low-education, women, elderly, can be considered novice Internet users such that they are on the disadvantageous side of the gaps for more sophisticated Internet activities such as e-government, e-banking, e-health and e-commerce.

Another important outcome of this analysis is that the gaps for most activities do not appear to be narrowing but rather widening (see Figures A3-A5 and Figures A8-A9). The number of people adopting a particular Internet service is continually increasing as shown in Figure 4.11. However, the non-adopters become further disadvantaged.

The following set of graphs (Figures 4.12-4.17) show how each demographic and socioeconomic group performs in various Internet service adoption. Also, I reorganized the graphs presented in the Appendix in a way to clearly illustrate how digital gaps evolve for each Internet service across all demographic and socioeconomic groups.

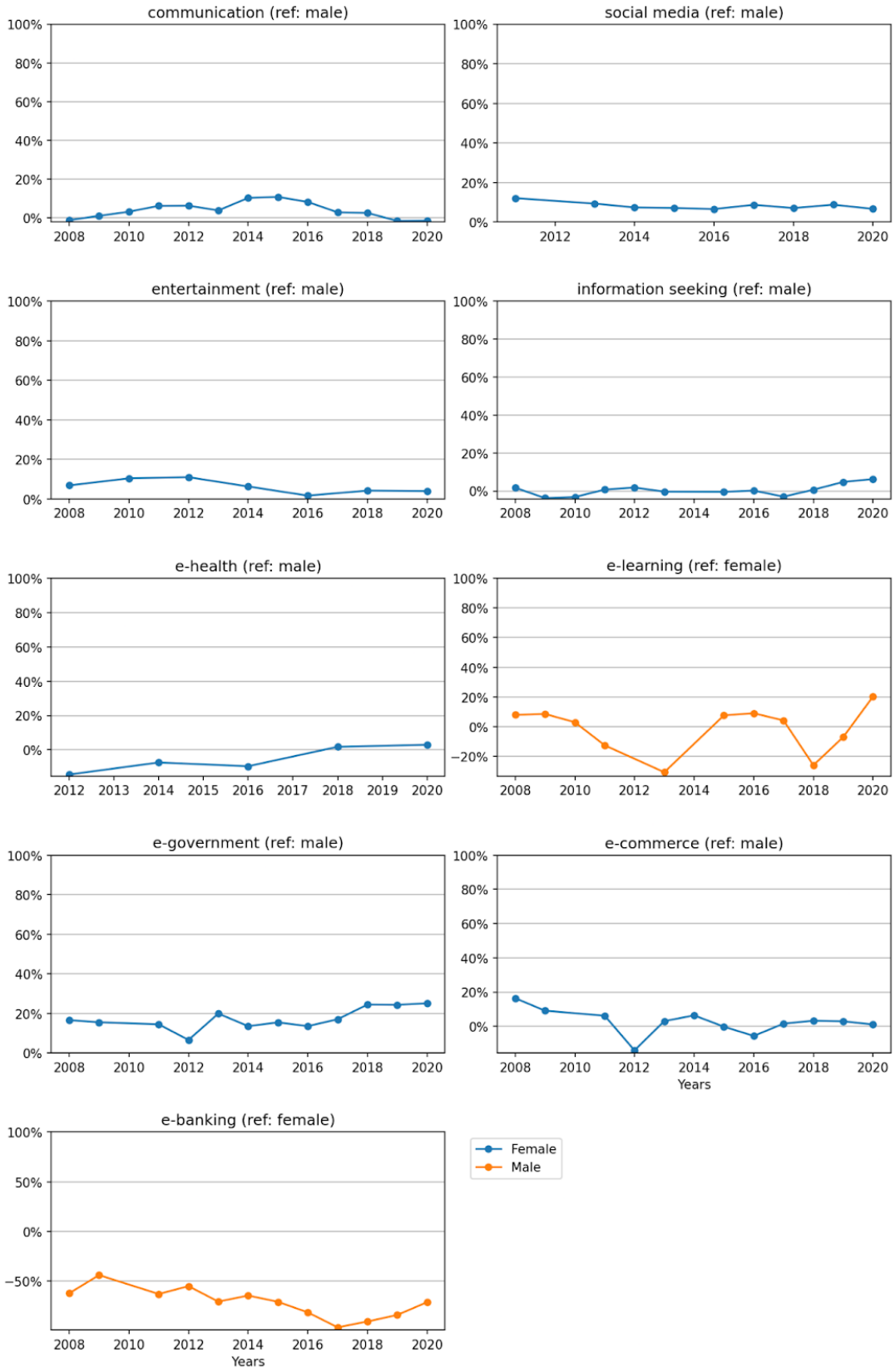

Figure 4.12 : Digital gap in adoption of Internet activities: Gender.

Figure 4.13 : Digital gap in adoption of Internet activities: Age.

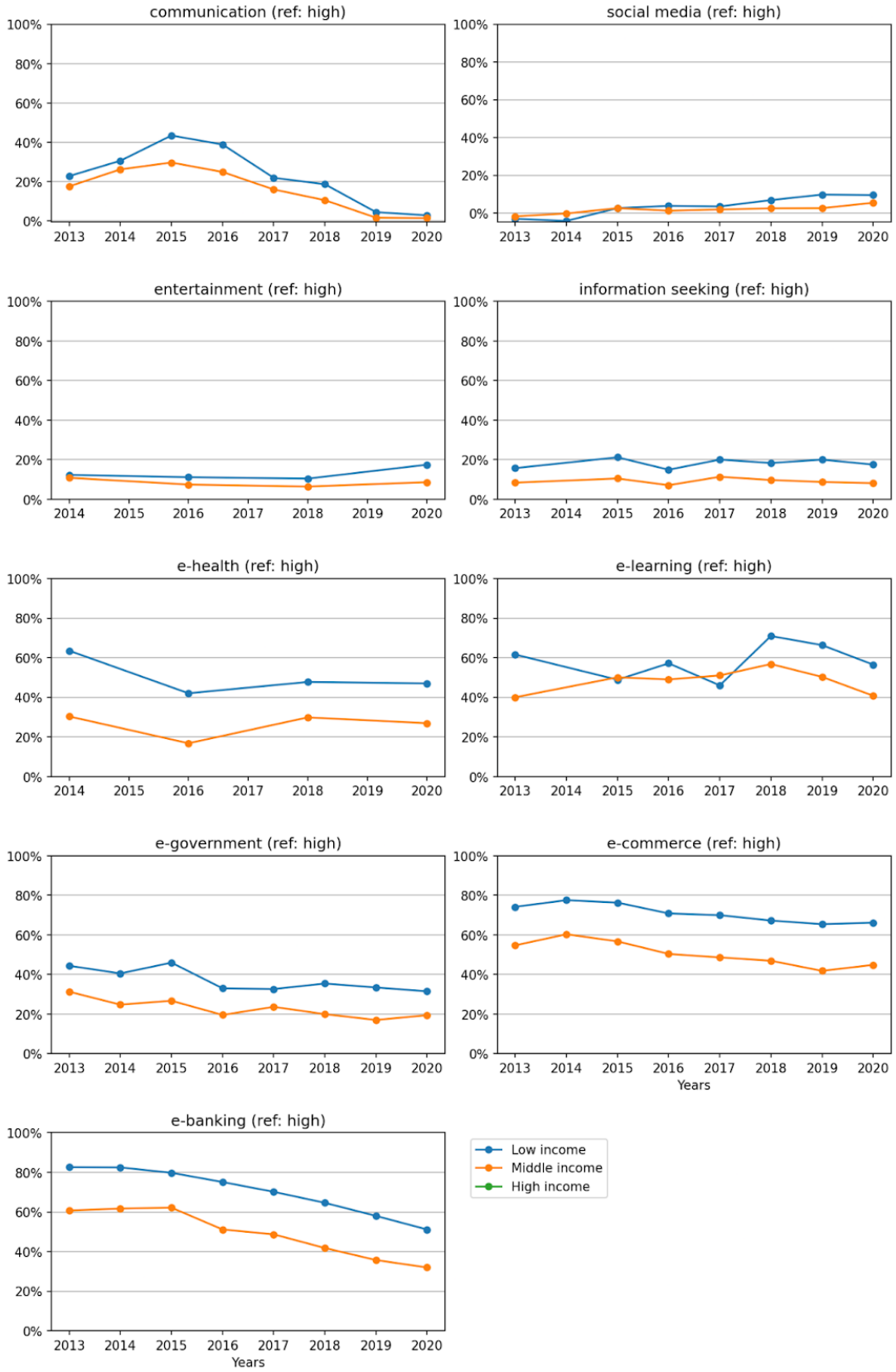

Figure 4.14 : Digital gap in adoption of Internet activities: Household income.

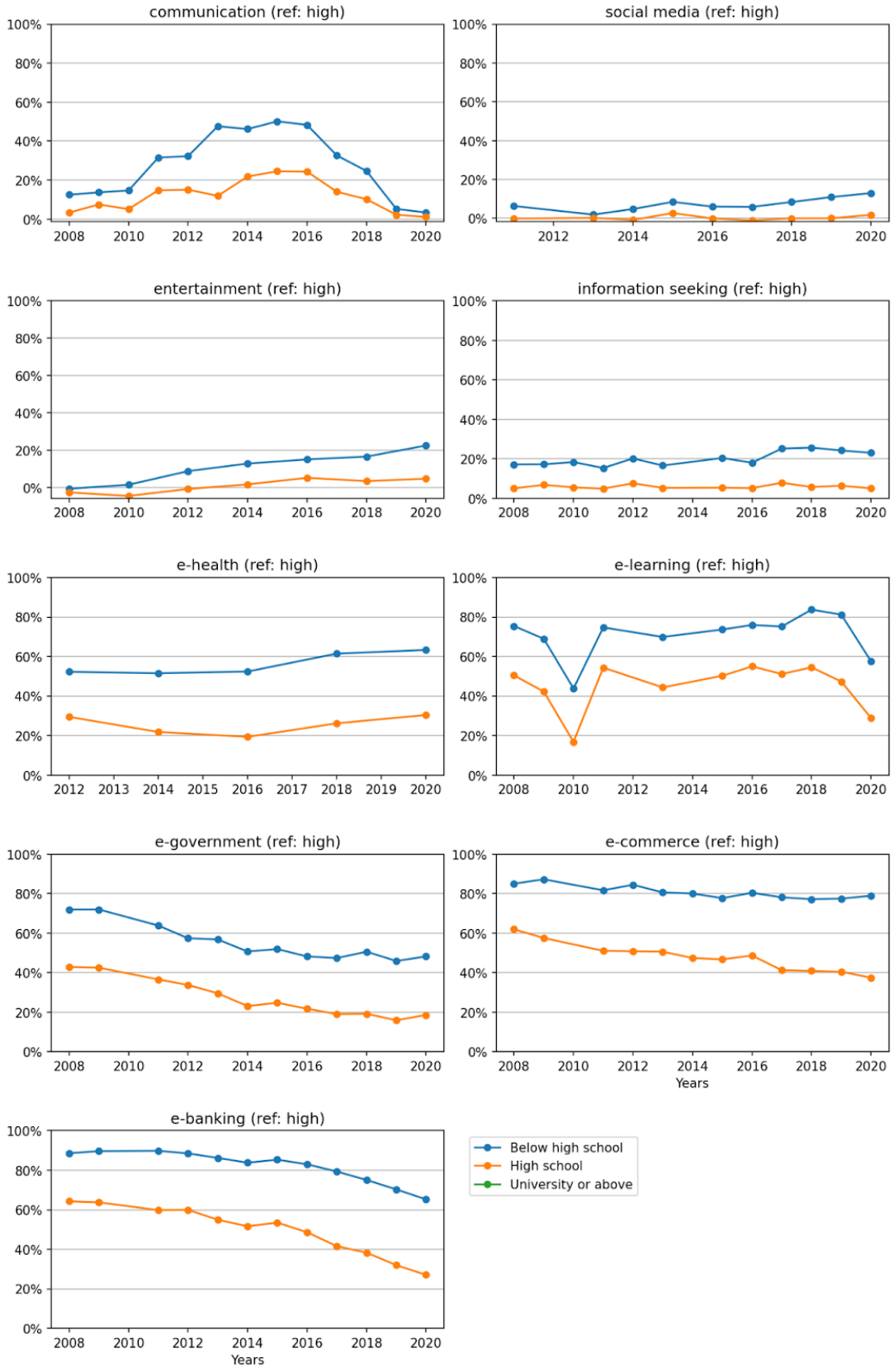

Figure 4.15 : Digital gap in adoption of Internet activities: Education.

Figure 4.16 : Digital gap in adoption of Internet activities: Employment.

Figure 4.17 : Digital gap in adoption of Internet activities: Region.

4.7 Conclusion

This chapter focuses on the digital gaps in Turkey for the period 2008-2020. For that, I investigate how the digital divide in Turkey has changed over time; particularly examine the change in digital gaps between different social groups over device access, internet access, internet use, and adoption of various internet activities with respect to years.

Unlike many other studies in the literature focusing solely on one variable or computing one gap per internet activity, in this chapter I try to convey a detailed analysis by taking as many variables as the survey data could provide into account at the same time as I try to allow for different aspects of the digital divide in order to adopt a more comprehensive approach which I will provide an accurate body of knowledge in the design of policies to address the digital divide in Turkey. In fact, the results offer policymakers the priority view towards the digital divide and allows for policy measures that are better targeted than more general policies during the country's digitalization process.

Closing the device divide is the first integral step to closing the digital divide. There is an increasing trend in device access, that is, the share of people with device access has increased so that the vast majority of the population now has a device that can connect to the internet. However, we know from Chapter 1 that the majority of the population are smartphone-only users. In this chapter, I show that smartphone ownership has increased at a faster rate compared to other internet-enabled devices. It appears that people in Turkey use smartphones as their primary means of online access. Although increase in the ownership of smartphone is a valuable progress towards digital divide, reliance on smartphones for online cannot perfectly aid in to mitigate the problem. The previous literature points to two critical conclusions: (i) smartphone-only users are likely to be those who are on the undesirable side of the digital divide (Tsetsi and Rains, 2017); (ii) although smartphones offer mobility, convenience, and more continuous Internet use (Mossberger et al., 2012), and location services, game playing, and video streaming (van Deursen and van Dijk, 2019), they allow limited online activities and limited capacity for professional purposes, while one can diversify their Internet experience by using different types of devices (van Deursen and van Dijk, 2019). Thus, these claims lead me to further analyze how gaps have progressed for another information device with a potential to offer

a different internet experience than that provided by smartphones. Therefore, I measured the gap over access to computers (desktop/laptop) which can be considered a relatively more imperative tool of today's social and professional life than other internet-enabled devices like smart TV and game console. The results demonstrate that despite the increased computer penetration over years, unlike smartphone access gaps, computer access gaps are still substantial. The socioeconomically disadvantaged groups have very low access rates compared to the advantaged groups. The results indicate that their Internet experience are limited to their capability to utilize what smartphones do offer them.

Internet access gaps have been narrowing over time, and in several cases they become small. There has never been a significantly large gap between women and men. In the case of regions, and income and education, their mid categories in particular, although large at the beginning, the gaps have ended up considerably small. The gaps concerning other social groups are also in a diminishing trend. Yet, the elderly, retired, and low income and low education people are still far behind in terms of internet access. The results point to the need for demand side programs intended to stimulate broadband adoption widely by those groups. The policymakers' attention should not remain exclusively on the supply side. Instead, they should pay increasing attention to demand side policies alongside supply side policies if greatly expanded adoption of broadband is the policy goal (Hauge and Prieger, 2010).

While device access and Internet access point to progress, the digital divide in terms of actual usage still persists between different social groups and regions. The lower levels of online engagement overall along with larger gaps in actual usage indicate lower and uneven digital participation in society. As illustrated in a set of Figures in this chapter, not all groups are homogenous and their digital engagement has been associated with their demographic and socioeconomic characteristics.

5. POTENTIAL POLICIES TOWARD DIGITAL EQUITY

5.1 Introduction

Internet access is a pathway to information, communication, and economic opportunities. It is increasingly necessary and becoming a requisite to access basic public and commercial services. It should be treated as a public service rather than as a luxury. For this reason, it is highly crucial for governments to ensure that all citizens have the necessary tools and opportunities for connectivity.

Ensuring that everyone has a meaningful internet connection, which is usually referred as "digital inclusion" is crucial for two main reasons: 1- digital equity is essential for digital empowerment, 2- the widespread use of ICTs has an impactful role on the realization of economic and social benefits from the digital transformation process. To elaborate a little more on these two main reasons, intensive use of ICTs in professional and personal lives would allow individuals to realize their potentials and improve their quality of life. Evenly distributed digital opportunities would diminish the socioeconomic gaps within society. Widespread and effective use of internet as well as other ICT tools in society would contribute to country's economic development. International organizations such as the United Nations, Organization for Economic Cooperation and Development, World Bank, European Union and International Telecommunication Union agree that ICTs are powerful tools for the delivery of essential services, offer greatest potential for disadvantaged groups' empowerment, contribute to enhanced government accountability and transparency, and help foster the social development of communities and countries. These organizations particularly point out the benefits that ICTs can bring are particularly crucial for the emerging economies. On the other hand, they identify digital divide as a major impediment to reaping the benefits of digitalization (ITU, 2020). Given the position of these organizations towards the issue, developing

countries as well as the countries that are in the dynamic phase of the (economic) development, should acknowledge the importance of the governmental and regulatory policies to address digitalization-related opportunities and challenges. Digital divide is one of the most critical issues that arises with evolving digital opportunities for such countries since these countries are already ranked lower in development indexes and show larger gaps in society in various social or economic categories within the countries.

Turkey is considered an emerging economy and its position requires particular attention in order not only to keep pace with its counterparts but also to catch up with the progress of developed countries. Therefore, Turkey should acknowledge and take advantage of its position to outperform on digitization process. For that, the country should realize a comprehensive policy which aligns digital strategies and commits them to a digital roadmap for sustainable growth. While doing this, it is extremely crucial to correctly detect the major issues that lie at the root of the problems for not scoring higher in the global development indexes. While addressing the digital divide in particular, policymakers should avoid imposing a single solution or overly prescriptive approaches, instead rely on nuanced, on-the-ground, evidence-based knowledge.

In the previous chapters, I showed that the digital divide in Turkey is a persistent issue that needs to be addressed from different angles. I identified the predictors of different levels of digital divide in Turkey by using scientific methods and proved that inequalities exist for certain groups in terms of Internet access and use. Although Internet access in Turkey has been on an upward trend and smartphones are nearly ubiquitous among society, in Chapter 2, I showed that the key demographic and socioeconomic factors such as age, education, income and region are still significant predictors of internet access. The elderly and those with lower household income or low level of education are significantly less likely to have Internet connection at home. Also, there are discrepancies with sharp regional differences between Istanbul, where the connectivity rate is the highest, and other regions. Even when Internet is available at home, the results show that some groups still not use it, at least effectively. The nonusers are predicted to be disproportionately female, older, less educated, people with low income, retired or homemaker, and those living in the eastern regions. When I analyze the interregional difference in particular, we observed that connectivity and usage appear to be differentiated in Turkey towards more

economically prosperous regions such that based on TurkStat (2019)'s report on the Gross Domestic Product (GDP) by Turkish provinces in 2018, the regions with higher connectivity and usage rates appear to be intertwined with the regions with higher GDP. In Chapter 3, I found similar gaps in level and scope of online engagement between these social groups such that the same disadvantageous groups are prone to undertake less tech-enhanced activities such as online information seeking or online entertainment activities, especially social media, which require less sophisticated digital skills.

There is no doubt that inequality has various unfavorable effects with multiple dimensions; it divides societies and undermines democracies, but, as Stiglitz (2015) rightly argues it is not inevitable as it is a result of policies and politics and there are such policies that can simultaneously reduce inequality, bridge societies' divides, and strengthen the economies (Stiglitz, 2015). Scientific research establishes an objective and a reliable source for policy-making. My aim is to further establish a baseline with the findings in this thesis for realization of improved policy frameworks by Turkish authorities. Hence, with this scientific study on digital divide in Turkey, I try to provide the essential and valuable knowledge for both scholars and policymakers. The analysis conducted in this study will provide a useful body of knowledge which can facilitate further academic research as well as debates and structural decisions among Turkish policy-makers and regulators. Furthermore, the findings would help the private sector, particularly those associated with digital sectors to anticipate and take action for human capital requirements and skills as well as for their potential consumers. The debate for Turkey has remained scientifically underdeveloped for so long. By drawing on the policy framework of digital divide in this final chapter along with scientific findings presented in the previous chapters, this thesis can serve as a guideline to policy-makers.

In this chapter, I analyze and discuss how should Turkish government use their policy and regulatory powers to address the digital divide in Turkey. By taking the findings of the previous chapters about the predictors of first and second levels of digital divide as well as the evolution of digital divide in Turkey into consideration, I focus on some policy measures which would be effective in addressing the issue in the Turkish context. These policy measures are especially critical for Turkey as an emerging economy and a country with an aim to become a focal point in "the production of science and technology that

uses ICTs as an effective tool, that produces more value with information-based decision-making process and that it is successful in global competition, with a high level of welfare", as stated in the e-Tranformation Turkey Project, 2006. With this general framing in mind, I develop a conceptual framework that encapsulates various policy measures that are applicable to the case of Turkey. The conceptual framework outlines five main policy areas based on the findings of the previous chapters: (i) infrastructure, (ii) inclusivity, (iii) institutions, (iv) market structure, and (v) digital competency. It is worth noting that the usefulness of these policies could be enhanced by the availability of coherent information on socio-demographics that are based on reliable estimation models as provided in the previous chapters of this thesis.

In this final chapter, I first revisit the past and present policies of Turkey which involve initiatives that are aimed to improve the national connectivity as well as to contribute to the digital transformation of the country. I discuss whether and to what extent these policies are efficacious in addressing the digital divide. Then, I present the conceptual framework which involves five main policies. Finally, I present policy recommendations along this conceptual framework.

5.2 Turkey's Initiatives for National Connectivity

Setting out a vision for widespread access to and effective use of ICTs, bringing more government services online, modernizing the operations of bureaucracies, smoothing the digital process of public administration, easing the online education for students and educators, promoting a more competitive IT sector and improving research and development activities are among essential strategies to be included within the digital roadmap of any country. Tremendous technological leaps are being made; however, the economic and social benefits remain relatively limited. Digital technology is advancing at an incredibly rapid pace all over the world, but it is not possessed evenly. Digital divides have been particularly salient in least developed and developing countries. Therefore, at this critical juncture, it is especially crucial for those countries to adopt the inclusive, strategic policies in the age of digital transformation.

Liberalization in the Turkish telecom sector began with a concession agreement signed with two GSM operators in 1998. The Telecommunications Authority, responsible for regulating and monitoring the telecommunications market, was founded in 2000; it was renamed the Information and Communications Technologies Authority (ICTA) in 2008 by the adoption of the Electronic Communication Act. These reforms had indeed significant economic implications on the internet and broadband market as the number of xDSL (Digital Subscriber Lines) subscribers immensely increased in time. However, according to Alliance for Affordable Internet's (A4AI, 2020) Report on Turkey, the telecommunications sectors experienced important challenges also during this time due to lack of competition in the telecommunications market, the rising dominance of mobile over fixed connectivity, and the emergence of over-the-top (OTT) services. Despite the time of great challenges, Turkish government recognized the opportunity to reset its agenda with a new national broadband plan and expedite internet connectivity and affordability for users. Although several policies, which will be discussed in the following sections, have been initiated since then, the empirical findings of this study show that there are a lot needs to be done to address the issues related to connectivity and affordability which constitute four main policy areas (i) infrastructure, (ii) inclusivity, (iii) institutions, (iv) market structure, and (v) digital competency.

In this section, I revisit the past and present policies of Turkey which involve initiatives that are aimed to improve the national connectivity as well as to contribute to the digital transformation of the country. This section will demonstrate a general framework in terms of shortcoming and possibilities to be able to make policy recommendations in the following sections.

5.2.1 WiMax

WiMax (Worldwide Interoperability for Microwave Access) is a broadband wireless access technology that supports fixed, portable and mobile access; point to point, point-to-multipoint and multipoint-to-multipoint applications, with or without line of sight, can carry and distribute data at 75 Mb/s speed within a coverage area of 50 kilometers with service quality and security requirements. The smallest scale network is personal area network PAN (personal area network), which allows devices to communicate with each

other over short distances, such as Bluetooth and Zigbie. A further step forward in terms of network scale is the local area network (LAN). The best known of the LAN is Wi-Fi. WiMax is the next step as the metropolitan area network (MAN). WiMax and 3N networks serve different customers with different applications and technologies that complement each other. Mobile WiMax is a technology that can compete with mobile data networks. These networks are emerging as a technology that has the potential to complement or replace the wireless broadband access provided by cellular networks (BTK, 2009).

WiMax' capacity promises a wireless access range up to 50 kilometers while Wi-Fi, which is a wireless access technology closest to WiMax with respect to service features, and Bluetooth connections can provide 100 meters and 15 meters, respectively. WiMax holds the promise of delivering broadband to underserved areas and to a broader customer base. Another advantage of WiMax is its potential lower cost owing to its IP architecture. Establishing WiMax extensively would eliminate cable and cabling labor and personnel costs that were required in physical infrastructure.

The Telecommunications Authority started to auction of licenses to build WiMax networks in only 2009, lagging behind of other countries in the enforcement of a technology which could have brought advancements in ICT use, could have been used to connect rural and remote parts of Turkey, and could have helped Turkey's overall connectivity by reducing congestion on existing wireless networks long before. Nevertheless, since then Turkey has been able to benefit from advantages of this technology as it offers a cost effective, easy to deploy and a high-performance broadband solution for the country. WiMax has also enabled competition in the broadband market and therefore reduced associated costs to the consumer. By continuing to install fiber optic networks all over the country and to be an inter-exchange point between countries of the region, as stated in its National Broadband and Action Plan, Turkey aims to reach 100 percent of household penetration with fiber and extend broadband wireless access infrastructure (LTE, 4G, WiMax) across the country.

5.2.2 e-Transformation Turkey Project

In June 2001, Turkey joined in eEurope+ Initiative, alongside other European Union (EU) candidate countries. eTransformation Turkey Project was initiated as a part of Turkey's pledge to join the EU in 2003. At first, the State Planning Organization as it was then called, then the Ministry of Development was the responsible institution for this project. The three main goals of this project were to implement EU technology-transformation initiatives, to achieve efficiency and effectiveness in e-government projects, coordination and alignment with EU in ICT and information society activities. In line with these goals, the main objectives of the project were to review the policies, laws and regulations regarding ICT and revise and update them, if necessary, with respect to eEurope+ Action Plan, increase and spread the use of ICT, enhance the e-government services, coordinate, monitor, consolidate and guide public IT projects and private firms according to the principles of the project. In order to speed up the progress and make it more effective, a separate division, Information Society Department has been established to serve as a coordination unit of the project. Information Society Strategy and Action Plan was set out under the project. The plan has sought to streamline organizational structures within government and to use the internet as a medium between citizens and government. There were seven strategic priority areas: (i) social transformation, (ii) ICT adoption by businesses, (iii) citizen oriented public service, (iv) modernization of public management, (v) globally competitive IT sector, (vi) competitive, widespread and affordable telecom infrastructure and services, and (vii) R&D and innovation in ICT. The table below shows the objectives and some of the key actions for each of the strategic priority areas:

Table 5.1 : The objectives and some of the key actions for the strategic priority areas under Information Society Strategy of e-Transformation Turkey Project.

Strategic Priority Area	Objectives	Key Actions
Social Transformation	▪ Widespread access ▪ Focused competency ▪ High motivation and rich content	▪ IT infrastructure in schools ▪ Public Internet Access Points ▪ Computer ownership and internet access ▪ ICT Literacy & Competency Development Programs ▪ Internet security and content development
ICT Adoption by Businesses	▪ Facilitating business transactions with the government ▪ Providing easier access to information ▪ Developing the ICT competency of enterprises and employees ▪ Developing e-commerce	▪ Supports for ICT infrastructure and competency ▪ e-Learning based sectoral vocational training ▪ e-Commerce security infrastructure ▪ Online company registry and environmental permits ▪ Investment information portal for FDI
Citizen Oriented Public Service	▪ Citizen focused approach ▪ Service transformation ▪ Communication management e-Government in the Strategy ▪ e-Government applications	▪ Health Information System ▪ Education and Information Portal ▪ e-ID Card ▪ Address registry
Modernization of Public Management	▪ Shared Technology Services and Infrastructure ▪ Effective Procurement Management ▪ Data and Information Management ▪ Electronic Communication ▪ Human Resources and Competency Development ▪ Security and Privacy of Personal Information	▪ Dissemination of e-Government Gateway Services ▪ Usage of Open-Source Software in Public Institutions ▪ Shared technology and services (e-Government Gateway, call center, secure government intranet, etc.) ▪ ICT project implementation and competency development in public institutions

Table 5.1 (continued) : The objectives and some of the key actions for the strategic priority areas under Information Society Strategy of e-Transformation Turkey Project.

Strategic Priority Area	Objectives	Key Actions
Competitive IT Sector	▪ Development of human resources ▪ Sector organization ▪ Developing sector competencies ▪ Increasing exports ▪ Fostering demand for IT	▪ Programs for development of IT workforce and academicians ▪ Establishment of ICT Sector Union ▪ Informatics Valley ▪ Promotion of software quality certifications ▪ Regulations for effectiveness in Public IT Procurement
Communication Infrastructure and Services	▪ Creating a competitive environment in the telecommunication sector ▪ Tax arrangements in communication services ▪ Developing and expanding communication infrastructure	▪ Strengthening of competition in infrastructure and services ▪ Tax reduction for data and internet services
R&D and Innovation	▪ Development of research capacity ▪ Improvement of university industry cooperation ▪ Increase the competitive power, R&D and Innovation spending of private sector	▪ Support of Innovation in ICT ▪ Academic career criteria and R&D

Source: Author's compilation from State Planning Organization, Information Society Department, E-transformation Turkey Project and e-government in Turkey, 2010.

E-transformation Turkey Projet has been successful in setting out the objectives and policies that should be achieved in the transformation of Turkey into an information society. It has been also effective in determining the methods that must be followed and identifying the tools and resources required to achieve these goals. This project has provided an opportunity for policymakers to reexamine the ICT policies and legistaltion within the framework of the EU acquis and to adopt good governance principles to contribute maxiumum use of ICTs and to disseminate the use of ICT within the society through the projects conducted, Also, the Information Society Strategy highlighted the

importance of the use of ICT in schools in a way that supports the curriculum and improves digital skills, and generates relevant content for lifelong education purposes.

5.2.3 Universal service funds

An increasing number of emerging countries are addressing the digital divide with the help of universal service funds (USFs). USFs were initially established to ensure that basic telephone equipment and services are widely available. The funds are now being utilized to support ICT/broadband programs, such as access to digital devices and broadband internet. The universal service has become part of the Turkish regulatory framework in early 2000s as part of the liberalization of the telecommunications markets. It has been financed from the budget and remained under the authority of the Ministry as well as financed by the ICTA as being the biggest contributor and the fixed-line and mobile operators (Oguz, 2013). The initial project was to provide broadband access (ADSL and VSAT technology) to schools and funded access for 40,000 public schools. In 2010, the Turkish government announced plans to equip rural areas with mobile broadband connection. The goal was to use WiMax technology to cover 2,500 villages and 3G technology to cover 2,000 rural zones with less than 500 inhabitants (UN ESCAP, 2017). The establishment of the USF allowed Turkey to quickly expand broadband services to every public school in the country, as well as improve public Internet access and usage through community Internet centers. In fact, many developed and emerging countries recognized universal service funds as the most efficient and sustainable source of funding. However, UN ESCAP (2020) reports that despite the deployment of USF-led projects, the digital divide between rural and urban areas has generally widened possibly due to faster Internet and broadband adoption in urban areas in some countries. Based on the data Urhan and Kizilca (2011), UN ESCAP (2017) reports that in Turkey, the percentage point difference between the shares of households using the Internet in rural and urban areas increased from 17.9 to 29.4 between 2008 and 2013. There is a limited number research examining the outcomes of USF-led projects. I discuss about how the policies should be designed so that the funds can actually be utilized to address the digital divide in Section 5.4.1 and Section 5.4.2.

5.2.4 Fatih Project in education

Equipping schools and other educational institutions with ICTs, a tendency which has long been popular in Turkey. Various projects have been carried out to provide schools with computer hardware and interactive education technologies. The Basic Education Project (Temel Eğitim Projesi) supported by the World Bank between 1998 and 2004 is an example to these projects, aiming to increase the quality of education by providing computer laboratories and educational materials to schools.[10] Although some classrooms were equipped with computer hardware, the World Bank also emphasizes the fact that computer software provided to schools was still insufficient and that the IT trainers are limited to teaching very basic computer skills.

The FATİH Project in Education[11] was established with the goal of ensuring equal opportunities in education and enhancing technology in schools by incorporating more senses into the educational process. The project was founded on five major success principles: (i) accessibility: offering service anywhere regardless of time and tools, (ii) productivity: providing target-oriented and more productive environments and subjects for development, (iii) equality: enabling all users to access the best service, (iv) measurability: providing accurate measurements of the process and results and providing feedback accordingly for better assessment of the development, and (v) quality: enhancing the quality of education in a measurable way. The goals are to provide equal opportunities, close the digital divide, and improve quality by implementing solutions that addresses all success factors. The project will fund VPN-broadband internet access and the necessary infrastructure for every school, interactive board and wired/wireless internet access for every classroom, EBA (Eğitim Bilişim Ağı/Education Information Network) applications which is a digital education system of the Ministry of National Education of Republic of Turkey, cloud account, online platforms for sharing course

[10] More information about the World Bank's Basic Education Project is available at https://projects.worldbank.org/en/projects-operations/project-detail/P009089

[11] The projects acronymic title stands for Firsatlari Artirma ve Teknolojiyi Iyilestirme Platformu, meaning Movement to Increase Opportunities and Technology in English, and recalls the conqueror of Istanbul, Fatif Sultan Mehmet as a symbol for opening a new era. A detailed information about the Fatih Project is available at http://fatihprojesi.meb.gov.tr/en/about.html

notes for every teacher, and EBA applications, cloud account, digital identity, online platforms for sharing homework, individual learning materials for every student.

The FATİH project was announced to the public in 2010. One of the most vital functions of education, increasing "opportunity equality", was highlighted as a justification of initiating the Project. However, due to issues related to project's design as well as some insufficiently prepared applications, this function could not be executed effectively. The Education Reform Initiative/Egitim Reformu Girisimi attributes this result to too ambitious goals, the necessity of some of which was controversial at that time, of the project. The Initiative even criticized Project's main actions which distributing tablets to each student in the first place and increasing the number of smart classes at a rapid pace without allowing a chance for students and teacher to adapt to change. Both students and teachers need to be supported to be able to adopt new and innovative practices. Furthermore, the mere presence of technology would be inadequate to improve school-level outcomes and to mitigate the digital divide. There is a huge demand for useful, relevant, high-quality digital teaching and learning materials after every student equipped with a tablet, schools get connected, and classrooms are equipped with interactive projection devices (Trucano, 2013). The project also disregards the significance of out-of-school use of technology.

The online education platform, EBA, which is a component of the FATİH project, was first released in 2012. The objective of EBA is to enable the use of ICTs at school, at home, wherever it is needed, and to support effective use of materials, to integrate technology into education, provide reliable and accurate e-content to the students and teachers. EBA was little publicized before the COVID-19 pandemic. The importance of the effective online education was realized, and the structural deficiencies of the system were revealed when the country had to undergo distance learning experience. Personal learning environments, individual study materials, online courses, synchronous publications, forums, and e-seminars provided by EBA should therefore be regarded as a tool rather than a goal.

5.2.5 Safe schooling and distance education project

As the Internet-based schooling is no longer an option but a requirement, the Ministry of National Education is working to improve and scale up existing education technology tolls. However, with the COVID-19 crisis started in 2020 in the country, limited access opportunities, inadequate distance education guidance and instructional methods for teachers, quality assurance mechanisms, and a school-wide approach clarifying the on-line learning support positions across school principals, teachers, parents, and students became imminent. Safe Schooling and Distance Education (SSDE) Project supports the immediate education response to the COVID-19 outbreak while also laying the groundwork for crucial investments in education human capital preservation over the medium term and in the face of future shocks. It reinforces the Turkish government's attempts to use distance learning for school-aged children to alleviate escalating pressures on education service delivery. SSDE Project design includes three interrelated components addressing emergency response, transition and education system recovery: (i) Emergency Connectivity and IT Infrastructure for Education in Emergencies; (ii) Digital Content for Safety and Quality; and (iii) Institutional Capacity for Education Technology Resilience.[12]

5.2.6 Digital Turkey Project

Digital Turkey Project, which involves online government (e-Government) services, continues to serve over 45 million registered users as of January 2019. The project provides digital solutions to ensure that the services rendered to the citizens are delivered in a high-quality, fast, uninterrupted and secure manner. The goal is to increase the number of high value-added services and make them available for everyone. Preparing user-friendly interfaces are also planned to allow people to use Digital Turkey easily.[13] In relation to this, TekDurak (OnlyStop) Service Point Project has been launched to improve service delivery channels and increase variety, facilitating the citizens' access to public services, particularly in relation to the disadvantaged sections of the society. The

[12] For more information SSDE project, http://yegitek.meb.gov.tr/www/turkiye-guvenli-okullasma-ve-uzaktan-egitim-ssde-projesi/icerik/3050%20accessed%20on%20March%2023, accessed on 23.03.2021.
[13] For more information on Digital Turkey Project, https://cbddo.gov.tr/en/project/project/dijital-turkiye-v1.0/, accessed on 23.03.2021.

work on project is still in progress to ensure equal access to public services for all individuals.[14]

5.3 Turkey's National Broadband Strategy and Action Plan

Turkey's National Broadband Strategy and Action Plan for 2017-2020 was announced with the ultimate goal as being "broadband to everyone, anywhere". The main targets for 2023 are listed as (i) providing broadband service at least 100 Mbps to each household, which is built on the Digital Agenda for Europe 2020 targets for 2025 within the framework of the European Gigabit Society, (ii) developing the infrastructure to carry fixed and mobile broadband Internet, and (iii) increasing the internet usage rate of the population between the ages 16-74 above 80 percent (European Commission, 2016a). Following these main targets, the Plan's aims include, but not limited to, the following actions: (i) improving access to fiber technologies and capacity and speed of internet connections, (ii) progressing in line with market competition principles and market requirements, execution of 5G research and development activities, making broadband common and increasing the demand for internet services and (iii) making internet services and applications widespread and common. If successfully fulfilled, these ambitious goals can also help address the digital divide. Nevertheless, it is worth highlighting that the most effective broadband policies essentially provide the public and private sectors with clear guidance and a concrete roadmap to sector enhancement. The Plans should be designated transparent and clear to support network development and expand internet access across the country and to greater number of people (A4AI, 2018).

The establishment of the Digital Transformation Office (DTO), along with the National Broadband Strategy and Action Plan, under the Presidency in July 2018 is therefore of great importance in the digitization process of Turkey. The DTO has a critical role in catching up on the contemporary developments, taking rapid decisions and effective actions, and building a capacity to produce innovative technological solutions as well as in ensuring a digitally inclusive society. The Office oversees digitizing and managing

[14] For more information on TekDurak (OnlyStop) Service Point Project, https://cbddo.gov.tr/en/project-description/4563/tekdurak, accessed on 23.032021.

various government services and is tasked with improving the accessibility and availability of these services. The Office can certainly enhance the ICT infrastructure and contribute to the internal capabilities to support automation and integration if supported with concrete policies and sufficiently subsidized. For that, it should follow the enablers to keep up-to-date about technological trends and innovative developments, jointly validating with the industry, as well as rapidly deploying to customers. It can assist in the reorganization of business services so that they become more proactive, while also capturing opportunities on how businesses can trigger individuals' demand in collaboration with potential business partners, for example, through social media or newly emerging online platforms. The Office should implement policies as though it will create a transformational change, rather than incremental kind of change, in ICT access and use, highly flounced by innovation and digital dynamics. By harnessing disruption, transformation and innovation, DTO should bring the strategies into life.

The digital transformation has a self-contradictory nature that can also exacerbate the digital divide. While the country is undergoing digital transformation and morphing into more innovative and technologically advanced organizations and systems, given the relationship between social connectivity and digital connectivity (Chen, 2013), the disadvantaged groups of the population would become more vulnerable to remain socially and digitally excluded. Digital transformation is more challenging for developing countries that have already lagged behind in this process.[15]

"Digital Transformation Roadmap of Turkey" includes strategies to achieve short-, medium- and long-term goals, and policies that will help to accelerate the country's

[15] According to IMD World Digital Competitiveness (WDC) Ranking 2020 by IMD World Competitiveness Center, Turkey ranks 44 out of 63 economies covered by the World Competitiveness Yearbook published annually by International Institute for Management Development (IMD). The IMD "WDC ranking analyzes and ranks the extent to which countries adopt and explore digital technologies leading to transformation in government practices, business models and society in general. The ranking defines digital competitiveness into three main factors each with three sub-factors: knowledge (talent, training and education), technology (regulatory framework, capital and technological framework) and future readiness (adaptive attitudes, business agility and IT integration)". Turkey is one of the countries with largest improvements, moving from 52nd in 2019 to 44th in 2020. The report notes that "the move originates from improvements in future readiness, particularly in adaptive attitudes (e.g., rise in e-participation) and business agility (e.g., private sector's use of big data and analytics)". https://www.imd.org/wcc/world-competitiveness-center-rankings/world-digital-competitiveness-rankings-2020/, accessed on 25.03.2021.

digital transformation. Short-term goals (1-2 years) are aiming to take actions that will ensure rapid progress in the field of production and to create an intellectual and physical infrastructure that will contribute to the digital transformation process. Medium-term goals (3-5 years) are aiming to close the gap with other countries with more robust improvements in digitization. Long-term goals (6-10 years) are aiming to become a regional and global leader country in selected areas of technology. Given these objectives, it is seen that every study that aims to contribute to the digital transformation literature would support the short-term goals. Every work carried out in line with short-term goals would contribute to the implementation of right strategies and hence to the long-term goals. There are seven criteria and 18 strategies in the report. By using TOPSIS method[16], which is a multi-criteria decision analysis method, Saçak, Gür and Eren (2020) identified "providing educators with digital competencies" as the most important strategy. According to the findings obtained in this study, the human factor is very important in the digitalization process. Thus, the digital transformation must be addressed from the ground up, and by focusing primarily on digital skills and competences. However, "Digital Transformation of Turkey" report only mentions the need for digital skills improvement on a rudimentary level, and only in response to European Commission's "New Skills Agenda for Europe" (European Commission, 2016b), which sets strategic objectives to be achieved by 2025 based on well-established quantitative objectives and asks Member States to develop national digital skills strategies.

In July 2020, the Commission launched the new "European Skills Agenda" for the coming five years. The Agenda defines actions for upskilling (improving existing skills) and reskilling (training in new skills) for sustainable competitiveness, social fairness and resilience. As a candidate country, Turkey, should make a good analysis of the current situation in regards to digital divide and produce concrete policies so that it could effectively respond to serve this Agenda. The Turkish government should be tasked with implementing government initiatives towards bridging the digital divide. It is especially critical for Turkey, an emerging economy with an aim to become a focal point in "the

[16] TOPSIS is abbreviation for Technique for Order of Preference by Similarity to Ideal Solution. The method compares a set of alternatives based on a pre-specified criterion. It is one of the methods mostly used to make an analytical decision based on a collected data.

production of science and technology that uses ICTs as an effective tool, that produces more value with information-based decision-making process and that it is successful in global competition, with a high level of welfare" (e-Transformation Turkey Project, 2006). For this, policymakers should comprehensively assess the current situation in Turkey in terms of ICT access and use, as well as the speed and quality of the connection, disparities in digital skills, the degree of utilization from ICTs, and strike a balance between interconnected issues (digitalization vs. digital divide) to be addressed when keeping up with digital transformation.

5.4 Policy Recommendations

The public policy should endeavor to make sure that the ICTs are distributed equally among the society. Only then, it would be possible to transform the use of ICTs into economic and social benefits. Intensive use of ICTs in professional and personal lives can allow individuals to realize their potentials and improve their quality of life. Scientific research on Internet access and use establishes a baseline of realization for a fundamental policy objective. The analysis conducted in this study provides a useful body of knowledge which can facilitate further academic research as well as debates and structural decisions among policy-makers and regulators. Furthermore, the findings would help the private sector, particularly those associated with digital sectors to anticipate and act for human capital requirements and skills as well as for their potential consumers. As the debate for Turkey remains scientifically underdeveloped, this is of more importance.

Improved inter-institutional coordination, information-based effective decision-making processes, competent human capital and improved organizational capacity, modernized education, and integrated and effective e-government system are essential measures to be taken towards meaningful digital transformation and sustainable growth. These can all be accomplished by taking advantage of the ICTs; however, these require more spending on physical infrastructure and the creation of human capital that can use these technologies effectively. "Soft-intervention strategies" that involve i.e. financial incentives for users, educating and encouraging people in the use of new technologies, are some of the effective initiatives to increase people's motivation and skills to use new technologies. In

order to promote adoption of new technologies, both supply side (as discussed in Section 5.2.1) and demand side policies should be put into place effectively (Cava-Ferreruela and Alabau-Munoz, 2006). The supply side policies involve strategic policy actions with proven effective ramifications, usually related to infrastructure and institutions whereas demand side policies involve initiatives that target society-specific needs to increase the availability, affordability and uptake of ICTs with socially inclusive policies, and education/training programs for digital competency improvement. The policies that stimulate broadband infrastructure deployment as well as the demand-side policies that directly target increased social uptake intertwine closely, and each policy measure has a multifaceted way of targeting an ICT-related objective.

In the following sections, I will discuss how should Turkish government use their policy and regulatory powers to address the digital divide in Turkey. By taking the findings of the previous chapters about the predictors of first and second levels of digital divide as well as the evolution of digital divide in Turkey into consideration, I will focus on some policy measures which could be effective in addressing the issue in the Turkish context. These policy measures are especially critical for Turkey as an emerging economy and a country with an aim to become a focal point in "the production of science and technology that uses ICTs as an effective tool, that produces more value with information-based decision-making process and that it is successful in global competition, with a high level of welfare" (e-Transformation Turkey Project, 2006). For that, first I will revisit Turkey's latest National Broadband Strategy and Action Plan and then develop a conceptual framework that encapsulates various policy measures that are applicable to the case of Turkey. My conceptual framework outlines five main policy areas based on the findings of the previous chapters: (i) infrastructure, (ii) inclusivity, (iii) institutions, (iv) market structure, and (v) digital competency.

On the other hand, new kinds of risks are emerging with the COVID-19 pandemic in the digitization process. Certain social groups have become more vulnerable to COVID-19 exposure due to existing digital and social inequalities. The socially isolated people, older adults, financially disadvantaged, digitally novice, and even women are among the vulnerable populations who have faced disproportionate opportunities in terms of ICT access and use. These digitally disadvantaged groups, as characterized as having inferior

COVID-19 exposure risk profiles (CERPs) by Robinson et al. (2020), have been susceptible to be deprived of opportunities which could have minimized the risk of exposure to crisis times.

Therefore, in addition to supply side policies, I will discuss society-specific needs based on the findings of the previous chapters. In other words, I will explain how and to what extent each of these policies may help addressing the demand side issues. It is known that Turkey's demographic and socioeconomic characteristics have been mostly disregarded while developing regulations and related policies (Köksal, 2021).

5.4.1 The conceptual framework

The conceptual framework involves policy areas that are applicable to Turkey to increase social ICT uptake: (i) infrastructure, (ii) inclusivity, (iii) institutions, (iv) market structure, (v) digital competency (see Figure 5.1). These policies constitute mainly the supply side approaches.

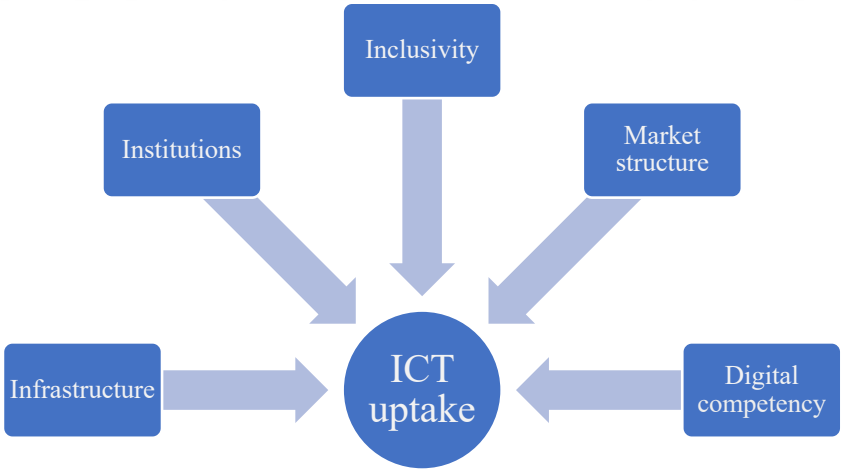

Figure 5.1: The conceptual framework outlining five main policy areas.

The infrastructure refers to broadband coverage, internet speeds and device diversity and use. Internet infrastructure is a critical component of the digital divide, but infrastructure alone does not assure adoption and beneficial use. Local and national institutions, accessibility and affordability, and digital competency all play important roles. Policies targeting institutions involve policies concerning political prioritization of broadband

strategy, best practice of government use of technology and alternative local broadband solutions such as public access. Inclusivity refers to affordability, equity of access and actual usage when access is available. Market structure is also important because when the broadband market is more competitive and diverse, it can be a path forward for increased inclusion and expansion of digital economies. Finally, policies that are aimed at increasing digital competency can address the gaps in digital skills/upskilling. These policy areas are summarized in Table 5.2.

Table 5.2 : Supply-side policy areas for ICT uptake.

(a) Infrastructure	Broadband coverage Internet speeds Device diversity
(b) Institutions	Political prioritization of broadband strategy Best practice of government use of technology Alternative local broadband solutions, rural/urban disparities, public access points
(c) Inclusivity	Affordability Equity of access Effective use
(d) Market structure	More competitive and diverse broadband markets
(e) Digital competency	Level and scope of online engagement Digital skills, upskilling

Turkey has made some progress in the area of becoming an information society in the recent years, and as a result, gaps in physical access are somewhat being addressed; but demographic and socioeconomic gaps are shown to persist. In this thesis, I investigated whether and to what extent key demographic and socioeconomic factors such as gender, age, education level, income level, occupational status and geographical regions are associated with first and second level digital divide in Turkey as well as Turkey's overall performance in closing digital gaps between 2008 and 2020. The results reveal that although there has been a progress towards closing gaps especially in broadband coverage, digital divide persists among different social groups and geographical regions. The findings demonstrate that almost all of the population have access to an Internet-enabled device thanks to smartphones. However, device diversity is considerably low.

Age, income and education are significant predictors of Internet access. Even when access is available, greater disparities exist among different gender, age, income, education, and employment groups in terms of Internet use. Moreover, the findings reveal significant regional differences for both Internet access and use. With respect to online activities, the empirical evidence provided in Chapter 3 shows that gender, age, economic level, education, and in some cases employment status and region are significant determinants of their Internet use behavior. Overall, there are four main policy areas that are directly associated with the demand-side, i.e. concerning demographic and socioeconomic factors. Those policy areas include device access, Internet access, Internet use, and online activities. Table 5.3 summarizes those main demand-side areas to be addressed to mitigate the digital gaps and the associated supply-side policies.

Table 5.3 : Demand-side policy areas and the associated supply-side policies.

Policy area	Identified problems	Associated supply side policy area
Device access	Low device diversity, dependency on smartphones	a, c, e
Internet access	Disparities with respect to age, income, employment, and region	a, b, c, d
Internet use	Greater disparities with respect to gender, age, income, education, employment, and region	b, c, e
Online activities	Limited online engagement, tendency towards using less-sophisticated online activities, social media use dominates, disparities among different social groups	b, c, e

In the following sections, I will discuss why demand-side policies should be prioritized and how supply-side policies should be implemented in a way that they can support and strengthen certain associated demand side policies.

5.4.2 Potential mitigation strategies for the digital divide

There are challenges related to policy and regulation affecting wide-ranging digital transformation process of a country. Some of them are indeed contextual factors that underpin the digital divide. In this section, I unpack policy-related challenges that act as a barrier to widespread connectivity. Along with the findings of this study, I will discuss

how supply-side policies should be implemented in a way that they can support and strengthen certain associated demand side policies.

5.4.2.1 Infrastructure

Turkey is representative of the trend in upper-middle-income countries that have experienced a rapid surge in fixed broadband subscriptions particularly from 2003 to 2007; the uptake in subscription rates has been impressive, yet followed by modest growth in later years (UN ESCAP, 2017) despite the affordable fixed-broadband services with outstandingly low prices that correspond to less than one percent of their GNI, i.e. below USD 8/month (ITU, 2018).

Liberalization process of the Turkish telecommunications sector started in 2004, following the establishment of the Telecommunication Authority. The Turkish telecom network has been rapidly modernizing since, with a noteworthy expansion of its geographical reach and number of lines, especially in mobile services. Turkey eventually becomes a mature market in terms of mobile penetration. Mobile broadband has become a popular service. ADSL remains dominant in the fixed broadband platform. On the other hand, fiber-optic cable is expanding across the country. However, as to the connection speed, Turkey still performs poor, ranking lower than the EU and world average. Turkey's broadband backbone is fine for data sent from point to point within the country, however, as individuals flock to broadband, capacity could get strained. Also, sending data into and out of Turkey is still an issue, with bottlenecks slowing the pace.

Connectivity enables generating and transferring data. The volume of data increases each year with the rapid change in technology and evolution of internet use accordingly. Therefore, the speed of internet connection becomes a critical factor for the capacity to generate and transfer data. The countries and the industries should adapt to this next-generation connectivity. There is a substantial disparity in the connection quality between the developed and emerging economies, reflecting infrastructure and technological gaps (UNCTAD, 2021b). Despite the relatively high rates of penetration, Turkey is among the

countries that perform poor in terms of internet speed.[17] Cable connections and high-speed internet connections are not yet sufficient especially outside major cities and industrialized areas. According to Speedtest Intelligence data by Ookla Global Fixed and Mobile Network Performance Maps, as of January 2021, the average download speed for fixed internet connections in Turkey was 30.31 Mbps, the average upload speed was 8.31 Mbps, and the latency was 25 milliseconds. According to the Broadband Europe Plan, access to a network of at least 100 Mbps is expected in all European households by 2025. In its recent Strategic Foresight Report, the European Commission reaffirmed the importance of "hyperconnectivity", appointing it as one of the key factors that will have a significant impact on the EU in the future. The term hyperconnectivity refers to the growing number of interconnected devices that enable the creation of new services, jobs, business models, and forms of human interaction.

There is a wide consensus among scholars and practitioners that the deployment of high-speed broadband networks has a positive impact on economic growth (Abrardi and Cambini, 2019). Research shows that faster broadband contributes positively to economic outputs in the OECD countries (Czernich et al., 2011) such that doubling the broadband speed will contribute to 0.3% increase in growth (Rohman and Bohlin, 2012) and the impact is even greater in countries with lower income (Kongaut and Bohlin, 2017). The studies further show that high-speed broadband has a greater impact on job creation than slower broadband (Bai, 2017; Lapointe, 2015; Lobo, Alam and Whitacre, 2020). Moreover, in rural or isolated areas, higher-quality broadband appears to have a disproportionately greater impact (Atasoy, 2013; Lobo, Alam and Whitacre, 2020). Building a nationwide high-speed network would generate employment, stimulate the economy, and boost the country's global competitiveness.

Therefore, the widespread availability and adoption of high-speed broadband Internet is considered a vital driver of the ICT capabilities and overall prosperity of a nation (Marcus, 2005). As a matter of fact, many governments have already decided to directly intervene in the deployment of advanced broadband networks on the search for economic

[17] Turkey ranks 58 out of 139 countries in mobile broadband internet speed, and 102 out of 176 countries in fixed mobile internet speed (Speedtest Global Index, November 2020, https://www.speedtest.net/global-index, accessed on 16.01.2021).

and social benefits. They seem particularly concerned with inequities in society in terms of access to telecommunications infrastructure and the lack of opportunities that its absence entails (Ferrandis, Ramos and Feijoo, 2021). Korea's experience, for example, in deployment of high-speed Internet connection, has been very successful in providing broadband Internet services to more than 70 percent of households by 2002, which has profoundly affected many aspects of country's economy, education and social culture (Lee and Lee, 2003). The empirical evidence further proves that increased penetration rate of high-speed broadband Internet not only had a positive impact on the creation of new enterprises but also acted as a springboard for future infrastructure in the network economy (Lee et al., 2005).

The European Data Journalism Network's dashboard for "Average Internet Speed Across Europe" joins the Speedtest data with the shapefiles of Europe's Nomenclature of Territorial Unites for Statistics (NUTS), and Local Administrative Units (LAU) in order to get a sense of the state of internet speeds across Europe. The dashboard reveals the overall performance of internet connections and the extent of the digital divide between, and within, European countries in terms of connection speed (Figure 5.2). Turkey currently has the lowest average fixed internet speed in Europe.

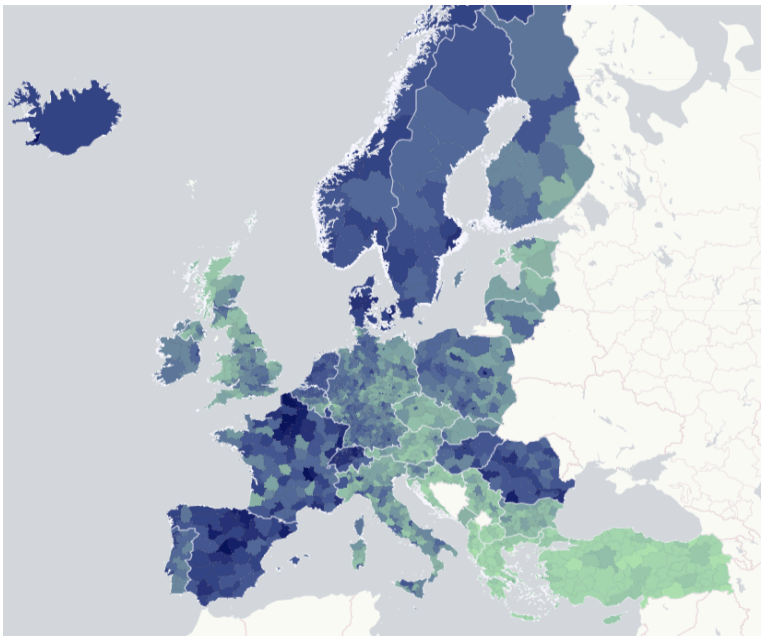

Figure 5.2 : Average Internet speeds across Europe.

Note: From lighter (green) to darker (blue) shades the average internet speed increases.

On top of relatively low connection speeds in Turkey, according to the Oxford Coronavirus Government Response Tracker (OxCGRT), the average broadband speed dropped by 5.86 percent during the most stringent COVID-19 lockdown periods. By using the OxCGRT data, cable.co.uk's study shows "a high correlation between lockdown periods around the world and dips in measured internet speeds, with some regions measuring the most substantial drops, and others more or less unchanged." (Figure 5.3). The countries that have the most accessible ultra-broadband deployments have experienced less latency and download speed slowdown (Katz et al., 2020). Turkey is among the countries, though not the worst, which experienced a drop in internet speed, revealing the vulnerability of its infrastructure.

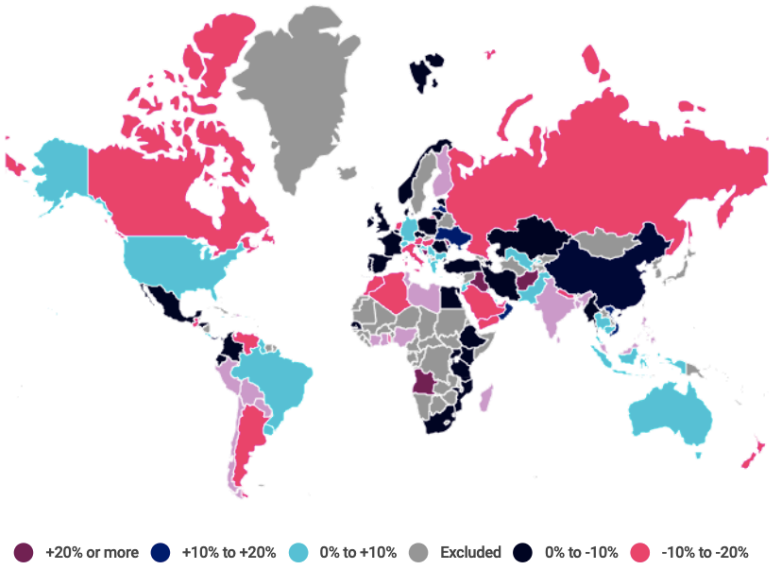

Figure 5.3 : Changes in average broadband speeds during countries' most stringent lockdown periods amid COVID-19 pandemic in 2020.

The COVID-19 pandemic exposed widespread inequities, highlighting the need for immediate steps to increase the deployment and implementation of high-speed internet. The demand for bandwidth grew as more members of a household were online at the same time undertaking schoolwork or working from home. The leading telecommunications companies have started to embark on plans to upgrade to fiber and 5G rollouts in order to support the growing long-term demand for reliable high-speed connectivity. For instance, as tens of millions in AT&T territory lack fiber, the company

promised to increase its fiber footprint by an additional 3 million customer locations (Brodkin, 2021). Pascal Desroches, AT&T Senior EVP & CFO, told the virtual Credit Suisse Communications Conference:

"In a world where you're going to have increased demand from gaming, online education, telehealth services and remote work, I'm just not sure that the fixed wireless is going to satisfy consumers that are using more and more connectivity in their day-to-day lives. Performance in the home needs to be excellent. And I think fiber is the only product out there that delivers that."

Regardless of socioeconomic level, geographic location, or other factors, everyone should have the option of receiving high-speed access. Fiber optic internet can reach the highest connection and can empower people by allowing them to engage in bandwidth-intensive activities that would be impossible with legacy copper lines. People require high-speed connection that fiber optic can provide for a range of purposes, including communicating with friends and family afar, obtaining an education, and using cloud-based internet services, among others. Therefore, government spending on broadband infrastructure that only provides slow connection will ultimately be insufficient to address the digital divide. In fact, the demand for high-speed connectivity is anticipated to persist even after the COVID-19 pandemic as online education, remote working and digital entertainment will be a more staple way of life.

On the other hand, the speed of the mobile broadband Internet connection, is on average lower than the speed of the fixed internet connection within all groups of countries, except the least developed countries (LCDs). Considering costs and technical capacities, the deployment of mobile broadband connectivity appears to be more favorable for developing countries (UNCTAD, 2021). Telecommunications infrastructure deployments on fixed and mobile networks must keep up with the fast-growing internet traffic. Given that the majority of the population uses mobile broadband Internet connection, Turkey should give more emphasis on the development of mobile broadband access. I will discuss why and how 5G networks should be constructed so that it will not cause a further segmentation among society.

With regard to fiber-based connection, the share of the fiber-optic internet in broadband is 22 percent in Turkey, lower than the OECD average which is 28 percent. The overall average usually hides the internal differences between regions. However, it is important to note that there is also disparity between regions in terms of fiber-optic cable lengths in the country. The three largest cities, Istanbul (TR1) (3.3m/person), Ankara (TR51) (4.5m/person) and Izmir (TR31) (4.3m person), have the highest number of total fiber-optic lengths whereas Sanliurfa (TRC2) (2.3m/person) and Hatay (TR63) (2.6m/person) have the shortest length. The data demonstrates stark differences with respect to the level of urbanization despite the deployment of WiMAX, a broadband wireless access technology that supports fixed, portable and mobile access, and holds the promise of delivering broadband to underserved areas and to a broader customer base. It appears that there is also a relationship between fiber-optic cable lengths and the extent of ICT access and use in that respective region as this study shows low rates of access and use in those regions where cities have relatively shorter fiber-optic lengths. Research shows that development of the Internet infrastructure stimulates regional convergence in Turkey (Celbis and Crombrugghe, 2018). Therefore, investing in rural broadband and expanding networks in underserved areas can also help mitigating the regional digital divide. For that, broadband service providers can be encouraged and funded to build out network infrastructure and provide service. Also, effective programs would likely need activities that go beyond traditional measures. In this regard, municipalities can be encouraged to build their own broadband networks which would increase competition in the market and give opportunity to local communities that have better understanding of the demographics of that particular region and unique challenges facing their communities to fight against the digital divide. In that sense, broadband networks can be considered as public service such as electricity, water, waste, etc., which are relied on public provision.

According to Dalgıç and Fazlıoğlu (2020), digital divide holds back Turkey's potential since the country is still at the initial stages of broadband deployment that is far behind the developed countries' broadband deployment frontier. Their study provides empirical evidence on Turkey confirming that adoption of faster broadband generates higher productivity gains compared with broadband with normal speed. On the other hand, Celbis and de Crombrugghe (2018) find evidence that Internet infrastructure increases

the speed of regional convergence by using the data from the 26 NUT-2 regions of Turkey for the period 1999-2011. Further investments to new technologies of networks can not only help Turkey's overall connectivity by reducing congestion on existing wireless networks but also play a role in eliminating interregional inequalities.

Supporting affordable backhaul connectivity and infrastructure is a way of enhancing Internet speeds. Backhaul connectivity which includes submarine cables and international bandwidth across countries and between cities and internet exchange points (IXPs), must be accessible at a reasonable cost so that more service providers can enter the market, which as a result will increase competition. Submarine cables enable carrier of greater volume of data at lesser costs. IXPs are physical sites where many networks link to exchange Internet traffic through shared switching infrastructure. Internet service providers, content providers, hosting firms, governments, and other networks can all engage in IXPs. IXPs are located throughout the world, allowing local networks to exchange information more efficiently by eliminating the need to transfer local Internet traffic overseas. It has been demonstrated that using an IXP can enhance access speeds for local content by tenfold because traffic can be routed more directly (Internet Society, 2015). Therefore, it is important to properly operate and regulate so as to allow operators to share infrastructure, invest in high capacity backhaul networks, and distribute spectrum in a fair and transparent way.

There are examples of governments (i.e., Mexico, Rwanda and Ghana) that are piloting investments in wholesale open access networks to help make connection more affordable for providers at the wholesale level. In the case of Ghana, a public-private partnership has added competition at the backhaul level and decreased internet prices (A4AI, 2019) and so potentially contribute also to affordability, which will be discussed in the next sections.

Turkey progressed to 4.5G, also known as LTE, which is ten times faster than 3G technology in April 2016. The preparations to shift to 5G, which will offer faster speeds and more reliable connections especially on mobile devices, are still ongoing. These ongoing debates need careful consideration. In the light of these discussions and by carefully assessing the efficacy and shortcomings of the national broadband plans of prototypical countries, Turkey should adopt a coherent broadband strategy and must

fortify every citizen with stable internet access and for that, rapidly scale investment to ensure everyone can have a meaningful connection from any place.

The development and deployment of 5G are necessary to handle massive volumes of data, lower congestion and reduce latency. The development of 5G networks will likely to be segmented in Turkey at the beginning, with most regions seeing no 5G deployment at all. Segmentation has the potential to widen the digital divide, restrict innovation, and even suppress much-needed digital transformations in health, education, and transportation. To tackle segmentation, the infrastructure structure must be significantly extended in a way capable of delivering 5G innovation and outcomes instantaneously. This begins with a rethinking of how 5G networks should be constructed. The traditional telecom architectures should be abandoned in favor of interactive, software-defined, accessible, and automated technologies. This will necessitate investment from major IT companies, which has already begun so but must accelerate. On the other hand, the government should enable for private operators to provide universal access to high-quality digital infrastructure networks for everyone and attract enterprises by sharing risk and creating incentives to reduce total implementation costs, avoid vendor lock-in, and allow for the transition to the next technology iteration. It is critical particularly for Turkey as an emerging economy to continue to make progress on digital infrastructure regulation; maintaining digital competitive intensity on one hand and connectivity of digital services on the other are the essential parts of such regulatory framework. Yet, the policy focus should not be narrowed down to promoting the rolling out of infrastructure, assuming that skills and effective engagement will follow the advancements and spread of high-speed broadband infrastructure.

Device access is another dimension of connectivity that can be analyzed under infrastructure policies. In Chapter 2, I examined the distribution of device ownership, reflecting the device diversity among the population. The majority of the population has a device with sufficient technology to go online thanks to smartphones. Smartphone ownership significantly dominates other Internet-enabled devices. Economic and social inequalities, as well as the rapidly changing technology might relate to the uneven distribution of Internet-enabled devices. Zillien and Hargittai (2009) show, in the German context, that the pricing of the technologies and socioeconomic background of the

individuals affect device ownership. Economic resources are essential to acquire and sustain both the Internet and devices. Other than the price of broadband plans, the consumers face the acquisition and maintenance cost of devices. These additional costs can significantly affect the affordability of overall ICT services in lower income countries in particular (ITU, 2020). On account of this, we see the distribution of device ownership in Turkey is concentrated towards devices that are considered essential, which are smartphones.

Both developed and developing countries have experienced rapid growth of mobile cellular penetration, but the growth of the average penetration rate was faster in developing countries (Sicherl, 2019). Mobile phones have become promising new mean for Internet access in developing countries in Africa, Asia and Latin America such that Internet subscriptions per telephone mainline in those countries are as high as in developed countries (Dasgupta et al., 2005). This findings in Chapter 2 indicate that the situation is similar in Turkey as smartphones are available to a vast number of people. Even though smartphones offer mobility, convenience, and more continuous Internet use (Mossberger et al., 2012), they allow limited online activities and limited capacity for professional purposes. Knowing that one can diversify their Internet experience by using different types of devices (van Deursen and van Dijk, 2019), the groups that are on the undesirable side of the digital divide with only mobile access to the Internet cannot engage in broad range of online activities, limiting the potential benefits of the Internet (Pearce and Rice, 2013).

Although smartphones are instrumentally useful as discussed, especially after the pandemic outbreak, the transition to remote work and education was not an easy experience for smartphone-dependent users. Even though technological advancements in smartphone technologies and digital platforms started to provide an easier and more convenient user experience than before, reliance on smartphones for online access today would not be sufficient to engage in more advanced online activities. Furthermore, previous research demonstrates the problematic relationship between smartphone dependency and underprivileged demographic and socioeconomic groups. Tsetsi and Rains (2017) show that smartphones are minority groups', such as "younger, poorer and less educated users", only mean of Internet access. Their findings further show that their

online activity over smartphones remains limited to social activities. It appears that smartphone-only users cannot utilize all the features of smartphones, indicating that widespread use of smartphones cannot perfectly aid in the digital divide. Since other Internet-enabled devices are not widely used, people are constrained by what smartphones provide them. The uniformity of device preferences in Turkey reveals the lack of multimodality of Internet use which is another critical indicator of digital divide (Wei, 2012). For this reason, it is important to introduce other Internet-enabled devices to those who are not using them, and to increase their motivation and competencies that enable their effective use. This will also enable them to use the Internet for more diverse purposes.

5.4.2.2 Institutions

Countries are speeding up the digital transition of government and public administration to take advantage of the potential of modern technologies. Building effective, transparent, and inclusive institutions at all levels necessitates the use of e-government in favor of good governance in general.

The United Nations E-government Survey assesses the efficacy of e-government in the delivery of public services, identifies trends in e-government growth and efficiency, and identifies countries and regions where the potential of ICT and e-government has not yet been fully realized and where capacity development assistance may be beneficial. The Survey tracks progress of e-government development via the United Nations E-Government Development Index (EGDI) biennially, which measures a country's readiness and capacity to use ICTs to provide public services (United Nations, 2020). Incorporating the access characteristics, the index reflects how a country is using ICTs to promote access and inclusion of its people and captures the performance of governments relative to one another. According 2020 EGDI, Turkey ranks 53 out of 193 countries, preserving its position in 2018, yet performing relatively better among its counterparts by ranking 9 out of 56 upper-middle income countries. However, considering the rank changes between 2018 and 2020, these countries show a more dynamic progress than Turkey such that they approach the top category countries more rapidly. Although e-government rankings tend to correlate with the country's income level, Liu Zhenmin, the

UN Under-Secretary-General for Economic and Social Affairs emphasizes that "financial resources are not the only critical factor in advancing digital government, [but] a country's political will, strategic leadership and commitment to advance digital services, can improve its comparative ranking." (UNDESA, 2020).

The ICTs can be utilized to improve government-citizen interaction. Demographic and socioeconomic barriers to internet access and one's capacity to use the technologies to the degree of ability to retrieve information have a substantial impact on intentions to use the e-government services. Therefore, governments should pay special attention to the way they provide online information, ensure the ease of navigation such that the content and interfaces are carefully designed to deliver relevant and succinct information especially to novice users, and of course be committed to advance these services on a regular basis according to all users' needs.

The digital divide appears to be impeding widespread e-government use. The research also supports the idea that vice-versa is also true. E-government service is just another technological advancement from which certain segments of society are excluded. The convenience of e-government may motivate technically savvy while disenfranchising individuals are less proficient with computers or mobile applications, or online interfaces. Consistent with the previous literature (Becker et al., 2008; Belanger and Carter, 2009; Gupta, 2020; Nam and Sayogo, 2011; Ragnedda and Kreitem, 2018), I find that younger generations, people with higher level of household income and more-educated people are more likely to use the internet for various online tasks in Turkey, which is also the case for e-government use. Hence, it is of crucial importance that government agencies not only acknowledge the divide among society, but also take immediate actions to bridge this gap. The country would definitely benefit from a more informed citizenry when e-government services are widely accessible to all groups.

The rural-urban digital divide is a common problem in many countries (Feijoo et al., 2017; Galloway, 2007; LaRose et al., 2007; Prieger, 2013; Whitacre et al., 2014) which can be considered under institutional policies and inclusivity policies. Rural connectivity is highlighted as one of the strategic targets for 2025 under the Digital Agenda for Europe

2020 within the framework of the European Gigabit Society[18]. The initiative proposes that all households, rural or urban, to have access to high-speed internet connection (European Commission, 2016a). The deployment of high-speed broadband in rural areas is generally related to the public goods features of broadband deployments (Cambini and Jiang, 2009) as well as to public-private partnerships in telecommunications infrastructures (Gomez-Varroso and Feijoo, 2010). However, investments in rural areas remain limited compared to urban areas which creates rural-urban dimension of digital divide (Lucendo-Monedero et al., 2019). The government policies are usually designed generic so as to support citizens' initiatives without paying particular attention to local specific needs, so solving the problem at the regional level still proves to be challenging to address the rural broadband gap (Salemink and Strijker, 2018). It is no doubt that the deployment of fixed technologies in rural areas would create a high cost. The recent studies (covering the period starting with the introduction of 3G and more frequently after the introduction of 4G/LTE) have examined the ability of wireless technologies to serve as an enabling, complementary or substitute technologies for fixed broadband services (Ferrandis, Ramos and Feijoo, 2021), which could be a potential strategy to address the high-cost problem of fixed broadband deployment.

Cable connections and high-speed Internet connections are not yet sufficient especially outside major cities and industrialized regions. I showed that geographic region of residence is associated with both first level and second level digital divide in Chapter 2 and Chapter 3, respectively. The regions with higher negative average marginal effect on Internet access and use are clustered mostly in the eastern part of Turkey (TRA, TRB, and TRC) and Black Sea Region (TR8). Likewise, the degree of online engagement is much lower in those regions. The results suggest that Internet access and use are differentiated within Turkey towards more economically prosperous regions. Also, I

[18] The Gigabit Society policy set out a vision for connectivity in the EU, stimulating the high-capacity networks needed to grow the digital economy. The main objectives for 2025 are (i) 100 Mbps networks for all households; (ii) gigabit connectivity for all businesses and institutions; (iii) uninterrupted 5G coverage for all urban areas and major terrestrial transport paths; (iv) Access to mobile data connectivity everywhere. More information about The Gigabit Society and the EU 2025 connectivity objectives are available at https://digital-strategy.ec.europa.eu/en/library/connectivity-european-gigabit-society-brochure, and https://5gobservatory.eu/category/gigabit-society/

pointed out that the fiber-optic lengths are shorter in regions with more rural areas and that the internet speeds are lower in those areas.

The rural development policy should be closely entwined in many aspects of the digitalization policies such that both policies should embrace digital inclusion in the first place. Region-specific, i.e. at the NUTS2 or NUTS3 level, studies need to be conducted where ICT access and use is low in order to meet the region connectivity objective, but currently TurkStat survey is limited to NUTS1 region data. From the perspective of NUTS2 or NUTS3 areas, the results are expected to predict more noticeable gaps between regions and, in a sense, reveal more consequential region-specific information. The regional approach to the digital divide would indeed give more useful insights than the country level approach since it will take regional socio-economic and cultural variation within the country into consideration. Also, the effects of "traditional" solutions that are suggested in the literature to bridge the digital divide likely be reverse when shifting the approach from the country level to the regional level (Szeles, 2018).

Public access points and community networks can be source for access. They can expand connectivity to greater number of people by helping onboard new users in areas where additional points of connectivity delivered and reaching people at the margins of society. Moreover, public access points can stimulate demand for internet access. On the other hand, they can boost market competition by serving as an additional option to the consumers and by driving operators to improve services and decrease prices. Thus, investing in public access can motivate operators to innovate and provide higher quality services at lower prices.

Public access has a complementary role for the broadband market. Public access services almost always link directly to private commercial telecom carriers and pay fees to them. Every retail public access connection, whether via a telecentre, internet café, or Wi-Fi signal, links to a combination of commercial network providers' wholesale transmission networks, data hubs, and network operating centers. The wholesale providers are competitors in the retail market. For this reason, most public access services buy wholesale data connections in bulk from commercial providers and "resell" that capacity to their customers at very low (or zero) per-unit rates. When compared to the retail, per-

MB option appears to be an inefficient deal for the commercial market, which appears to lose the utmost possible revenue from such consumers (A4AI, 2019). The greater amount of data consumption by public access users reflects traffic that would simply not exist if they had to pay for it at market price. Those users have a high price elasticity for data usage since they can usually only afford a certain volume of data per month and will therefore avoid using the service once that limit is reached. Hence, public access points give users the possibility to acquire more data they could have used otherwise, for little or no additional cost, without causing considerable revenue loss for retailers. These benefits indicate a net gain for the economy, which can be significant when spread across hundreds of thousands of users (A4AI, 2019).

5.4.2.3 Inclusivity

Affordability and accessibility two main dimensions that need to be addressed to create a more inclusive society. Affordability is one of the barriers towards internet access and meaningful internet use. The inequalities concerning people's ability to afford to purchase the necessary ICTs divide society further which exacerbate the existing inequalities given the opportunities that internet can offer. Affordability refers to the ability of consumers to pay for connection and cover the costs of devices necessary for connectivity. There are millions of people around the world who either do not have internet access at all or cannot maintain a stable and quality connection just because they cannot afford it. The lower the internet connection and internet-enabled devices costs in local currency as a share of monthly GDP per capita, the more affordable they are. The results in Chapter 2 and Chapter 3 show that household income is a significant indicator of first level and second level digital divide. The UN Broadband Commission on Sustainable Development's affordability target suggests 1 GB of mobile data to be priced at less than 2 percent of monthly GNI per capita. Although costs of data and entry-level internet-enabled devices have continued to decline in recent years, they are becoming less affordable in many countries (GSMA, 2021). Broadband has a median price of only 0.6 percent of GNI per capita in developed countries, but broadband in developing countries costs 2.5 percent of GNI per capita (ITU, 2021).

The Alliance for Affordable Internet (A4AI) publishes the Affordability Drivers Index each year with an aim to provide policymakers with guidance on regulatory policies to enhance their broadband services. The index focuses on low, lower-middle and upper-middle income countries in which Turkey is included and takes into account investments in backhaul infrastructure, smartphone adoption, broadband availability, international bandwidth per user, and the policy environment in the country to support internet access. The index shows strong correlation with the mobile broadband prices and degree of broadband market competition in the respective country. According to the Affordability Drivers Index 2020, Turkey is among the top ten performers of the index, ranking 8th among 72 countries in 2020 (A4AI, 2020b). Although it may first seem a promising rank for Turkey, there are two facts need to be noted; first, since the index covers mostly the "developing countries", it indicates Turkey's performance only relative to countries with low GNI per capita. Second, although its advantageous position in terms of higher GNI per capita compared to the majority of the countries covered in the index, Turkey fell back two places in the ranking 2020 compared to 2019 and 2018, by scoring behind Argentina, Colombia, Costa Rica, Malaysia, Mexico, Peru and Thailand. Therefore, it is important to acknowledge Turkey's current precarious position in terms of affordability while addressing the digital divide in the country. Knowing that internet affordability is highly correlated with the mobile broadband prices and the degree of broadband market competition, both should be taken into consideration as policy pillars in order to drive progress towards greater affordability. In addition to this, community networks should be considered as a source for internet access. Investing in public access can help onboard new users by generating additional points of connectivity at no cost and make possible to reach people at the margins of society and expand connectivity to greater number of people.

An alternative course of action that can improve affordability is to implement and administer programs aimed at lowering the costs of broadband adoption for low-income households. For example, in the United States, such program is administered by the Universal Service Administrative Company (USAC) which is funded by telecom

providers.[19] The program is called Lifeline and establishes guidelines based on household size and income. Citizens can apply for Lifeline assistance and qualify if they have proof of income or proof that a household member is enrolled in one of the recognized assistance programs. The eligible consumers are provided with a monthly discount. A similar model can be adopted in Turkey. However, such initiative requires a careful assessment as to the determination of the subsidy amount on one side, and the potential impact on other consumers due to increased bills if and when service providers pass the charges along to them. Well-managed USFs can make major, systemic impacts on efforts to mitigate the digital divide also by financing, for example, infrastructure expansion, digital skills training, and free or subsidized access to devices and/or internet in public spaces.

Accessibility refers to having access to the Internet and all other necessary information and communication technologies. It is an essential factor that enables people to obtain information, communicate and participate in social, educational or professional programs. However, accessibility is still a concern for people at the margins of society for whom the connection itself, devices or the online content is not accessible at home or at work. Bearing in mind that ICTs play an increasingly critical role in the daily personal, professional, civic and business lives, improving digital accessibility would enhance social capital, workforce diversity and expand opportunities for everyone.

Access to ICT should be a rights issue because these technologies govern people's access to civic participation, education, health, employment, travel and entertainment. People left out mostly include those with disability, those who are not digitally literate or are experiencing age-related or culture-related barriers. Governments should ensure everyone is able to operate ICTs with ease and confidence. For that, the policymakers can develop accessibility guidelines for the digital equipment and can offer variety of training materials and tutorials, can design tips and techniques for the disadvantageous people, and can also encourage organizations to work on to improve accessibility to the

[19] USAC is responsible for data collection and maintenance, support calculation, and disbursement for the low-income program. USAC administers the Universal Service Fund under the direction of Federal Communications Commission (FCC). More information is available at https://www.usac.org/ and https://www.fcc.gov/general/lifeline-program-low-income-consumers

information and services that their websites offer. The necessary actions should be acknowledged by the policy makers require a collective act from the public and private sector. The foremost action is working on better awareness of accessibility for each individual facing barriers to accessing the technology itself or to digital interface use due to disability, illiteracy, digital illiteracy, aging or social and cultural norms and biases. They should offer more convenient solutions to people who need help in accessing the technology. The policymakers should encourage redesign or codesign more flexible interfaces to address the accessibility challenges.

In order to address digital gender gaps, incorporating women's perspectives in project design is critical. The projects, therefore, should be designed and implemented with a more gender-responsive and participatory approach. To overcome social or other barriers to female participation, policymakers should consider using women facilitators in community and other design sessions, and hosting gender-balanced or, where necessary, women-only focus groups to get feedback. As Thakur and Potter (2018) states "the reality is that most gender discrimination is systemic and a function of everyday norms that we all take for granted, even when laws are in place to prevent it. Without programs designed specifically to tackle these barriers to access for women, the digital gender gap is likely to continue growing wider".

5.4.2.4 Market structure

More competitive and diverse broadband markets can be a path forward for increased inclusion and expansion of digital economies (A4AI, 2020). The number of providers in the market and the size of their market share determine the level of market competition. In a competitive broadband market, large number of sellers (broadband service providers) compete to satisfy the wants and needs of a large number of buyers (buyers of the broadband service). Although there has been a historic trend towards liberalization, according to the Affordability Report 2019 by A4AI, the progress towards broadband market competition is stalling and so, markets are becoming more consolidated. By relying on Herfindahl-Hirschman Index (HHI), the report analyses different regions (continents) and compares the trends in mobile broadband market competition in

respective regions. All continents show a decrease in mobile broadband market competition as illustrated in Figure 5.4.

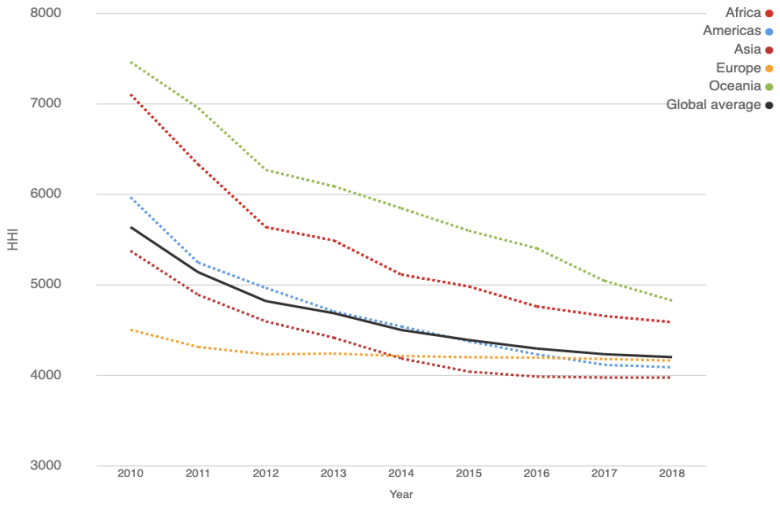

Figure 5.4 : Mobile broadband competition (2010-2018), as HHI.

A more competitive market can create the advantage of an increased consumer surplus and economic welfare when operated and regulated with right policy measures. Policy makers and regulators can foster competition and support healthy competition with fair and transparent market rules and evidence-based policies and regulatory visions. Operators can improve their networks faster and provide better services if they have more flexibility in their licensing system to adapt to new technology. Also, local communities (municipalities) can establish their own networks with explicit and inclusive licensing (A4AI, 2020) which is discussed in Section 5.4.2.1.

The empirical evidence indicates that given that there is sufficient infrastructure, infrastructure competition can be used as a strategy to support greater broadband adoption in OECD countries (Kongaut and Bohlin, 2014). Based on the assumption that promoting technological competition is the most effective policy for accelerating broadband deployment (i.e. between DSL and cable networks), the results obtained from the empirical analysis of most representative government policies to promote broadband in OECD countries support the foundations of "soft-intervention strategies" that are characterized by low government involvement in broadband infrastructure deployment, for public policies to promote broadband supply. However, given that rural areas are

likely to remain underserved, foundations of "medium-intervention strategies" characterized by more proactive government involvement with public funding for infrastructure supply is more appropriate for an extensive coverage (Cava-Ferreruela and Alabau-Munoz, 2006).

According to the estimation reported in The Affordability Report 2019, the transition from a consolidated to a more competitive broadband market could save users up to USD $3.42 per GB of mobile data. Low or middle-income countries that proceed from a one-provider to a two-provider mobile market could even see a drop of USD $7.33 per GB.[20] The result show the effect of increased market competition on users (lower costs, higher consumer surplus). Turkey is considered an upper-middle income country and hence does not fall into this category of countries. Also, there are three main mobile network operators (MNOs) in Turkey, namely Turkcell, Vodafone and Turk Telekom. Turkcell, the largest of the three operators, has established and continued its dominance through its first-mover position in the market. The dominance of Turkcell, is still an issue in the mobile broadband market. On the other hand, Turk Telekom has been widely thought to have wielded undue influence over the Ministry, which has hindered the liberalization and implementation of procompetitive regulations (Atiyas and Dogan, 2010) despite the fact that the penetration rate is predicted to rise significantly as a result of new entry and higher level of competition (Atiyas and Doğan, 2007). On the other hand, with respect to the regulatory coherence, the division of roles between the sector regulators, ICTA and the Ministry is still not clear under particular circumstances. Furthermore, despite its *de jure* existence, the regulatory authority's degree of independence is generally considered limited (Ozel and Atiyas, 2011) and the lack of legal instruments and incomplete ownership of the liberalization agenda contribute to the delays in the advancement of competition (Atiyas, 2011).

DSL services, which constitute 97 percent of broadband access in Turkey, have been provided by TTNet, Turk Telekom's internet services component, as ADSL (Asymmetric Digital Subscriber Line) since 2000. Alternative operators point to a number of significant barriers, including expensive installation fees, high backhaul service fees, and delay

[20] The report assumes all other factors, such as education, population, and income, as being equal.

tactics by Turk Telekom with insufficient ICTA enforcement. Although Turkey has made some progress in the area of information society and media in the recent years, in the fixed voice and broadband markets, there was insufficient competition, and as a result, operators and users of information and communications technologies faced high taxes and costs. TTNet share in fixed broadband is 65.75 percent (ICTA, 2020). The degree of competition is considered low. The low level of competition in broadband internet is mostly due to Turk Telekom's strategic behavior in preventing alternative Internet Service Providers (ISP) from entering the market (Ozel and Atiyas, 2011). Despite the government's drive for telecommunications sector liberalization, formerly state-owned Turk Telekom (TTNet) retains a near-monopoly, as most internet connections are made by Turk Telekom or by private companies using TTNet's communication lines. In the third quarter of 2019, alternative fixed voice operators had a 49.4 percent share, up from 45.5 percent in 2018. The scholars show that ISPs offerings of broadband services are more likely to be driven by the competition in the market (van Gorp, Maitland and Hanekop, 2006). However, the degree of competition of the broadband industry in Turkey is still significantly low. In order to sustain a higher degree of competition in the market, besides the abovementioned requirements, physical network connectivity and increased fiber penetration are essential.

Although the mobile broadband penetration increased marginally to 75 percent in 2019, it is still at a lower level than the OECD average of 109.7 percent. The fixed broadband penetration rate was 16.1 percent while the OECD average was 30.8 percent. In the third quarter of 2019, the number of 4.5G subscribers reached 76 million, up 4.7 million from the previous quarter's 71.3 million (European Commission, 2020). The increase in the number of subscribers and quality in broadband internet depends on the level of competition to be provided in the sector (Köksal, 2010). Bearing this in mind, it is important to note that establishing and developing competition requires a clear division of roles and effective cooperation between the ICTA and the Competition Authority to control the market power of the incumbent operator. This can only be possible if the ICTA makes and implements sector-specific regulations, the Competition Authority fills the gaps outside the regulation and inspects competition violations. Unless this coordination is achieved and competition is successfully established in the sector, Turkey will face

high economic and social costs (Köksal, 2010). The legal gaps between the EU and the Turkish telecommunications policy have been minimized as a result of the enactment of Law No. 5809 in 2008. We can infer that the lack of progress in the growth of competition is mainly due to poor implementation and enforcement.

There are a number of regulatory strategies to attract new entrants and support healthy competition, as also suggested in The Affordability Report 2019:

(i) Through licensing framework and spectrum allocation processes, regulators can establish rules of market entry. Smaller enterprises may find it easier to get into the market, and alternative models, such as community networks, can be created as a result of these developments. This would foster market diversity, which is critical for the resilience of the broadband industry.

(ii) Regulators should rely on solid evidence and use consensus-based methods that involve stakeholders from all parts of the industry. Resilient procedures would allow industry and organizations to participate and contribute to the regulatory process.

(iii) Regulators should ensure the industry's long-term viability by ensuring the sector's long-term management. They can use a dynamic combination of catalyzing interventions to encourage competition in stagnant markets while also ensuring that markets are a sustainable environment for providers to operate, develop, and innovate (A4AI, 2019).

5.4.2.5 Digital skills

As the internet becomes increasingly embedded in the lives of individuals, it is critical to ensure digital literacy and digital skills for everyone. The 2020 issue of "Digital Skills *Insights*" by The International Telecommunication Union (ITU) features different aspects of capacity development and skills requirements in the digital era and calls for an urgent need to develop the global skills needed towards new risks and technological developments in the digital economy and society. The lack of essential skills is a barrier to benefit the technology at full potential. Examining the issue of inequality in digital skills can promise to deliver a better understanding of opportunities and challenges ICT

can bring and also, provide an outlook on countries' infrastructure developments and government policies to improve the utilization from ICT use.

The uneven knowledge levels and capacities to use ICT are generally associated with people's demographic and socioeconomic background and considered as a cause for exacerbation of the societal gaps. The second level digital divide is concerned with the degree of relationships individuals develop with ICT and how much they can make use of the digital resources (Selwyn, 2004). The need for digital skills disseminates in almost every sector and to all segments of society. Digital skills are essential for digital literacy, future labor market as new jobs demand new skills, and for lifelong learning. However, although ICT access has become widespread over the years, populations with ubiquitous access are riven with digital knowledge and skill inequalities and differentiated usage.

Connectivity alone is not necessarily the best indicator of the technology's value. Rather, how much benefit people get from the internet is largely determined by its use (Goldfarb and Prince, 2008). The research shows that "meaningful digital connectivity – that is, having the technical skills necessary to engage technology and mobilize information resources to address everyday needs" can empower the disadvantaged social groups to tackle the challenges related to associated disparities (Katz and Gonzales, 2016).

The formal education is one of the most crucial steps for gaining knowledge and competency. The results presented in Chapter 2 and Chapter 3 reveal the influence of education level in Internet access and use as well as diverse online engagement. Turkey has a youthful population, which is in need of an education that will prepare for its demands in a globalized and digitalized workplace. This is an issue that needs to be placed at the center of the debate. While progress has been made (FATIH Project, Safe Schooling and Distance Education) the country still has some way to go to ensure that its education system produces graduates able to compete in the digital era. The government still has a lot of work to do to bring the system up to the international standards both accessibility and enrolment on the one hand, and quality and content on the other. The inadequate utilization from ICTs in education as well as the poor quality of ICT education present a serious challenge towards digital transformation of the country. The provision for ICT is yet to reach international levels. It is essential to put emphasis on opportunities for a more

constructive, learner-centered and skills-based teaching model and on learning through ICT.

With advancements in ICTs, it is now possible to present information to students using a variety of methods in educational settings. The emergence of contemporary ICTs has resulted in major shifts in educational perspectives. ICTs hold tremendous potential as a method for improving the quality of teaching and learning processes. Transformation to an information society by widespread use of ICTs necessitates an integrated process that includes social and cultural changes as well as changes in conventional education system.

Countries have been working to adapt their educational systems in order to raise qualified human capital who can contribute to the globalization process. The importance of the effective education over ICTs was realized, and the structural deficiencies of the system were revealed only when the country had to undergo distance learning experience after being hit by the COVID-19 pandemic. Turkey's official digital education platform, EBA, and universities have continued education almost uninterruptedly during the lockdowns. Gessler (2021) argues that with its existing digital infrastructure, Turkey could achieve its goal preserving educational services during the crisis. However, bridging the digital gap is critical for the advancement of ICT-based distance learning and the attainment of an egalitarian and inclusive education.

There are still discrepancies with sharp regional differences which remain a significant obstacle towards improvement. This is an issue of inequality, for which I can refer to Section 5.4.2.3 on inclusivity and requires social policy intervention. There are still discrepancies with sharp regional differences which remain a significant obstacle towards improvement. This is an issue of equality and requires social policy intervention. Although functioning under a centralized education system by the Ministry of National Education, the quality and relevance of the available education as well as teaching standards and physical opportunities vary greatly among schools, e.g., public or private, in Turkey. This is also true for the higher education system, which functions under another central body, the Council of Higher Education. The disparity among different education institutions leads to widening gaps among students. The most important thing in enhancing the efficiency of Turkey's human capital is to strengthen the country's

educational system. Vocational education and training by taking full advantage of the digital technologies is critical for the development of human capital, especially for meeting the needs of intermediate workers in the new labor market. Increasing the standard of teachers could be accomplished by instructing them on how to use the ICT more effectively and keeping up with technical advancements and integrating them into the education system. As mentioned in the previous sections, Saçak et al. (2020) identified that the most important strategy for Turkey in the "Digital Transformation Roadmap of Turkey" report is "providing educators with digital competencies", by using a multi-criteria decision analysis method. The findings of this study acknowledge the importance of the human capital in the digitalization process of Turkey and indicates that digitalization process should be addressed within the framework of education.

Essentially, regardless of a person's socioeconomic or sociocultural characteristics, what people do online have an impact on outcomes in other domains. This indicates that through skill development and providing the opportunities for engaging with the Internet in a wide range of ways, policy and interventions of skill development could potentially mitigate digital inequalities (van Deursen and Helsper, 2018). As a result of inadequate investment in skill development, people on the margins of society in particular, languish, technological advancement does not translate into economic growth, and countries can no longer compete in an increasingly knowledge-based global society. There is an urgent need for integrated policies and practices in order to ensure that all students have access to modernized education and training and maintain their participation. Providing hardware and broadband internet to all schools, providing e-content, and creating platforms for teachers to participate in IT are all very crucial actions to be taken to rival for digitalization. On the other hand, people are increasingly learning outside the classroom, mostly online. Students themselves are the driving force in the adoption, development and deployment of education technology. Thus, such learning experiences must be recognized by schools as well as the employers. Promoting the acquisition of digital skills in conjunction with lifelong learning can assist unemployed workers of all ages in transitioning to new occupations where there are more opportunities (ILO, 2020). Moreover, not only students but also teachers should be trained to effectively utilize digital tools. As suggested by Gil-Flores et al. (2017), teachers' competency should

be prioritized in initial teacher training with a focus on skill acquisition for ICT usage in the classroom and the development of favorable attitudes towards the usefulness of ICT in education. In the age of digital information, it is necessary to restructure the education system that favors the integration of ICT into education and advanced teacher competence in the use of ICT. Students' motivation, learning and digital literacy will then be improved as a result of integration of ICT use in classrooms.

On the other hand, boosting the spending on research and development (R&D), with the aim of transforming the country from a labor and manufacturing-based economy into one that is knowledge-based, would be one of Turkey's main economic goals to rival with countries in the digital era. The economy's digital transformation is reshaping how people work and conduct business. The private sector must collaborate with the public sector in order to develop a skillset supply that meets demand. The types of skills required, such as creativity, innovativeness and entrepreneurship, are evolving as a result of new (digital) ways of working. Many industries are experiencing rapid technological change, and digital skills are needed for all types of employment, from the most basic to the most complex. People with high skills may adjust to unexpected changes. However, those who are on the disadvantageous side of the digital divide cannot easily adapt to them. The existing educational system is clearly not doing enough to assist in the development of a talent pool that is adequately trained for the new job market. As digital transformation has a positive effect on enterprises around the world, the education system who has had to develop and deliver their curriculum remotely overnight with the pandemic, will use this as a facilitator to begin re-evaluating their curricula to ensure that they are better matched to the potential needs of the workplace in all sectors. In order to provide new forms of flexibility and protection for job seekers, employees, and employers alike, skill training and development are critical for the success and modernization of labor markets. Skills mismatches hinder productivity and development, as well as affect countries' capacity to withstand economic shocks (European Commission, 2016b).

Unlike ageing and shrinking EU workforce, Turkey has a relatively advantageous position with a younger population to train to adapt them to new job market demands and

avoid skill shortages.[21] All citizens, including the low-skilled and disadvantaged groups, should be able to benefit from inclusive labor markets. Turkey must cultivate digitally savvy workforce, reduce brain drain, try to attract qualified workforce from abroad, and hence make better use of their skills in the global digital competition. Given the fact that labor force participation rate in Turkey (58.5 percent) is lower compared to OECD (72.8 percent) and EU (74.2 percent) averages[22], these strategies are particularly important for Turkey. One of the most obvious reasons for this is that women have not yet occupy the position that they deserve in the labor market. The female labor participation rate in Turkey (38.7 percent) is significantly lower than the OECD (65.1 percent) and EU (67.3 percent) averages.[23] This study shows that the number of individuals who report to be "working at home" is considerably high; in fact, most of them are women. The data as well as the findings of this study clearly indicate the high-priority target groups. Turkey should also develop policies specifically targeted at groups with lower attachment to labor market by taking the changing nature of labor market dynamics always into consideration.

Moreover, the industry should also take an active role in this process of improving the quality of human capital and transforming the economy into a more competitive knowledge-based model. The private sector should be incorporated into the planning and content of vocational programs, thereby ensuring greater quality and relevance to the new demands of employment. Turkey's technology has significant room for growth, and more significant investments in communications infrastructure and R&D are needed to spur that development within the sector. Hence, public and sectoral policies should together aid investments for the upskilling and reskilling of workers to keep up with the

[21] The median age of Turkey's population is 32.7 in 2020 (TurkStat, 2021), https://data.tuik.gov.tr/Bulten/Index?p=Adrese-Dayali-Nufus-Kayit-Sistemi-Sonuclari-2020-37210#:~:text=Ortanca%20ya%C5%9F%20ayn%C4%B1%20zamanda%20n%C3%BCfusun,%2C4'e%20y%C3%BCkseldi%C4%9Fi%20g%C3%B6r%C3%BCld%C3%BC. According to EuroStat data, the median age of the EU-27's population is 43.7 in 2019 and increasing in a faster pace. https://ec.europa.eu/eurostat/statistics-explained/index.php/Population_structure_and_ageing. Both data retrieved on 27 March 2021

[22] The percentages in brackets refer to the labor force participation rates of 15-64 year-olds in 2019, according to OECD (2021), Labour force participation rate (indicator). doi: 10.1787/8a801325-en https://stats.oecd.org/Index.aspx?DataSetCode=lfs_sexage_i_r. Accessed on 31 March 2021

[23] The percentages in brackets for Turkey and OECD average refer to the female labor force participation rates of 15-64 year-olds in 2019.

requirements of the digital age, as well as for the implementation of new technologies and development of innovative projects.

5.5 Conclusion

There are a number of ways to improve ICT access and use and provide people with the opportunities of a stable and open Internet. This includes strategic objectives such as expanded digital infrastructure which enhances availability and accessibility, reduced telecommunications costs, improved network efficiency, more competitive and diverse broadband markets, strengthened digital literacy through a restructured education system, empowering human capital that can use the technologies effectively and implementing policies at the local level. Each of these measures contributes to narrowing the digital gaps. It is especially important to make progress on ICT access in the case of Turkey. The situation necessitates special attention in order to keep up with not only its counterparts, but also to catch up with developed countries' advancement in every aspect. Therefore, Turkey should accept and take advantage of its position to outperform on digitization process. To do this, the country must implement a comprehensive policy that aligns digital strategies and commits to a digital roadmap for long-term progress.

Scientific research establishes an objective and a reliable source for policy-making. In light of the findings presented in the previous chapters, I surveyed the literature and analyzed the scientific evidence that would also be useful in the Turkish context in order to establish a baseline for realization of improved policy frameworks by Turkish authorities. From this research and discussion, it is discernible that fixed and mobile connectivity rollout, more affordable data plan costs, expanded use of Internet-enabled devices, and faster Internet connections will contribute to the upward trend in ICT access and use in Turkey. The deployment of next-generation telecommunications infrastructure will necessitate an integrated policy approach. Innovation, information society development, and new user empowerment by specifically addressing the disadvantageous groups, namely women, elder, low-income and low-educated people are all part of the right policy mix.

6. CONCLUSIONS

This thesis contributes to the literature by proposing a methodological and comprehensive analysis of digital divide in Turkey by focusing on the disparities in ICT access and use as well as differences in Internet service adoption. I investigated how demographic and socioeconomic factors such as gender, age, education, household income, employment and geographical regions affect ICT access and use. In Chapter 2, I provided a quantitative examination of first level digital divide from three perspectives: device access, internet access, and internet use. In Chapter 3, I examined whether Internet usage and digital skills differentiate according to certain demographic and socioeconomic factors. In Chapter 4, I provided a yearly analysis and an overview on the evolution of the digital divide in Turkey. In Chapter 5, based on the findings of previous chapters, I discussed Turkey's initiatives toward digital equity and potential mitigation strategies for the digital divide.

The findings presented in Chapter 2 and Chapter 3 point out the target groups of first priority to address digital inequalities. According to the results, there are significant disparities in the likelihood of having access to an Internet connection and using the Internet between certain social groups. Elderly, lower income and low education are less likely to have internet access. There are statistically significant differences between Istanbul and other regions of Turkey. Istanbul is in a more advantageous position in terms of Internet access and use. Gender is not a statistically significant factor for Internet access. In regards to device access, majority have access to an Internet-enabled device which is a smartphone. Smartphone ownership significantly dominates other Internet-enabled devices. Also, the results indicate that it is the only mean for connectivity for most of the population. The uniformity of device preferences in Turkey reveals the lack of multimodality of Internet use which can be considered another critical indicator of the digital divide. The regression analysis for predicting Internet use demonstrate more

statistically significant results and even stronger relationships between predictors and Internet use. For example, the results show gender divide in terms of Internet usage such that women are less likely to use the Internet compared to men. Also, Internet users in Turkey are predominantly young people. Another important result is that the regions with greater negative impact on Internet usage are mainly clustered in the eastern part of Turkey.

Despite the inequalities in Internet access and use that have been demonstrated in Chapter 2, we observe a high device and internet access rates. A very high device and internet access rates can create an illusion that everyone is actively participating in Internet activities and using the Internet at full potential. However, as I dive into actual usage of different types of Internet services, I found out that's not really the case. In fact, there are digital disparities between certain social groups in terms of Internet service adoption such that low-education, low-income, elderly groups adopt fewer and less-sophisticated Internet activities. Women are less likely adopters of e-banking, e-government, and e-commerce. Age is a significant factor for all Internet service types such that with aging the probability of engaging in a particular online activity decreases. Higher levels of education and income are associated with partaking in more activities online. The scope of Internet use varies according to employment status. Homemaker is the most disadvantageous category. Students usually have more advanced digital skills and greater motivation to use most of the services. Other identified issues include low device diversity, and dependency on smartphones which limit the level of online engagement. Also, there is tendency towards using less-sophisticated online activities by the disadvantageous groups.

The analysis that focuses on digital gaps between years 2008-2020 reveal that despite the upward trend in access and usage rates, there are considerable gaps over Internet usage. Also, unlike smartphone access, computer access gaps are still substantial. Internet access gaps have been narrowing over time, and in several cases they become small. Only the elderly, retired, low-income and low-education people are still behind in terms of Internet access. However, Internet usage gaps persist; even widened for certain internet services. These results point to the need for a more coherent vision on the ICT policies concerning

demand-side policies, and the need for accelerated policies targeted at the disadvantaged social groups.

In Chapter 5, I presented a conceptual framework for ICT policies to address the digital divide issue in Turkey. The framework involves five main policy areas namely, infrastructure, institutions, inclusivity, market structure, digital competency/digital skills. The ICT policy agendas should be reframed and operationalized for these policy areas.

In conclusion, connectivity issues and digital gaps between social groups, and regions persist in Turkey. The groups at the margins of society have been overlooked. There are government projects/programs that recognize the importance of digital technology, but fall woefully short of the mark on digital inclusion. Critical progress is yet to be made towards inclusive digital development for all people. Firstly, connecting everyone, everywhere should be an absolute priority. The ICT policy agenda should allow for data- and evidence-based decision-making. The data and the findings presented in this thesis provide useful body of knowledge as to the high-priority target groups and Internet services as well as the potential policy measures that are critical to address issues concerning the digital divide in Turkey.

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APPENDICES

APPENDIX A: The evolution of digital gaps in adoption of each Internet service by different social groups.

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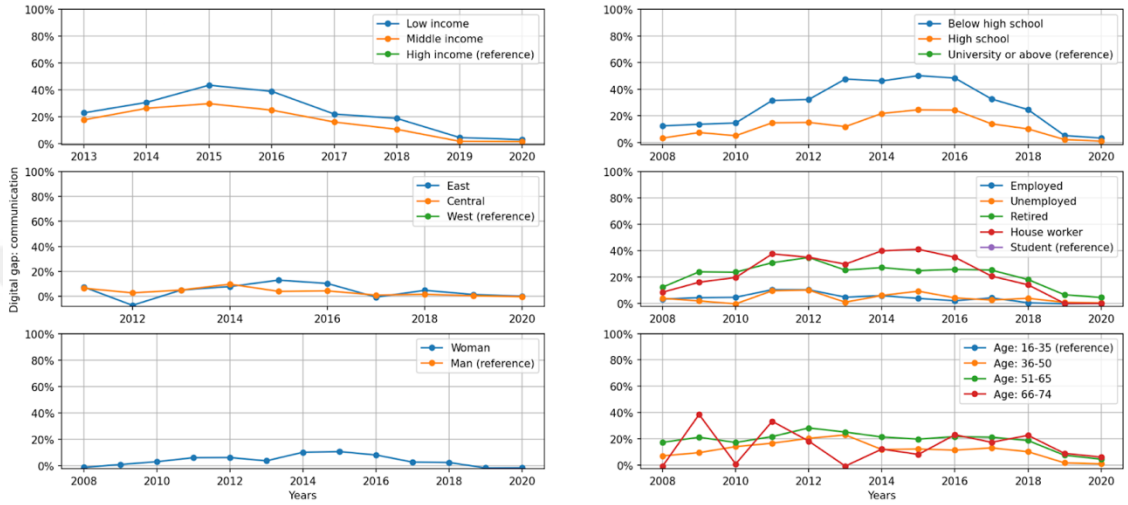

Figure A1. Digital gaps: Online communication.

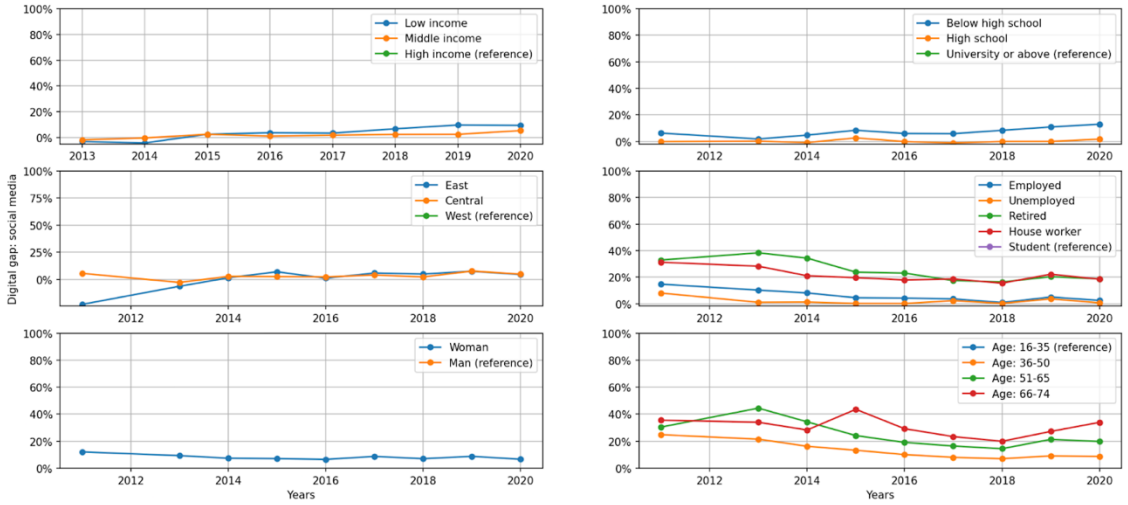

Figure A2. Digital gaps: Social media use.

Figure A3. Digital gaps: Online entertainment.

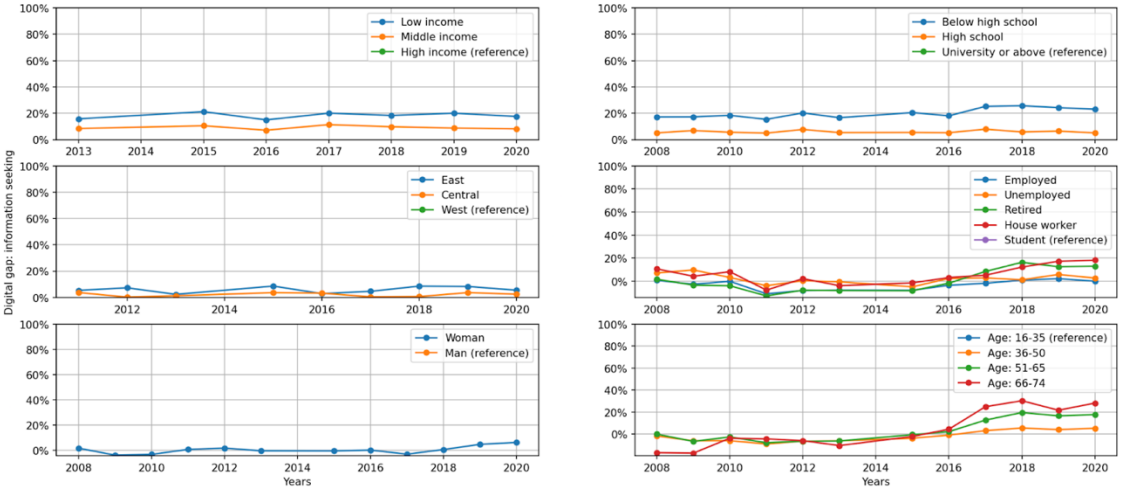

Figure A4. Digital gaps: Online information-seeking.

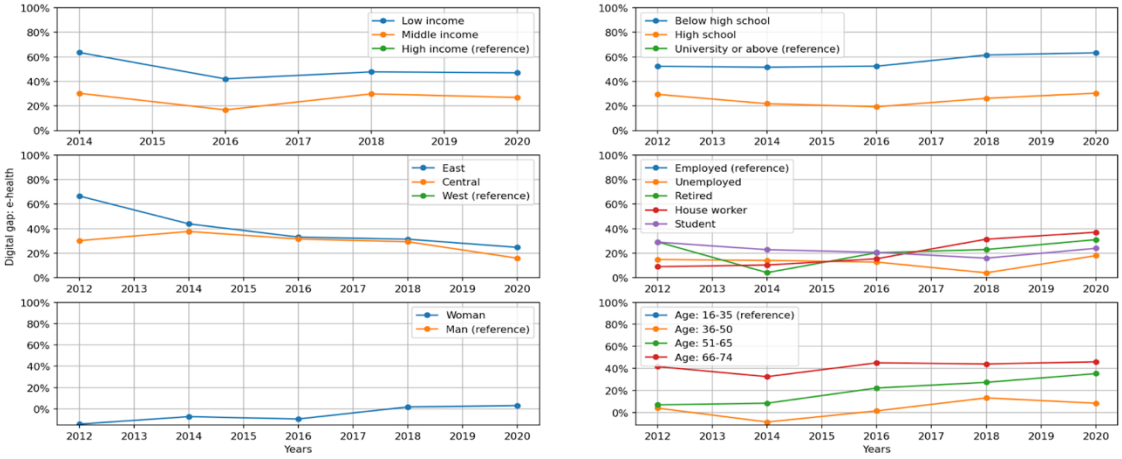

Figure A5. Digital gaps: e-health.

Figure A6. Digital gaps: e-commerce.

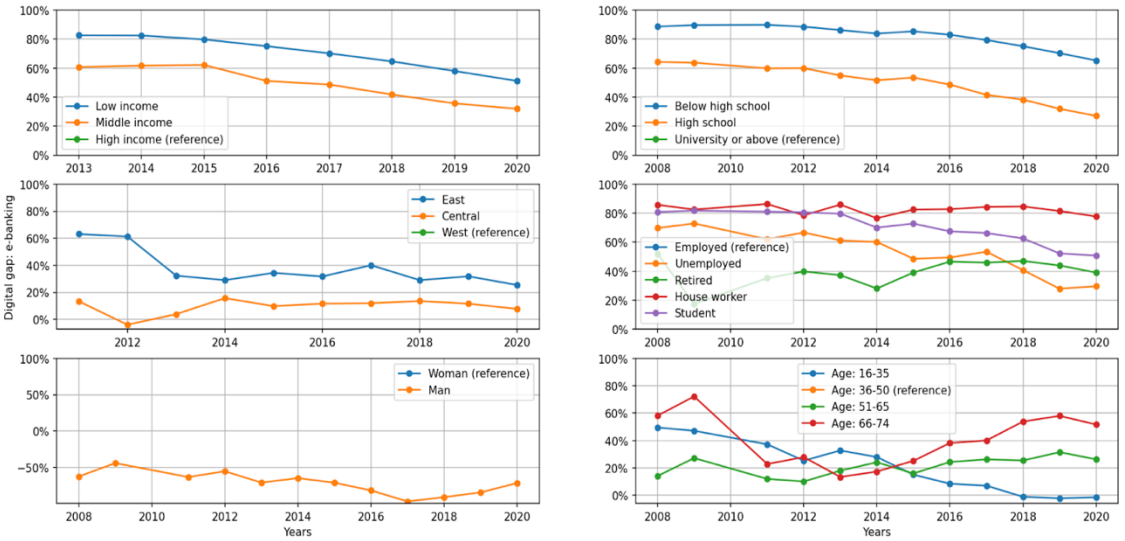

Figure A7. Digital gaps: e-banking.

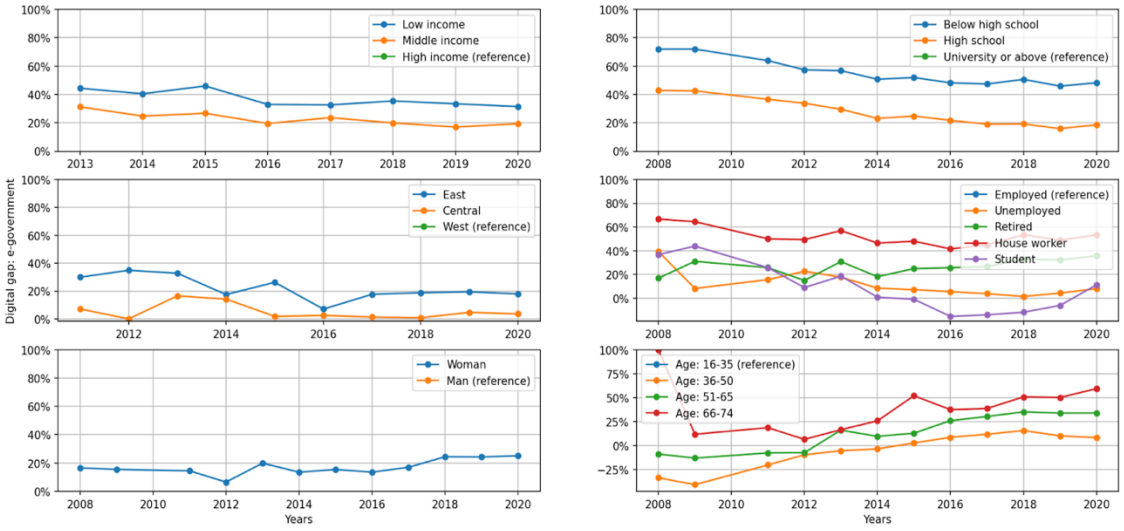

Figure A8. Digital gaps: e-government.

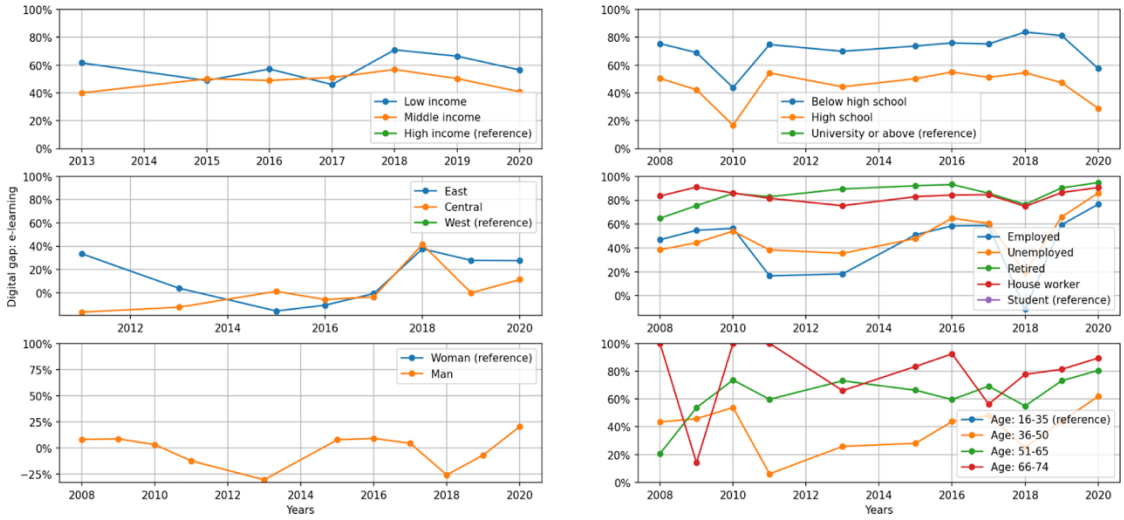

Figure A9. Digital gaps: e-learning.

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- 2015-2021 Istanbul Technical University, Department of Economics, Research Assistant
- 2018-present Istanbul Center for Regulation, Manager and Researcher
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PUBLICATIONS AND PRESENTATIONS ON THE THESIS:

- **Dalgic-Tetikol, D. E.,** Guloglu, B., & Köksal, E. 2022. Determinants of internet adoption in Turkey and the need for a more coherent vision on information and communication technologies policy. *Competition and Regulation in Network Industries*, *23*(4), 311-336.

- **Dalgic-Tetikol, D. E.,** Köksal, E & Guloglu, B. 2023. The Evolution of the Digital Divide in Turkey. *Journal of Research in Economics. 7*(1), 65-83.

OTHER PUBLICATIONS, PRESENTATIONS AND PATENTS:

- Bakis, O., **Dalgic, D. E.,** Deniz, P., Finger, M., Gumus, I., & Köksal, E. 2022. Assessment of a Carbon Tax as a Tool to Decarbonize Turkey's Energy Supply 2050. *IC4R| İstanbul Center for Regulation, Report Series*, (1).
- **Dalgic, D.E.** & Finger, M. 2022. A contribution to the climate change debate in Türkiye: Assessment of a Carbon Tax as a Tool to Decarbonise Türkiye's Energy Supply. *Network Industries Quarterly*, 24(2). 22-26
- **Dalgic-Tetikol, D.E.** 2022. "The relationship between device diversity and disparities in online engagement" at International Graduate Research Symposium-IGRS'22 on 1 June 2022 in Istanbul Technical University, Istanbul, Turkey.
- **Dalgic, D.E.** & Finger, M. 2019. Dijital Platformlar ve Türkiye icin Bölge Odakli Yeni bir Regülasyon Vizyonu. *ITÜ Vakfi Dergisi*, 62-65.

PROJECTS

- Researcher, "SI-Drive | Social Innovation: Driving Force of Social Change". (2015-2017). This project has been funded by EU's Seventh Framework Programme for research, technological development and demonstration