

# Digital Transformation in Tunisia: Under Which Conditions Could the Digital Economy Benefit Everyone?

Adel Ben Youssef



# **DIGITAL TRANSFORMATION IN TUNISIA: UNDER WHICH CONDITIONS COULD THE DIGITAL ECONOMY BENEFIT EVERYONE?**

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## Abstract

Adoption of digital technologies has accelerated largely in the last decade and has reached a critical stage today. The rapid diffusion of digital technologies has fostered the use and exploration/exploitation of new possibilities based on the internet. Therefore, this paper discusses the current state, main opportunities and challenges of digital transformation in Tunisia. First, it relies on up-to-date information to describe the current diffusion and use of digital technologies in Tunisia. This would allow a better understanding of how infrastructure, equipment, access and use of these technologies are diffusing among the population. Second, it takes account of the effect of the COVID-19 pandemic on how the use of digital technologies is developing and to what extent the pandemic has fostered or hampered the digital transformation in Tunisia. Third, most of the existing literature describes digitalization and its impacts without offering clear explanations related to the prerequisites for full exploitation of the potentialities of the technologies in an inclusive manner. Fourth, we examine the prerequisites for reaping digital dividends and moving toward building new jobs and skills, the change of organizational practices and towards safe, secure digital technologies.

**JEL classification:** L86, D83, D63, E24

**Keywords:** digitalization, digital transformation, digital divide, digital skills, Tunisia

## ملخص

تسارع اعتماد التقنيات الرقمية إلى حد كبير في العقد الماضي ووصل إلى مرحلة متقدمة اليوم. أدى الانتشار السريع للتقنيات الرقمية إلى تعزيز استخدام واستكشاف/استغلال الإمكانيات الجديدة القائمة على الإنترنت. لذلك، تناقش هذه الورقة الوضع الحالي والفرص والتحديات الرئيسية للتحويل الرقمي في تونس. أولاً، تعتمد الورقة على أحدث المعلومات لوصف الانتشار الحالي واستخدام التقنيات الرقمية في تونس. سيتيح ذلك فهمًا أفضل لكيفية انتشار البنية التحتية والمعدات والوصول إلى هذه التقنيات واستخدامها بين السكان. ثانيًا، تأخذ الورقة في الاعتبار تأثير جائحة فيروس كورونا كوفيد 19 على كيفية تطور استخدام التقنيات الرقمية وإلى أي مدى أدى الوباء إلى تعزيز أو إعاقة التحويل الرقمي في تونس. ثالثًا، تصف معظم المؤلفات الحالية الرقمنة وتأثيراتها دون تقديم تفسيرات واضحة تتعلق بالمتطلبات المسبقة للاستغلال الكامل لإمكانيات التقنيات بطريقة شاملة للجميع. رابعًا، نفحص المتطلبات الأساسية لجني الأرباح الرقمية والمضي قدمًا نحو بناء وظائف ومهارات جديدة، وتغيير الممارسات التنظيمية ونحو تقنيات رقمية آمنة ومؤمنة.

## **Introduction**

For three decades information and communication technologies (ICTs) or digital technologies have been reshaping the economy, social interactions and lifestyles. The significant reduction in their relative prices in recent decades, has sharply increased connectivity across the world. To date, more than 4.1 billion people have an internet connection i.e. 53.6 percent of the world's population in 2019. More interesting, International Telecommunication Union (ITU) data show that 97 percent of the world's population has access to a mobile cellular signal and 93 percent have access to a 3G (or higher) network.

Most development agencies are promoting investment in digitalization and digital technologies as key drivers (enablers) of economic development and social progress for developing countries. The potential socio-economic impacts of digitalization are considered unlimited and include emergence of new economic sectors, economic diversification, new jobs (employment) especially for higher educated unemployed people, capacity to attract foreign direct investment (FDI), social inclusion of disabled people, cost reductions, availability of free services, better education, export of e-services, time saving, coordination of work, greater accountability and transparency and better governance. At the same time, they warn of digital divides. There is a need to tackle e-inclusion (regional inequalities, lack of equipment among poor people, lack of skills among older people, lack of time among women, etc.) to fully exploit the possibilities of digitalization.

Since the early 1980s, Tunisia has been employing ICTs and formulating strategies for their implementation in its economic and social development plans (Kamoun et al., 2010). Despite good connectivity and early adoption of digital technologies, Tunisia does not seem to be fully benefiting from the opportunities provided by these digital technologies. Its economic performance is weak and during the COVID-19 lockdown some key sectors were unable to move online (ITES, 2020). This emphasizes the need to highlight the existing gaps and the prerequisites that have not been met.

This policy paper offers an overview of the digitalization of Tunisia's economy and society, and discusses the existing and potential effects on growth, employment, and inequality. It offers some insights into the impacts of digital technologies at the sectoral level, and highlights some of the conditions needed for their potentialities to be fully exploited and benefit everyone. Digital technologies will be used as interchangeable concepts in this paper.

This paper makes three main contributions. First, it relies on up-to-date information to describe the current diffusion and use of digital technologies in Tunisia. This would allow a better understanding of how infrastructure, equipment, access and use of these technologies are diffusing among the population. Second, it takes account of the effect of the COVID-19 pandemic on how the use of digital technologies is developing and to what extent the pandemic has fostered or

hampered the digital transformation in Tunisia. Third, most of the existing literature describes digitalization and its impacts without offering clear explanations related to the prerequisites for full exploitation of the potentialities of the technologies in an inclusive manner. This paper discusses the conditions needed for these technologies to benefit everyone in Tunisia.

The paper is organized as follows: section 1 provides an overview of digital transformation and the digital economy in Tunisia; section 2 analyzes the inequalities and the diffusion of digital technologies; section 3 describes the economic impacts of digitalization in Tunisia; section 4 provides a sectoral perspective and describes the two major bottlenecks; and section 5 discusses prerequisites for reaping digital dividends and provides the policy recommendations.

## **1. The challenges of digitalization in Tunisia**

In this section first we define the digital economy, digital technologies and digital transformation. Second, we characterize the macroeconomic situation in Tunisia during the last decade and highlight the main economic challenges.

### **1.1. Digital transformation and the digital economy**

#### **1.1.1. Digital economy: definitions**

An Economist Intelligence Unit and IBM joint study defines the digital economy as one that “can provide a high quality of ICT infrastructure and harness the power of ICTs to benefit consumers, businesses and governments”(World Bank, 2016). UNDP (2018) defines the digital economy as the entirety of sectors that operate using Internet Protocol (IP)-enabled communications and networks” irrespective of industry; distinguishing between the internet economy and the digital economy , where the latter relies on enhanced interconnectivity of networks and the interoperability of digital platforms in all sectors of the economy and society to offer convergent services.<sup>2</sup>

These technologies evolve rapidly. Several waves of digital technologies have emerged during the last three decades characterized mainly by being general purpose technologies (GPTs) (Bresnahan and Trajtenberg, 1995; Helpman and Trajtenberg, 1998; Lipsey et al., 2005).

#### **1.1.2. Digital technologies as General Purposes Technologies**

Digital technologies are generally considered as GPTs (Bresnahan and Trajtenberg, 1995; Helpman and Trajtenberg, 1998, Basu and Fernald, 2007, Cardona et al. 2013). GPTs are defined by Lipsey et al. (2005, p. 98) as “a single generic technology, recognizable as such over its whole

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<sup>2</sup>[https://www.undp.org/content/dam/undp/library/capacity-development/English/Singapore/percent20Centre/FramingPolicies\\_DigitalEconomy\\_2018\\_NUS-UNDP.pdf](https://www.undp.org/content/dam/undp/library/capacity-development/English/Singapore/percent20Centre/FramingPolicies_DigitalEconomy_2018_NUS-UNDP.pdf)

lifetime, that initially has much scope for improvement and eventually comes to be widely used, to have many uses, and to have many spillover effects”.

According to Cardona et al. (2013) there are three main characteristics of an innovation which make it a GPT: *pervasiveness*, *improvement*, and *innovation spawning*. GPTs have followed a sustained development dynamic; they are ubiquitous in the sense that they have multiple uses in many sectors, and are known as enabling technologies since they offer many opportunities for more innovation.

GPTs promote economic transformation in the production of services and goods, skills, and the location of production. These affect growth and income levels through increased multi-factor productivity based on both the labor and capital savings features of the technology (David, 1990, 1991; David and Wright, 1999, 2003)<sup>3</sup>.

Like GPTs, digital technologies can induce structural change in the economy and society. This process is known as the digital transformation. The digital transformation is generating fierce debate among policy-makers, economists and industry leaders about its societal impact. The digital transformation is affecting society profoundly, and concern is growing about how it is affecting jobs, wages, inequality, health, resource efficiency and security. According to Vial (2019, p. 121) digital transformation is “a process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies”. Matt et al. (2015) identified four dimensions of digital transformation: use of technologies, changes to value creation, structural changes, and financial aspects. These dimensions need to be integrated within a single digital transformation framework to allow formulation of a digital transformation strategy. The deep changes to the structure of the economy could take several decades as in the case of electricity.

### **1.1.3. Economic impacts of digital technologies**

Digital technologies have deep impacts on the economy at the microeconomic, mesoeconomic and macroeconomic levels.

At the microeconomic level, digital technologies change firms’ business models and enable (i) lower search costs, (ii) lower replication costs, (iii) lower transportation costs, (iv) lower tracking

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<sup>3</sup> However, little attention has been paid to the capital saving effects of GPTs. Devine (1983) and David (1990, 1991) show the effect of capital savings from a historical perspective focusing on electricity. They show that 40 years after Edison’s invention of the carbon filament incandescent lamp in 1879, electrification led to a huge transformation. This transformation was slow but produced noticeable changes to the shapes, material used, and capital requirements of firms. It eventually generated multi-factor productivity gains across the whole economy.

costs and (v) lower verification costs (Goldfarb and Tucker, 2019).<sup>4</sup> As people spend more time consuming digital media and buying products online, and as businesses and governments increase their use of digital technology, this prompts the question: how does storing information in bits rather than atoms affect welfare?

Consequently, the prices of goods and services can be reduced and the variety of goods and services extended. The welfare of the consumers will be increased. At the same time, changes in costs have consequences on market competition. Overall, digital technologies have benefited the firms by allowing them to propose goods and services with new business models and the consumers by allowing them to access a variety of products and services with reduced prices.

At the meso-economic level (industrial economics), digital technologies are removing barriers to entry, modifying competition and transforming the boundaries between sectors. Entry barriers are removed because new business models allow new firms to enter specific sectors and become powerful competitors. New economic sectors are emerging (new economy) linked exclusively to the use of digital technologies. At the same time, these technologies are fostering firms' innovation capacity. Implementation of digital technologies at the meso-economic level is allowing sustainable and innovative development (Chernykh et al., 2020).

At the macroeconomic level, digital technologies have an impact on economic growth, productivity and employment. Discussion about how much ICTs might impact the economy originated in Robert Solow's (1987) famous sentence: "You can see the computer age everywhere but in the productivity statistics". This became known as the Solow or productivity paradox. The new growth theory literature (Romer, 1990; Aghion and Howitt, 1992; Grossman and Helpman, 1991) focuses on the drivers of technological change and considers that it requires increasingly efficient use of available resources to produce long-term economic growth through processes of technological development and innovation. The impact of ICT in growth and productivity is both directly and indirectly. The technological improvement and productivity growth in ICT-producing sectors have a direct effect on overall productivity that is proportional to the size of the ICT sector (Jorgenson, Ho and Stiroh, 2002 and 2008, Gordon, 2002 and van Ark et al, 2008).

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<sup>4</sup> "Search costs are lower in digital environments, enlarging the potential scope and quality of search. Digital goods can be replicated at zero cost, meaning they are often non-rival. The role of geographic distance changes as the cost of transportation for digital goods and information is approximately zero. Digital technologies make it easy to track any one individual's behavior. Last, digital verification can make it easier to certify the reputation and trustworthiness of any one individual, firm, or organization in the digital economy. Each of these cost changes draws on a different set of well-established economic models, primarily search, non-rival goods, transportation cost, price discrimination, and reputation models."

## **1.2. Tunisia macroeconomic situation and challenges**

In this section we describe the macroeconomic situation and the main socio-economic challenges before and after the outbreak of the COVID-19 pandemic.

### **1.2.1. Macroeconomic context**

Over the years, the Tunisian economy has become more open and integrated. Tunisia's strong and sustained economic growth experienced since the early 2000s came to a halt during the revolution of 2011. After the revolution, Tunisia aimed to pursue an ambitious agenda, but the low growth of macroeconomic indicators has slowed its progress. While GDP expanded by an average of nearly 4.2 percent per year between 2000 and 2010, the rate growth was only 1,7 percent between 2011 and 2019 (IMF, 2020).

Poor governance, low levels of investment, a large informal sector with low productivity, are the causes of slow economic growth in Tunisia. Since 2011, one of the major factors of economic slowdown was the political instability as well as the multiple terrorist attacks that have negatively impacted many sectors (for instance tourism), the ability to implement reforms (multiple reshuffling of governments) and to build a confident and stable climate business to attract investors. Since 2011 foreign direct investment (FDI) has declined sharply. There was a 47 percent decrease in FDI from 2012 to 2019 (World Bank, 2020). Tunisia has tried to attract investments in different industries, by taking different measures such as the legislation to simplify the procedures required to work and do business as a foreigner (Giambrone Law, 2020).

Public spending has increased significantly since 2011, focused on current rather than capital expenditure. This increase has been financed primarily by external borrowing. Public debt, mostly external (70 percent), increased by 95 percent between 2010 and 2019 putting Tunisia at risk of serious shocks and reducing liquidity for the private sector (World Bank, 2020). Public debt is estimated to have risen from 72.2 percent of GDP in 2019 to 86.6 percent of GDP in 2020 (World Bank, 2020).

The current account deficit increased from 7.4 in 2011 to 11.2 percent in 2018. However, it still remains high at an expected 7.1 percent of GDP in 2020, since imports declined at a faster pace than exports (World Bank, 2020).

### **1.2.2. Social challenges**

Poverty was generally declining in the years before the 2010 revolution in Tunisia, a trend driven by economic growth. The poverty rate fell from 25.4 percent in 2000 to 15.2 percent in 2015 (Kokas et al, 2020). According to the global Multidimensional Poverty Index (MPI), approximately 1.3 percent of Tunisians are multidimensionally poor (OPHI, 2019).

Rural areas and children are more affected by poverty. However, less than 1 percent of the population in Tunisia fall below the income level of US\$1.90 per person per day, meaning that Tunisia is achieving the Sustainable Development Goal by eliminating extreme poverty (Kwasi et al. 2020).

The unemployment rate in Tunisia remains high. Unemployment has dropped from 18,3 percent in 2011 to 16 percent in 2019. Unemployment disproportionately affects the youth and women. In the third quarter of 2020 Tunisia was characterized with an unemployment rate of 35.7 percent for youth and 22.8 percent for women (INS, 2020).

### **1.2.3. Recent socio-economic impacts of the COVID-19 in Tunisia**

Tunisia's government quickly realized the critical problem posed by the COVID-19 outbreak and took measures to contain the virus. After the first case of COVID-19 was announced in March 2020, the Tunisian government put in place a series of measures to mitigate health, economic, and social effects.

The COVID-19 outbreak quickly evolved from a health crisis to a large-scale economic crisis. The lockdown measures of spring 2020 to prevent the spread of the COVID-19 virus were very costly and had severe socio-economic impacts. The growth rate of GDP in the second quarter of 2020 was -21.3 percent (INS, 2020), -5.7 percent in the third quarter of 2020, and -6.1 percent year-on-year in the fourth quarter. The Tunisian economy recorded a contraction of 8.8 percent of GDP in 2020 (INS, 2020). This decrease is the largest since independence.

Tourism, transport and manufacturing have been the most affected by the COVID-19 crisis. Tourism receipts fell by 64 percent in 2020 (BCT, 2020). The manufacturing sector saw a decline of -27 percent in the second quarter, -3.2 percent in the third quarter and -4.5 percent in the fourth quarter of 2020 (INS, 2021). Transportation saw a decrease of -77.3 percent in the second quarter, while in the third half a decrease of -39.1 percent and -49.1 percent in the fourth quarter of 2020 (INS, 2021).

For Tunisians, this crisis had considerable consequences on their standard of living and on poverty. According to the study of Kokas et al (2020), the poverty rate has increased to 19.2 percent from 15.2 percent in 2015, pulling an additional 475,000 individuals below the income poverty line.

The impact of the COVID crisis on the labor market was immediate. The unemployment rate rose sharply following the first wave and the lockdown decision. It rose from 15.3 percent to 18 percent in the second quarter of 2020 and then fell in the third quarter of 2020 to 16.2 percent, and 17.4%

in the fourth quarter (INS, 2021). The unemployment rate has evolved in the same direction according to gender. It rose to 14.4 percent for men and 24.9 percent for women in the fourth quarter of 2020 (INS, 2020).

Most sectors of economic activity experienced a decrease in the number of employed during the second quarter of 2020. The most impacted sector was the service sector (decrease of 52.7 thousand employed) and the manufacturing industries sector (decrease of 51.9 thousand occupied).

## **2. Inequalities remain despite rapid diffusion of digital technologies in Tunisia**

This section presents the state of diffusion and use of digital technologies in Tunisia and discusses the digital divides. It also presents the specific role of the government in the digital transformation.

### **2.1. Rapid diffusion of digital technologies**

Tunisia's digital infrastructure is opening new opportunities for economic growth. The effect of waves of new digital technologies will be significant and will lead to major transformations to the country's economic landscape by removing sectoral barriers, introducing modifications to the types of services that can be offered, allowing the emergence of new ranges of goods and services and enabling the redistribution of added value among the actors.

Tunisia is experiencing rapid diffusion of digital technologies. Fixed broadband subscriptions have grown steadily in Tunisia and increased from 26 in 2002 to 1.19 million in 2019 (ITU, 2020). In the last years, the rapid evolution of mobile-broadband subscriptions (substituting for fixed lines), was followed by an increase in fixed phone lines due to offers from mobile phone operators of fixed+Internet+mobile phone bundles (triple play offer).

Tunisia, like many other Middle East and North Africa (MENA) countries, is a mobile-focused country<sup>5</sup>. Internet speed and quality is better with mobile internet than with broadband and the average internet speed is increasing.

The rapid adoption of mobile phones in Tunisia has been notable. In January 2020, there were 17.77 million mobile connections in Tunisia (an increase of 219,000 or 1.2 percent since January 2019). This number increased to 17.84 million in January 2021 (an increase of 228 thousand or 1.3 percent since January 2020). The ratio of the number of mobile connections to total population reached 151 percent in January 2020 and 150.2 percent in January 2021 (Data Reportal, 2020 and 2021).

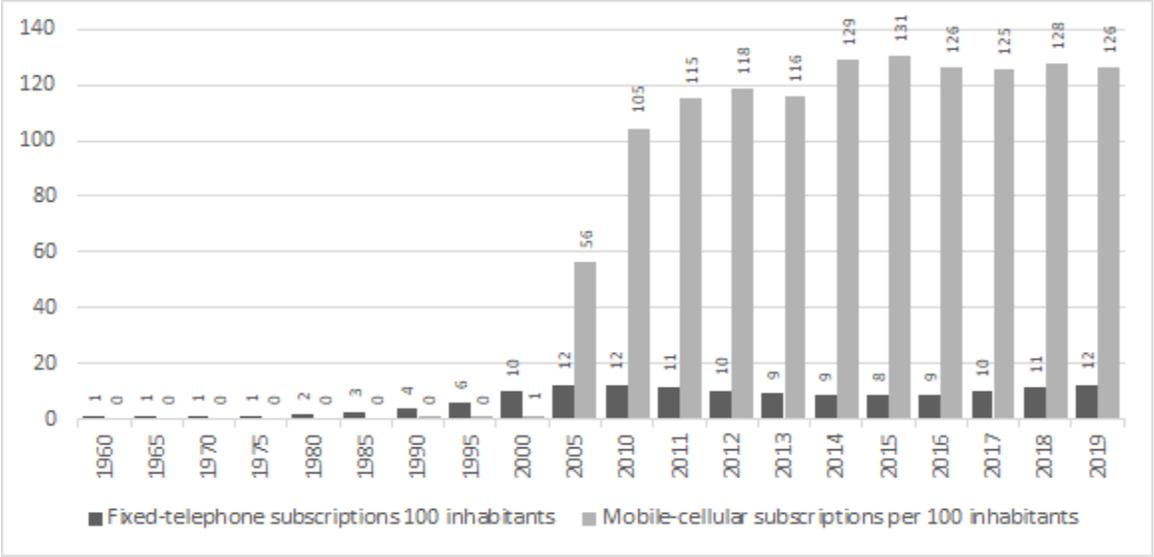
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<sup>5</sup> There are three mobile network providers in Tunisia: Telecom Tunisie, Ooredoo and Orange. Tunisie Télécom and Ooredoo have the biggest networks compared to Orange.

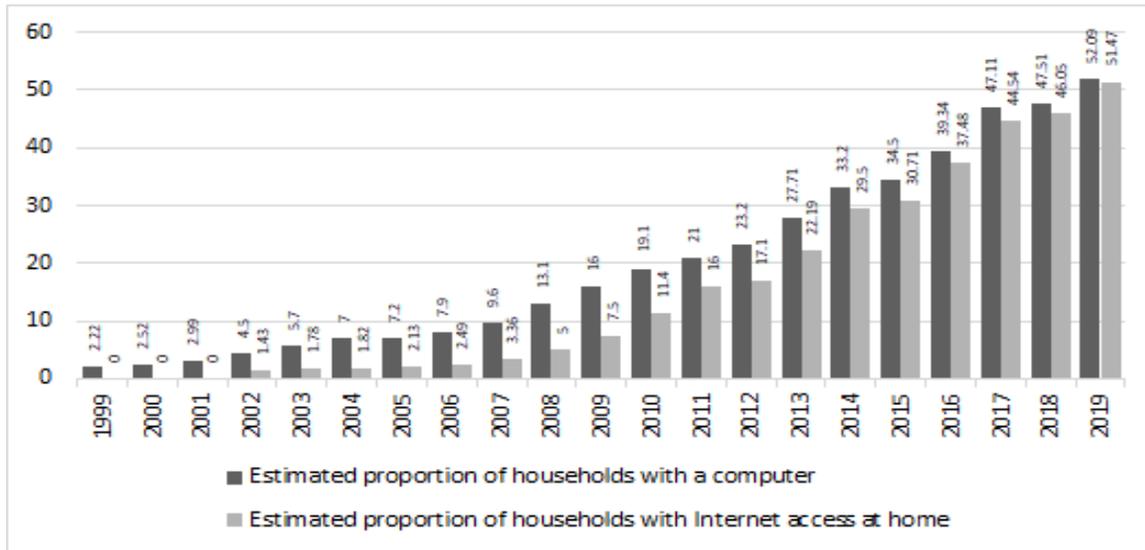
Tunisia provides 3G and 4G, but 5G is not yet launched. The 4G speed is good compared to other African countries but digital infrastructure lags behind that in Europe and Asia and needs investment. Tunisia was ranked 68th in the world for mobile speed and 160th for fixed broadband speed in August 2020. In Tunisia, 4G/LTE has been available since 2016 in major cities and is on 800 MHz and 1800 MHz with theoretical speeds of up to 150 Mbps. In January 2020, the average speed of mobile internet connections was 25.32 Mbps and 29.80 in January 2021. The average speed of fixed internet connections was 9.12 Mbps in January 2020 and 9.52 Mbps in January 2021 (Data Reportal, 2021).

In 2020, the overall mobile connectivity index score is 60.28, including mobile network infrastructure index of 63.22, affordability of devices and services 54.56, consumer readiness 61.33, and availability of relevant content and services 62.43 (Data Reportal, 2020).

**Figure 1. Fixed-telephone and mobile cellular subscriptions per 100 inhabitants (data from ITU 2020)**



**Figure 2. Estimated proportion of households with a computer and Internet access at home (data from ITU 2020)**



Computer ownership and internet access in Tunisia have changed dramatically since 2011. The estimated proportion of households with a home computer increased from 21 percent in 2011 to 52.1 percent in 2019, while those with internet access at home grew from 16 percent to 51.5 percent. The percentage of the population with access to at least a 3G network has increased hugely in the last 10 years, from 65 percent in 2010 to 100 percent in 2019 (ITU, 2020).

The number of Internet users was 266,800 in 2000, increased to 3,915,223 in 2010 and 7.55 million in 2020. Internet penetration in Tunisia stood at 64 percent in January 2020 and 66.7% in January 2021 (Data Reportal, 2021).

Social media penetration in Tunisia was 62 percent in January 2020. There were 7.30 million social media users in January 2020 and 8.20 million in January 2021 (Data Reportal, 2021). During the lockdown in March 2020, social media use increased by 137 percent (ITES, 2020). Facebook is the most used social network in Tunisia and had in January 2020 more than 6.9 million active users representing 75 percent of the population (+13 years old).

The quality of connections and infrastructure (internet speed, bandwidth especially broadband) has major implications for e-uses, productivity and growth (Bretschek et al. 2018; Ben Aoun and Ben Youssef, 2016). As equipment use and digital infrastructure sophistication increase, e-uses increase as well as the expected effects on productivity and growth. Tunisia is following the digital pathway to provide an adequate digital infrastructure, but it has not yet the sufficient digital infrastructure in order to show the effects on productivity and growth. The Internet infrastructure (broadband) is performing well, but is still fragile in less populated areas and needs huge investments. Tunisia is also tackling the challenge of 5G implementation, which will allow the

improvement of internet quality and provide new opportunities for digitalization and digital transformation as well.

## **2.2. Despite important progress digital divides persist**

Digital divide refers to the gap between individuals, households, businesses and geographic areas at different socio-economic levels with regard to both their opportunities to access IT and ICTs, and their use of the internet for a wide variety of activities (OECD, 2002).

Four levels of digital divide are identified (Ben Youssef, 2004). The first focuses on the economic and social inequalities in access to equipment and infrastructure. The second focuses on uses linked to digital technologies. Inequalities are manifested by the uses of digital equipment by individuals and social groups. The third focuses on efficient use which allows some nations and some individuals to increase their performance more rapidly. The fourth focuses on learning modes in a knowledge-based economy. As information and knowledge proliferate the changes to learning processes require use of digital technologies to increase performance.

### **2.3.1. The first level of the digital divide in Tunisia**

As we have seen previously, the equipment divide is narrowing due to the rapid evolution of the technology and the sharp fall in the prices of equipment. Mobile phones and smartphones are allowing a large share of the population to access Internet and communications services. While in the previous decade access was through collective devices and public devices, now private devices that allow access to Internet services are becoming the norm. However, significant differences on the issue of internet access are still evident between the poor and the non-poor as well as between regions. People living in the big cities (Tunis, Sousse, Sfax) have better quality of the bandwidth and better coverage of the 4G than the countryside. Specific public policies are still needed to address social inequalities in access to equipment and infrastructure. We need to mention also the gender gap in matter of access is still important. Women's and men's presence in the digital world have both increased since 2011 but there remains a persistent gender digital divide. In 2019, 72.5 percent of men have regular access to the internet compared to 61.1 percent of women (ITU, 2020).

### **2.3.2. The second level of the digital divide**

As equipment becomes more common among citizens, inequalities in the uses of digital equipment by individuals and social groups are becoming more pronounced. In fact, several services are developed nowadays online in Tunisia. The scope of these services is very wide ranging from e-learning, to e-commerce and e-administration. It is worth noting that the use of these e-services differs among the population. While some people are taking advantage of using these services and improving their well-being, others are not able to take full advantage of all the opportunities offered by the digitalization of the economy. During the COVID-19 lockdown, people were forced

to embrace the digital world and the question of the use of digital technologies became central. While some people were able to keep working, learning, buying and selling things, accessing entertainment programs, accessing e-government services, others were not able to do so even if they were well equipped. Unfortunately, there are no systematic surveys regarding the use of the internet and the use of digital technologies in Tunisia. Surveys conducted by the National Institute of Statistics have not taken this dimension into account. Mobile operators and large technology firms have valuable data regarding the use of these technologies, which can help to better understand patterns of consumption, mobility, learning etc ... Important research agenda needs to be put in place in order to better understand how Tunisians are using these technologies (intensity of use and variety of use). Hadhri et al. (2011) have shown that internet use provides consumer surplus, that on average the French have a surplus which varies between 2107 and 2651 dollars. The consumer surplus related to internet use varies among Tunisians and this difference is an aspect of the digital divide.

### **2.3.3. The third level of the digital divide**

The rapid spread of the internet in everyday life is requiring all citizens to have some level of digital skill. Studies and concepts related to digitalization have evolved over time with several focusing on techniques and "button knowledge" related to internet use (Hargittai and Hsieh, 2012; Krueger, 2006; Potosky, 2007). Abascal et al. (2016) suggest that "Even if people have access to the technology, some basic knowledge is required to use it". Internet skills are considered as an important explanation of differences in internet use (van Dijk, 2005).

The European Union defines the e-skills as "critical and sure use of digital technologies". A large part of the society in Tunisia is lacking basic e-skills. Most of Tunisians have not followed specific training in order to acquire the fundamental skills while they are using digital technologies and especially the Internet. For example, they are lacking basic skills about "privacy" and "security" of the use of digital technologies. At the same time, the digital world needs at least that people are literate in order to read and write online. Overall literacy is an important factor, which leads to inequalities regarding the use of digital technologies. In January 2021, only 79 % of the population were literate in Tunisia (Data Reportal, 2021). Digitalization may induce deeper marginalization of illiterate people. Specific training and programs are needed for 21% of the population before shifting some services totally online.

The digital divide is also found in the labor market where digital technologies are benefitting more skilled people Aissaoui and Ben Hassen (2015)<sup>6</sup>.

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<sup>6</sup> See the discussion about the impacts in the labor market in the next section.

#### **2.3.4. The fourth level of the digital divide**

The fourth digital divide is linked to the performances. While some categories of people are well equipped, well skilled and able to use the e-services with efficacy they are not making any extra performance in terms of earning, happiness, job opportunities... other people are using these technologies and are making extra performances and are benefiting from new opportunities to have better earning and better life quality and happiness. Even though digital transformation can bring many benefits, it also can cause new inequalities in society. According to the Skill biased Technological Change Theory (SBCT) digitalization is benefitting the most skilled people and is marginalizing the less skilled people. In Tunisia the digitalization seems to work accordingly. The less qualified and skilled people are less benefiting from the opportunities of digitalization. Moreover, digitalization is not benefiting unemployed people and unemployment is remaining high despite the progress of equipment and use of digital technologies.

#### **2.3. The role of government on digital transformation**

The role of the government in the digital transformation is dual (Hanna, 2018). First, it acts as policy and rule maker to create the enabling environment. Second, it is a strategic investor in digital technology applications and data in support of transformation of the target sector. On the other hand, digital transformation leads to less corruption. Paper is considered power in the bureaucracy system, which in the same time increases the level of corruption. Digital transformation improves efficiency and transparency, due to the digitalization of the services and e-government.

The digital transformation requires the development of a national strategy, offshoring and innovation as well as a legal and regulatory environment, a training and skills development policy as well as a culture of trust in digital technology.

The Tunisian authorities have drawn up several national strategic plans, the most recent of which is the national plan "Digital Tunisia 2020" with a budget of 5.5 billion dinars for the period 2014-2020. The aim of this strategy is to make Tunisia an international digital hub and to promote ICT as an essential lever for the socio-economic development of the country. In addition, the aim of this strategy was to create 95,000 jobs over 5 years and increase exports from 1 billion to 6 billion dinars in 2020.

However, only 25% of the objectives of the strategy have not been achieved by 2020. Out of more than 72 major projects programmed under the Tunisia digital 2020 strategy, only 5% have been completed, 20% are in progress and 75% are still in the project idea phase.

Tunisia has presented now the plan of the “Digital Tunisia 2025” which aims to reduce the digital divide, foster digitalization of education, transition toward e-administration, support entrepreneurship and innovation and the implementation of the national cyber security strategy and the strengthening of digital sovereignty.

### **3. Economic impact of digitalization in Tunisia**

This section explores the impact of digitalization at the macroeconomic level. We propose to discuss firstly, in a classical way the contribution of these technologies to economic growth, before explaining the potential impacts on employment.

#### **3.1. Impact on economic growth and productivity**

In general, previous studies have found a positive relationship between ICTs and economic growth (Jorgenson and Vu, 2016; Niebel, 2018). According to the neoclassical view of ICT, economic growth is increased through capital deepening due to fall in the prices of ICT (van Ark et al., 2008). On the other hand, according to the non-traditional view ICT fosters innovation by facilitating business-to-business transactions, production spillovers and network externalities (Cardona et al., 2013; Paunov and Rollo, 2016).

Digitalization has a transformative effect on socio-economic development. According to the study made by Palvia et al. (2018), ICTs have lowered the cost of doing business in developed countries. The use of ICTs has enabled the access to information and to reach consumers through the internet. Access to digital technologies is instrumental in facilitating communication and connectivity between the firms and customers. This helps the firms to sustain a long-term relationship with their customers.

However, Tunisia has not increased its economic growth or productivity despite increasing investment in digital technologies suggesting a productivity paradox. There are only a few studies that have investigated the link between digitalization and macroeconomic performances (growth and productivity). Most of the works restricted the digitalization to the adoption and use of digital technologies. Saidi et al. (2014) have examined the impact of ICT on economic growth in Tunisia and find a positive relationship between GDP growth rates and the ICT use index. Bakari et al. (2020) investigate the relationship between innovation, internet use and economic growth in the case of Tunisia. In the short run, their results show that the use of the internet positively impacts economic growth. In the long run they found a negative impact of the innovation and the use of the internet on economic growth. This is a surprising result and it may be interpreted as a problem with the way that the Tunisian economy is using the Internet for productive aims. Additional explanations linked to e-commerce will be provided later.

Naanaa and Sellaouti (2017) explore how trade, FDI and new technologies could increase productivity in Tunisia. They show that the interaction term between factor productivity and ICT penetration is significantly positive, implying that Tunisia needs to reinforce its ICT infrastructure. More recently, Kallal et al. (2021) investigates the short and long term relationship between economic growth and ICT diffusion in Tunisia. Their findings show that the impact of ICT diffusion on economic growth is significantly positive in the long term and significantly negative in the short term, since the Tunisian ICT infrastructure needs to be developed. Several papers in the growth literature have shown the relationship between broadband and economic growth. It is worth noting that the broadband network is not well developed and the three mobile phone operators are planning to invest jointly in a new Broadband network.

Further, Dahmani, Mabrouki and Ben Youssef (2022) have examined the relationship between economic growth and ICT diffusion. Their findings are summarized by Table 1 in the annex 1. Their results show an impact of digitalization on economic growth in Tunisia, but quite weak. The impact of ICT diffusion on output is significant, with an elasticity which ranges between 0.040 and 0.056 (when ICT diffusion doubles the output increases by 4 to 5.6%). This is still very weak compared to other countries. Three main explanations can be given about this fact. First, the productivity of digital use is still very low and the country has not yet reached a threshold (in matter of ICT accumulation) under which greater benefits of economic dividend are achieved. The second hypothesis is that digital technologies will produce their dividend in the long run (as in the case of other GPTs). The third explanation is related to the low macroeconomic impact, that is due to non-optimal use of these technologies. The conditions under which these technologies are used do not permit to obtain the expected dividend. This hypothesis will be developed in the fourth section.

### **3.2. Decomposition of the economic impact at the sectoral level**

While the contribution of digitalization - captured partially by recent economic works - to economic growth is weak, there is evidence of important heterogeneity among the sectors in matters of productivity and economic growth. Dahmani, Mabrouki and Ben Youssef (2021; 2022) have also decomposed the impacts of ICT on Value-added at the sectoral level in Tunisia (table 2 in annex). Their results show three categories of sectors:

***Sectors with a positive and significant impact of ICT on value added:*** Sectors with a positive and significant impact of ICT are financial services, transport, building and civil engineering, hotel and restaurant services and other market services. In the case of the financial services sector, the elasticity found is very high (between 0.192 and 0.387). The same is also the case of agriculture, food and tobacco, suggesting that the agribusiness sector is also benefiting from the use of ICT.

***Sectors with a negative and significant impact of ICT on value added:*** Sectors with a negative and significant impact of ICT are trade and various manufacturing industries. The case of the trade can be explained by the increase of the adoption and the use of ICT in the firms, which is fostering the use of e-commerce by firms. However, e-commerce is not well organized in Tunisia and most of the transactions are made in the informal sector. This has resulted in a sector dominated by the new informality. People are buying and selling without any control. Moreover, formal firms are selling some of their products in an informal way. This explains the negative and significant impact of ICT in the sector of trade.

***Sectors with the productivity Paradox:*** For several sectors the impact of ICT on value added is not significant. In the case of public administration, despite a huge investment in ICT there is no impact on the value added. The insignificant impact of ICT in public administration relies on the absence of a deep organizational change as we will explain later in the paper.

### **3.3. The impact on the labor market is increasing**

The macroeconomic relationship between adoption and use of digital technologies and the labor market in Tunisia is not sufficiently established in the current literature. One of the main reasons is the lack of data. However, there are few studies that examine the relationship between the labor market and digitalization in Tunisia.

Aissaoui and Ben Hassen (2015) examine the impact of ICTs on intra-national inequality and technological change in the Tunisian context. They find that there is a technological bias in favor of skilled workers in the Tunisian labor market and that organizational change is contributing to amplifying wage inequalities. Ben Youssef et al. (2014) found that the use of new technologies is pushed by prior adoption of new organizational practices. They suggest that employees' skills will be upgraded through adoption of new technologies and implementation of new organizational practices. Arouri et al. (2019) found that small firms in Tunisia have a strong social impact in the creation of new jobs, but a weak economic impact in terms of wealth creation. They also emphasize the need for Tunisia to promote and create new jobs in technology start-ups and to recruit people with technological qualifications. A study by Arouri et al (2020) found that only 15 percent of firms are responsible for 65 percent of new jobs in Tunisia and these are fast growing firms.

Tunisia is set for a significant technological shock to its labor market. Tunisia has clearly positioned itself as an international platform of offshoring in digital professions. The effects of digital technology on the labor market are not linked only to the number of jobs that can be created. Other effects are already visible. The demand for digital skills is growing and digital skills are increasingly becoming core competencies in many professions. However, the qualification of employees is in question. The digital transformation is accompanied by a strong demand for re-qualification of employees. This will challenge Tunisia's capacity to accelerate training in new

digital professions, and especially to disseminate the new digital culture across the wider population.

At the same time, in some sectors, ICT capital / labor substitution is emerging and will reach a large scale in Tunisia. In sectors such as tourism, mass distribution, catering, construction, the first effects are visible. The cost of labor will be a determining factor in this dynamic of substitution. Until now, the costs were moderate and the employment of the labor factor was justified and rational, but faced with the technological surge and the arrival of expert systems, new materials could change the situation and put the labor markets-which are already in critical situations- under strain.

#### **4. Sectoral perspective: New opportunities and two major bottlenecks**

In this section we describe the potentialities and main problems of the digitalization in Tunisia by deepening the discussion at the sectoral level. In fact, digitalization is transformational change induced by adoption and use of digital technologies. One of the key aspects of digitalization is the fact that it changes the boundaries and the frontiers of the traditional economic sectors by removing barriers to entry. As a consequence, newborn firms (startups) based on new business models are benefiting from the technology to develop their business. Tunisia has seen the rise of startups creation but also a rapid development of e-commerce without strict regulation inducing the development of an e-informality.

##### **4.1. New opportunities**

###### **4.1.1 Industry 4.0 as a lever for innovation in Tunisia**

The concept of Industry 4.0 refers to a new phase of the industrial revolution linked to the development of interconnectivity, automation, machine learning and real-time data processing. Industry 4.0 "a new industrial maturity stage of product firms, based on the connectivity provided by the industrial Internet of things, where the companies' products and processes are interconnected and integrated to achieve higher value for both customers and the companies' internal processes" (Frank et al., 2019).

Tunisia has already taken initiatives in the implementation of Industry 4.0. In December 2020, the HUB I4.0 initiative was set up as part of the Digital Transformation Program in Tunisia. It aims to accelerate the country's transition to Industry 4.0 and to increase awareness of Industry 4.0 in the country. I4.0 competence centers to support the strengthening of the skills necessary for the professions of the future are created.

The HUB I4.0 initiative seeks to reach all stakeholders in the ecosystem. It seeks to raise the awareness of political decision-makers, increase the interest and impact of academia, help

industrial companies, offer actions and opportunities to technological supplier-integrators and finally create tech-startups. The initiative is to provide I4.0 startup incubation and acceleration programs and access to R&D Space (Lab I4.0 / IA) and open production space.

Two industry 4.0 competence centers have been set up. These competence centers are located in Sousse and Sfax and seek to provide support tailored to the needs of manufacturers for the transition to industry 4.0. The centers will concentrate both expertise in Industry 4.0 through access to experts in the field and to training, as well as access to a range of support and support services for Startups interested in leading a transition project towards Industry 4.0. Two other centers are under development, which are linked to key industries in Tunisia (agrifood industry and textile). These two centers will be located in Bizerte and Monastir.

The potential of industry 4.0 as a new industrial policy is very important and can induce huge changes in the productivity and competitiveness of key industrial sectors in Tunisia.

#### **4.1.2. Start-ups dynamics**

With the adoption of new regulation (Start-up Act adopted by the Parliament in October 2018), 401 start-ups have received the start-up label, as of January 2021. On average, each labeled startup employs more than 11 people. One of the most relevant indicators, which highlights the development capacity of startups, is the number of jobs created. Indeed, new jobs were created during the first year of the Startup Act, with an average of 3 new jobs per startup. The new regulation deals with issues such as paperless administration, exporting, international money transfers, recruitment of international staff, etc. New start-ups are accelerating the emergence of new services and industries (clusters) such as the educ-tech cluster (e-education services), the video gaming cluster, creative industries, 3D modeling and artificial intelligence. The start-up act was a game changer and has triggered a new dynamic in Tunisia. This is not just confined to the coastal parts of Tunisia; it is also affecting the whole territory. Something new is happening.

The regulation covers the whole start-up ecosystem from inspiration and ideation to concept, product development, market entry and growth. Recent efforts focus on the growth stage. The growth stage is crucial to resolve the problem of youth unemployment and the contribution of startups will continue to be important in the coming years. Ideation and early-stage start-up have been facilitated by the provision of incubators, fablabs, co-working spaces, etc. It is important also to mention the key role of ecosystem governance ensured by Tunisian start-ups. However, in the industrial area, some equipment at the stage of industrial testing is lacking and some start-ups are forced to move abroad in order to follow their development. . Also, risk capital is critical in Tunisia. Recently, the country started to attract international business angels and already has benefited from several new national business angels.

The six main sectors of activity targeted by startups are: software development and services (Business Software & Services), e-commerce or the creation of marketplaces (Marketplace), education (EdTech), finance (FinTech), cultural and creative industries and health (Health Tech). These six sectors alone account for 60 percent of the startup population and reflect the degree of maturity of these sectors as well as the expectations and concerns of Tunisian business and citizens.

#### **4.1.3. Fintech**

Fintech is becoming an important part of Tunisia's development, and the country is among the first in North Africa to have welcomed emerging fintech. Fintech has a huge potential and has created job opportunities for Tunisians. The main technologies that have helped the evolution of Fintechs in the country are three advanced technologies: “Big data”, “artificial intelligence” and “blockchains”.

The speed of emergence of new firms linked to technology is triggering the formation of clusters. The banking and fintech cluster has been reactive and highly innovative during the COVID-19 crisis. While traditional banking operations have become difficult and more people are working from home, startups and fintechs have provided solutions and offered new organizational practices such as contactless payments, e-banking platforms, mobile payments, and loans for small businesses which highlight the importance of fintechs and their innovativeness during this period. Fintech can help the promotion of financial inclusion (Allen, 2021). In 2020, the Central Bank of Tunisia has launched the BCT-fintech website, which allows among other things, labeled start-ups to develop their activities in a more flexible regulatory framework, without being forced to leave their country to settle abroad. The main objective of the BTC-fintech is to ensure inclusion and financial innovation and change the banking model by moving towards the restructuring and digitalization of banks, to change the financial ecosystem quickly.

#### **4.1.4. Leading sectors: Tourism, Press and E-health**

Some sectors, such as tourism, are heavily influenced by digital technology. Traditional players in this sector have revised their business models: for example, tour operators have been forced to reconsider the range and functioning of their physical agency networks, while airlines have increased direct distribution which relies on the internet.

*Tourism* was among the first sectors to experience the digital transformation in Tunisia. It is linked to international value chains and was one of the first adopters of digital technologies. Important actors are already part of international markets. Hotels, travel agencies, guest houses, tourist restaurants, marinas, and museums are all involved in the digitization of the tourism sector with e-travel agencies operating for over a decade in Tunisia. Several museums in Tunisia are offering virtual visits. The COVID-19 crisis hit the tourism sector hard while also fostering innovation and digital transformation of this sector (Ben Youssef et al., 2020a, 2020b). To maintain their

relationships with users many businesses have implemented virtual tourism strategies. Innovation and the use of technologies are vital for the tourism sector in Tunisia. Tourism linked services are the most used online through the digital platforms (E-commerce). Having a competitive digital infrastructure is key

**Online Press and online Media** are the cornerstones of the media system in Tunisia fostered by intensive use of social media. Most traditional actors have adapted their content, channels of distribution and format. The business model has been transformed and traditional newspapers are facing a crisis. The internet has allowed rapid entry of new online newspapers, and web radio is becoming influential in the Tunisian landscape. Tunisians spend more time surfing the net (29 hours per week on average) than watching television (26 hours), listening to the radio (15 hours) or reading newspapers (3 hours). Online news has overtaken print news and Tunisians are likely to use TV, social media and radio rather than newspapers as their source of information. In addition to constantly increasing internet penetration rate, the rise of social media has enabled online media to increase their reach.

However, the sector is heading towards a new trend, where radios are developing their own television channel on the Internet, newspapers are shifting to video and audio forms, TVs are proposing to write information online. In some ways, the sector is converging on channels that bring access to news and entertainment. Moreover, media performance is more related to web metrics than to traditional ways of consuming information. Competition is becoming fierce in this sector.

**E-health services** use is increasing in Tunisia. Teleconsultations and remote diagnosis are becoming more common. The improvements to the e-health system are important to enable medical decision-making and offer better quality health care to patients. However, despite greater digitalization of the health sector, there remain some difficulties related to digital transformation. Sadok et al. (2016) identifies a number of problems in Tunisia such as lack of a political agenda, structural reforms and a coherent investment program, and market regulation affecting the telemedicine and e-health developments. Important progresses were made during the COVID-19 lockdown in order to overcome these obstacles. For instance, Tunisia has launched a mobile application which identifies and alerts users who may have had contact with people infected with COVID-19. Mansour and Ben Salem (2020) stress that the COVID-19 crisis has accelerated a digital transformation which will allow Tunisia to benefit from increased productivity and achieve competitive advantage since digitalization is key to further development. Tunisia should invest in and strengthen its use of digital tools in the e-health sector.

## 4.2. Two major bottlenecks

As it is explained in the previous subsection, two sectors seem to have barriers in embracing the use of ICT: trade (especially e-commerce) and public administration. These sectors are considered as two major bottlenecks in Tunisia.

### 4.2.1. A need for full digitalization of public services and moving toward E-gov in Tunisia

In 2020, Tunisia is ranked 91 out of 193 world countries in the E-government development index 0.6526. Its E-government development index is 0.6526 making, which is still lower and should be improved.

Despite opportunities to modernize public services and reap the benefits of ICT in the public sector, Tunisia has been lagging behind. E-services are scarce and undeveloped. Public administration websites are most static and include few features. In most countries, governments have economic development policies in place to allow the building of advanced infrastructure and implementation of e-services to allow people to interact and share knowledge, experience and interests. Implementation of e-services improves citizens' quality of life.

However, digitalization of public services and public administrations has accelerated since 2018. The new Tunisian e-gov strategy includes adapting the infrastructures, fostering transversal projects and promoting new applications for public services.

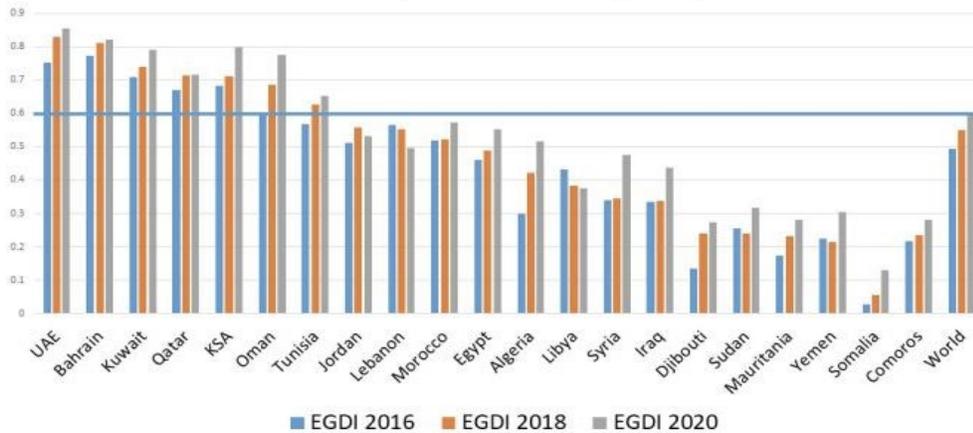
In the case of infrastructure, 760 national administration websites and 980 local administration websites are under construction/revision (since end 2019) and a national cloud is being built to house databases and citizens' data. Several transversal projects are also under development. The first project is *the unique e-identifier to link individual* citizens to all public services which is the most important and transformative project. While citizens currently have several identifiers depending on the ministry involved, this project will allow everyone to have a unique identifier which will persist from birth to 30 years after death. All life cycles will be covered. The second project *Madaniya* aims to digitize all civic registration documents. The third one is TUNEPS<sup>7</sup>, which has been implemented and is used to facilitate publication and submission of public tenders. Other structural projects are under revision or being implemented (78 projects).

However, the implementation of the e-government project depends in large part on the fluidity of the legislative process... The challenges are (1) Administrative reform (excessive administration), (2) Citizens' perception of services rendered and (3) the ability to address the weakness of monitoring and evaluation». The current challenge is interoperability... today interoperability is the citizen!

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<sup>7</sup> Tunisia On-line E-Procurement Services

**Figure 3. E-government development index 2016, 2018, 2020 (Source: UN, 2020)**



In terms of the digitalization of **public utilities**, Tunisia is still lagging behind. Digitalization of public utilities and public services (electricity, water and other public services, such as titling, judicial, identity...) must be imperative for Tunisia. Recently, Tunisia launched the Gov tech project for citizen oriented public services. The GovTech digital transformation project for citizen-oriented public services will support an approach to promote technologies applied to public administration (or GovTech) for the improvement of social protection and education systems. This approach will put citizens at the center of the reform process and combine innovations in public sector reform, change management and digital technologies. Smart metering in electricity will be explored in the region of Sfax, before its generalization, in order to improve the transparency and encourage behavioral change regarding the energy use. Energy efficiency can be increased with the implementation of smart grid projects and smart metering. Similar projects will be implemented in the provision of water. But all these projects have not been implemented over the last decade and are still in their pilot stages.

#### ***4.2.2. The problem of e-commerce in Tunisia***

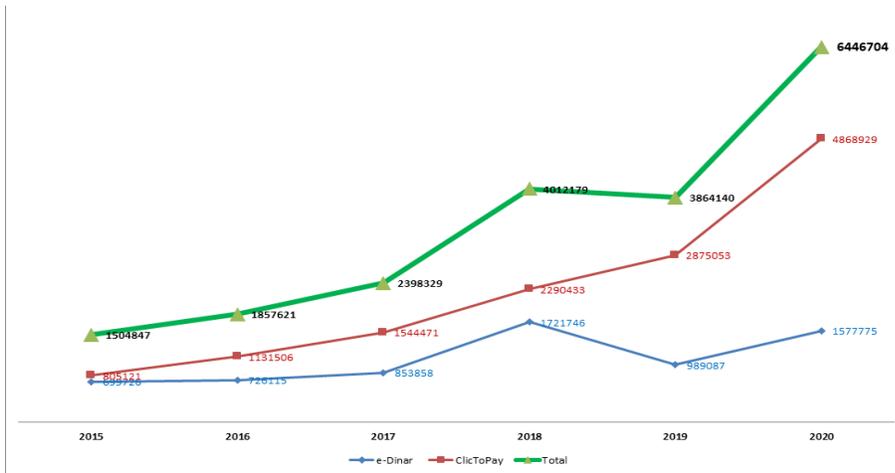
E-commerce is an important sector in Tunisia, since it creates new channels for value creation and value capture (Mahroum, 2021). E-commerce use remains limited, since e-payments and m-payments are not well developed. However, during the COVID-19 we have observed an important increase in the transactions online and the use of e-commerce, with many businesses making efforts to change their business models and sell online. Despite the weak payments system, they have been finding different ways to reach consumers.

In terms of e-commerce, only 6.6 percent of the population make online purchases and/or pay bills online as of January 2020. Use of e-commerce by gender shows that 6.4 percent of Tunisian women and 6.8 percent of Tunisian men make online transactions (Data Reportal, 2020). The e-payment problem means that e-commerce is confined to local transactions and most transactions

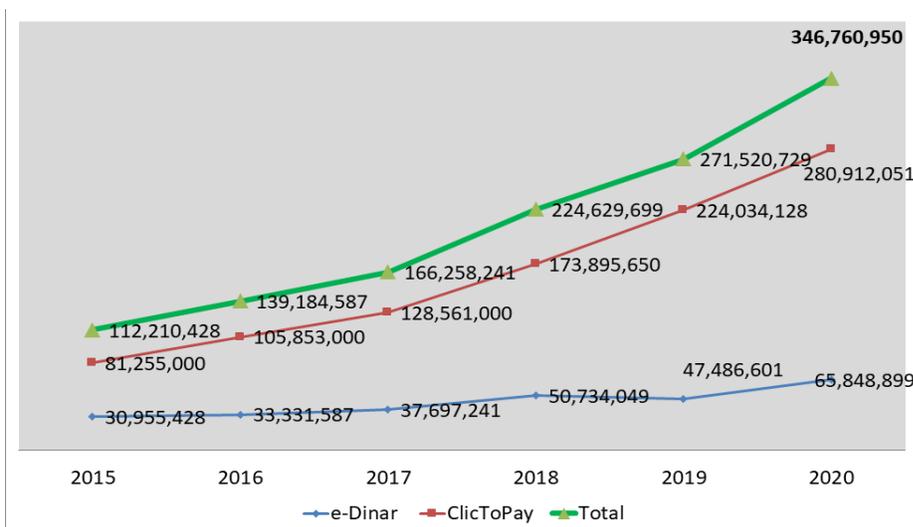
involve cash on delivery (COD). COD is preferred to allow the user to assess the quality of the goods, since there is no regulation saying that refunds are obligatory for poor quality products.

The number of online transactions is increasing very rapidly, and reached 6 446 704 in 2020, and their value reached 346 760 950 TD. The number of e-commerce websites is increasing, reaching 2100 by 2020.

**Figure 4. Number of transactions online**

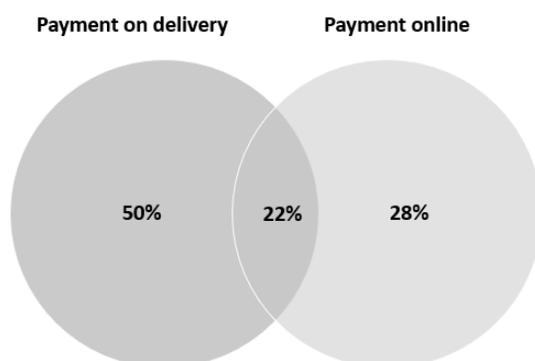


**Figure 5. The value of transactions online in TD**



According to a study conducted by MDWEB<sup>8</sup>, which measures the impact of COVID-19 on Tunisia's e-commerce, 50 percent of e-buyers make the payment only on delivery against 28 percent exclusively online, and 22 percent make the payments either online or on delivery.

**Figure 6. Means of payment for buying online during COVID-19 crisis in Tunisia (Source: MDWEB, 2020)**



The major telecommunications operators Orange, Ooredoo, and Tunisie Telecom have set up online accounts to enable users to buy data and phone services using domestic bank accounts and prepaid mobile cards. The digital technology card was launched in May 2015, to make online purchases of software, mobile applications, web services, and publications in support of entrepreneurial activities<sup>9</sup>. Tunisians also can buy many public services using the electronic payment system, e-dinar. However, they are unable to purchase from many e-commerce sites even using the digital technology charge card.

During the COVID-19 pandemic a new mobile payment solution has been launched – the digital wallet. This allows Tunisians to create a virtual money wallet on their mobile phones, to receive money and make digital payments. The start-up KAOUN launched mobile payments through the Attijari Bank based on their mobile application Flouci.com. This allows users to open an account without visiting a physical bank or postal agency to allow instant financial transactions<sup>10</sup>.

One of the main problems of e-commerce in Tunisia is the lack of regulation. Nowadays, most e-commerce activities are made in an informal way. Firms are using the social networks instead of regular websites to sell their products and the payments are done at the delivery. According to the

<sup>8</sup><https://www.tunisienumerique.com/mdweb-limpact-du-covid-19-sur-le-e-commerce-tunisien-50-des-e-acheteurs-paient-exclusivement-a-livraison/>

<sup>9</sup> In September 2018, parliament passed the Start-Up Act which permits qualified companies to purchase up to 100,000 Tunisian dinars (\$34,400) worth of foreign goods in a foreign currency, using the digital technology charge card.

<sup>10</sup> In terms of financial inclusion, 37 percent of the population have an account with a financial institution, 7.1 percent of the population have a credit card and 2.0 percent of the population have a mobile money account. According to Data Reportal (2020), 5.1 percent of the women have a credit card and 9.3 percent of men have a credit card.

director of E-commerce service in the Ministry of Trade, this informal e-commerce is four-fold that of the regular one and it needs to be regulated in some way. The regulation of the sector is key because consumers are experiencing bad experiences and there are a lot of frauds and problems. People hesitate to make online transactions, due to the fear of frauds. Tunisia needs to tackle this issue in order to foster e-commerce and to benefit from the digital economy.

## **5. Prerequisites and recommendations for reaping digital dividends**

This paper discussed the current state, main opportunities and challenges of digital transformation in Tunisia. Adoption of digital technologies has accelerated largely in the last decade and has reached a critical stage today. The rapid diffusion of digital technologies has fostered the use and exploration/exploitation of new possibilities based on the internet.

Unfortunately, Tunisia's progress so far has had little impact at the macroeconomic level. The adoption and use of digital technologies have not increased economic growth, productivity or employment. Recent studies have found that the effect of digital technologies seem to be null or negative in the short run, meaning that Tunisia's digital infrastructure should be developed and improved. However, the effect on the long run is found to be positive.

At the sectoral level, the diffusion process is unequal among economic sectors in Tunisia. Some sectors are leaders in embracing the digital transformation in Tunisia, such as tourism and media. These sectors are proposing advanced e-services and have changed their business models accordingly. However, other sectors, like public administration, agriculture and building have lagged behind and the rate of digital transformation process remains low. The unequal adoption and use of these technologies among economic sectors leads to a non-systemic approach (coherent approach) to digital transformation at the national level.

Some of the building blocks required for the digital transformation of the Tunisian society are not in place. In this section, we examine the prerequisites for reaping digital dividends and moving toward building new jobs and skills, the change of organizational practices and towards safe, secure digital technologies. We also suggest recommendations to overcome the major bottlenecks in the development of e-government and e-commerce.

### **5.1. Building the needed skills (new jobs, new tasks)**

The new technologies are requiring new skills and training to upgrade existing skills. The jobs and skills needed to work are changing. The future is an automated world, where artificial intelligence, machine learning and other technologies can take on tasks previously performed by humans. However, it remains to be seen whether the projected displacement of jobs comes to pass (Yusuf, 2021).

It is clear that many companies have validated their technological trajectory: that of automation. In Tunisia there are automatic checkouts and drives in supermarkets and robots are used to assemble orders related to online sales. However, not all tasks and work can be fully automated; some tasks require human decision-making. Nevertheless, all tasks are likely to be affected in some way by technology which brings the need for appropriate skills. Digital skills are needed for efficient functioning of society using digital platforms.

Companies are faced with a growing demand for expertise in fields linked to the technological revolution (digital, automation, science). The key strategic sectors offer new perspectives to be seized: Artificial Intelligence, 3D printing, augmented reality, virtual reality... Digital skills are required in various branches and sectors. In general, digital skills - the foundation of skills essential to all and not only to the most qualified - are a prerequisite for any implementation of a procurement strategy.

The COVID-19 pandemic has accelerated digital transformation and the need for new digital skills in the workplace (ITES, 2020a, 2020b). Lockdown triggered the transformation of many business models. Also, people's behavior has also been impacted by the pandemic. They have been forced to acquire new skills to enable distance learning and remote working, and these skills and experiences will have an impact on post-pandemic work practices. Technologies such as the IoT, artificial intelligence, robots, mega-data, augmented reality and virtual reality will make companies more resilient.

A skilled workforce is essential for the introduction of Industry 4.0. Tunisia should invest in developing the appropriate infrastructure for new IT such as IoT, AI, etc. and invest in upskilling, understanding the added value of those technologies and the large opportunities (economic and social) they can offer. It should also invest in and provide people with the skills necessary to be able to work effectively using these technologies. During the pandemic, companies have shown their potential for creativity, innovation and critical thinking by finding new ways to work and deliver their services. After the COVID-19 pandemic, most of today's essential skills will change, and companies will need to provide employees with the skills required for them to be effective. The new reality of a post-COVID-19 world will involve continuous updating of skills.

### **Recommendations about the needed e-skills**

1. Tunisia is performing well in the creation of new ventures and start-ups, but these firms are facing structural problems with lack of high profiles and specific skills in key technologies. Building these skills locally will be one of the biggest challenges. Private sector and the Ministry of Higher Education need to tackle this issue by implementing a 'core e-skills' observatory and proactively deploying appropriate training to meet these needs.

2. Tunisia is suffering from a brain drain and losing its core e-skills. Individuals highly skilled in digital technology issues are leaving the country to receive higher salaries and opportunities in foreign labor markets (especially in Europe). The lack of e-skills could constrain future economic development and limit start-up growth. Foreign policies based on circular migration and attraction of the Tunisian diaspora need to be implemented.
3. The education sector has been ignored in the digitalization process due to lack of equipment and labor unions' opposition to using technologies for education. Tunisia missed the shift to e-education made by most MENA countries during the crisis, as public schools were simply closed. However, the private sector is investing in technology and this is widening the gap between public and private education. Investing in e-education should be a priority for Tunisia.
4. Tunisia should implement strategies to reduce the digital gender divide. It needs to provide more opportunities for female workers in the labor market based on remote working and e-work.
5. Tunisia needs to build e-skills also for e-inclusion. Specific training programs for skilling and reskilling the existing workforce. Tunisia should support education programs, vocational training and industrial doctorates related to Industry 4.0 in order to develop skills and prepare people for the labor market.

## **5.2. Adoption of New Organizational Practices (NOP)**

The economics literature has emphasized how prior IT investments and new forms of workplace organization may be complementary with investments in IT (Brynjolfsson and Milgrom, 2013). According to this literature, weak or lack of performance within firms that have invested in ICT is directly related to the lack or weak adoption of the complementary new organizational practices (NOP) especially in the emerging countries context (India (Lal, 1999); Nigeria (Apulu and Latham, 2011; Lal, 2007); Tunisia (Ben Youssef et al. 2011); Pakistan (Mughal and Diawara, 2011); Malaysia (Alam and Noor, 2009)).

Previous work shows that ICTs are changing the internal organization of Tunisian firms. Ben Youssef et al. (2014) show that the evolution of technology will be strengthened by complementarity between ICTs and adoption of NOP. Prior adoption of NOP pushes adoption and use of the latest technologies. Thus, adoption of digital technologies requires adoption of NOP to support organizational change. Ben Khalifa (2017) investigates the importance of investment in ICT, organizational change, and human capital in Tunisia. He shows that adoption and use of ICTs, organizational innovations and human capital have a positive effect on the innovation performance of Tunisian firms. He highlights that ICT adoption complements human capital and organizational innovations. Bellakhal and Mouelhi (2020) investigated the relationship between digitalization and SME performance using firm-level data for 446 Tunisian companies. They found a positive relationship between digitalization and SME performance in Tunisia, and suggest the urgent need for Tunisia to invest in digitalization to remove the barriers of SMEs' use of digital technologies.

In the last few years, digital transformation has been high on the firm's agendas (Jelassi and Martinez-Lopez, 2020). The COVID-19 crisis has disrupted work and business, and emphasized the need to rethink business strategies. To keep businesses running has required new digital work practices, management and organizational change, and new employee skills. It has posed problems for both managers and employees and driven the search for solutions and adoption of new organizational practices. The COVID-19 crisis has forced firms to embrace digital transformation or risk the survival of their business.

Remote working has helped to sustain production and business during the COVID-19 crisis in Tunisia. However, the effects of remote working on productivity are unclear. In the short term, considering the exceptional conditions surrounding its implementation, remote working might have decreased productivity among individuals with no experience of working from home. In the longer term, we assume that productivity will improve and that remote working will become normalized.

### **Recommendations about adoption of New Organizational Practices**

1. Tunisia should implement strategies in order to promote the new organizational change practices, since so far organizational change has been limited. Implementation of new organizational practices models driven by adoption of new digital technologies need to be imperative for the firms in Tunisia.
2. Policy strategies are needed to foster the adoption of disruptive digital technologies (particularly artificial intelligence, blockchain, drones, augmented reality). Tunisia should adopt proactive policy frameworks to promote digital development and technological innovation in firms.
3. Business strategies should be reformulated. Remote working should be practiced more in the post COVID-19 world, since it could save time and increase efficiency.

### **5.3. Towards safe, secure and digital technologies**

As the economy becomes progressively more digitized, there is a need to ensure that digital technology can be used safely by consumers and firms. Worldwide, e-security is becoming the top priority with the increased incidence of cyber-attacks and cyber-crime, which have increased even more during the COVID-19 crisis.

Despite these efforts to ensure safe and secure digital services, cyber-crimes remain a problem. Technological developments, network openness, and lack of appropriate data protection are affecting Tunisia's networks. A Shadow Server (2020) report suggests that Tunisia was subjected to the highest number of cyber-attacks among African countries. Tunisia is ranked 6<sup>th</sup> in Africa for computer viruses; over 20,000 of them were detected by malware analysis in 2020.

It is vital that Tunisia invests in improving network security and implementing new strategies to protect citizens and firms from cyber-crime. It should invest to ensure internet resilience and raise awareness among citizens so that they can understand how to protect themselves from these risks.

### **Recommendations about cybersecurity**

1. Providing adequate digital infrastructure, “internet for everyone” and improving network security should be one of the most important priorities for Tunisia. Investing in broadband and equipping rural areas could reduce regional inequalities and help to close the digital divide. Improving network security could protect firms and citizens from cyber attacks.
2. Tunisia needs to put in place the national cloud in order to ensure the data security of sensitive data and have its ownership. Protection of sensitive data and raising awareness of data protection must be high on the digitalization agenda in Tunisia. Provision of cloud storage could help to protect sensitive national data.
3. Tunisia should implement the cybersecurity policies in order to make it possible to protect the public and private infrastructure from cyber attacks. Specific policy should be in the use of AI-based cybersecurity systems and data collection, in order to detect and identify new threats.
4. Organizations should put in place the policy of protecting sensitive data of customers, partners, shareholders, and prospective employees. Each firm should at least have the basic cybersecurity practices like guidelines for setting passwords in order to protect their privacy, the rules for using email encryption and the social media, steps for accessing the telework platforms.

### **5.4 A central role for accelerating E-government**

Public administration and the services provided by the state are not playing a transformative role in accelerating the digital transformation in Tunisia and fostering gains in productivity and value creation. Despite important progress related to e-governance and the establishment of new laws and regulations, Tunisia has not reached a critical level of e-government and e-administration. However, the public administration is following the pathway of digital transformation as a result of pressure from citizens and non-governmental organizations. Tunisia’s commitments within the OPEN-GOV partnership have resulted in over a thousand open data sets. Open gov initiatives promote transparency and foster the creation of start-ups. Digitalization of public administrations is at the core of government agendas, but the end-to-end approach is lacking and digitalization of services is still partial. Promoting digital transformation in Tunisia requires accelerating the transformation of public administration and e-government. The COVID-19 crisis has clearly shown the need for such a change.

### **Recommendations for E-government and e-services offered by the state**

1. E-government regulations are needed in Tunisia. Tunisia should implement e-government policies based on achievement of more efficient and effective government, allowing greater public access to information, and making the services consumer oriented. The benefits offered by e-solutions and other innovations are limited by existing laws and regulations. E-gov advances will depend on legislative developments. On November 18, 2020, Tunisia adopted electronic signatures for documents via a new application allowing administrative documents to be electronically signed and adopted by the administration. Electronic signature is straightforward and fast. Other similar regulations need to be amended to take full advantage of digitalization.
2. E-administration solutions need to be developed in order to meet the needs of the customers (citizens). The state can benefit from the resources offered by the internet; digitalization should be focused on adaptations and customization of existing technologies.
3. Digital technology should be implemented for restructuring the public sector and for better management of public utilities (water, electricity...). Despite the existence of technical solutions in the water and energy sectors, the adoption process is very weak. The usage of digital technologies in those sectors should be increased, which could help to avoid “losses”, improve the services delivered and cut costs.

### **5.5 A high priority to E-commerce and financial inclusion**

While private initiatives are progressing - due to the progress of equipment and usage of digital technologies - there are structural barriers for the e-economy: the absence of an effective e-payment system. Recently, efforts are made by the State and start-ups to improve the current environment of the e-economy. Several start-ups are created to help the development of e-commerce and e-payment. However, limited development of e-payments and mobile payments are hampering the use of technology and more actions need to be taken to boost their development. This problem must be resolved for the whole economy to benefit from the opportunities offered by e-commerce and the savings on transaction costs.

### **Recommendations for E-payment and financial inclusion**

1. E-payment and m-payment systems need to be strengthened as soon as possible in order to unlock the potential of e-commerce and increase the transparency about the prices. Tunisia should provide flexible e-payment options.
2. Tunisia should ensure that unsafe products, which are prohibited from the offline market, are not sold to consumers online. It should foster the cooperation between businesses and relevant authorities to address the problem.
3. Policy for regulation and better organization of e-commerce activities should be implemented in order to avoid the informality in this sector. The development of e-commerce business models should be analyzed, improved and supported in Tunisia.

4. The promotion of digital financial services needs to be a priority to expand financial inclusion. Tunisia should support the development of e-financial services and implement a national strategy for e-financial services in order to better manage financial inclusion.

The new digital technologies are causing the 4<sup>th</sup> industrial revolution. Industry 4.0 should make economies more resilient and contribute to achieving the UN sustainable development goals of poverty reduction, reduced gender gap, education for all, energy for all, mitigation of climate change, and decent jobs for all by 2030. This paper has outlined the pre-conditions for unlocking the potential of digitalization and highlighted Tunisia's current progress in this domain and its weaknesses.

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## Annex 1. Estimation Of the Results And Description Of The Variables

**Table 1. Panel model estimation results for elasticities of output – CCEMG and AMG approaches**

	CCEMG		AMG	
	Coefficient	Std. Err.	Coefficient	Std. Err.
Capital	0.291***	0.113	0.298**	0.129
Labor	0.320***	0.112	0.212**	0.107
ICT Diffusion Index	0.056**	0.024	0.040***	0.015
Constant	-0.678	3.036	2.535*	1.526
Common dynamic process			0.596*	0.326
CD test	-1.18		-1.51	
Root Mean Squared Error (sigma)	0.0377		0.0446	

Notes: The CD test was performed under the null hypothesis of cross-section independence. (\*\*\*) (\*\*), and (\*) denote statistical significance level at 1%, 5%, and 10%, respectively.

**Table 2. Long-run elasticity of output with regard to ICT: individual sectors**

	CCEMG		AMG	
	Elasticity	Std. Err.	Elasticity	Std. Err.
Agriculture and fishing	0.103	0.070	0.010	0.060
Agriculture, food and tobacco industries	0.101*	0.055	0.156***	0.025
Construction materials, ceramics and glass	0.015	0.058	-0.024	0.031
Mechanical and electrical industries	-0.008	0.012	-0.008	0.012
Chemical industries	-0.009	0.011	-0.003	0.013
Textile, clothing and leather	0.109	0.096	0.097	0.086
Various manufacturing industries	-0.041***	0.011	-0.019**	0.008
Mines and hydrocarbons	-0.014	0.050	0.009	0.047
Electricity, gas and water	0.017*	0.010	0.018*	0.009
Building and civil engineering	0.029***	0.011	0.034***	0.008
Trade	-0.025***	0.009	-0.012*	0.007
Transport	0.069*	0.041	0.085***	0.035
Post and telecommunications	0.026*	0.015	0.028**	0.013
Hotel and restaurant services	0.074*	0.041	0.044**	0.022
Financial services	0.387***	0.096	0.192***	0.063
Other market services	0.098***	0.039	0.080**	0.037
Public administration	0.011	0.038	-0.005	0.041

Notes: (\*\*\*), (\*\*), and (\*) denote statistical significance level at 1%, 5%, and 10%, respectively.

### Data and Variable Description

The data were collected from the national accounts provided by National Institute of Statistics of Tunisia (INS) and Tunisian Institute of Competitiveness and Quantitative Studies (ITCEQ). The sample is composed of 17 sectors of the Tunisian economy. The different sectors are presented and follow the international standard industrial classification of all economic activities (ISIC) to ensure a clear and relevant industrial classification. All data are annual and cover the period 1997-2017.

The capital variable is measured by stock of capital at constant price 2010 and the labor variable is represented by the active population.

The ICT Diffusion Index (IDI) represents an ICT measurement that is constructed to capture the level of diffusion of ICT throughout the economy and determines the share of the ICT sector in the added value of a particular sector. The main objective of the index is to provide policy makers with a useful tool to benchmark and assess the information technologies diffusion and to promote ICT investments and, consequently, improve economic growth. Technically, the IDI is built based on input-output analysis (Heo and Lee, 2019; Lee et al., 2019; Li et al., 2019; Suh and Lee, 2017; Xing et al., 2011). According to Leontief (1986), input-output tables record intersectoral transactions in a national economy during a certain period, each producing a product/service and at the same time, consuming products/services from other industries such as intermediate consumption. The rows of such a table determine the value of total intermediate supply for each sector and represent the horizontal demand-side of the Leontief model. The columns show the supply-side and describe the composition of inputs required by a particular industry to produce its output.

The ICT Diffusion Index is obtained by dividing the intermediate input of sector  $j$  from ICT sector by total input of sector  $i$ . The IDI is based on the demand-side or supply-driven model (Suh and Lee, 2017), and is specified as follows:

$$IDI = \left( \frac{x_{ij}}{x_{j\bullet}} \right)$$

where  $i$  and  $j = 17$  economic sectors.

### **CCEMG (Common Correlated Effects Mean Group) and AMG (Augmented Mean Group) estimators**

In order to cope with the issues of coefficient slope heterogeneity and especially issues of cross section dependency which can bias the results there are used the estimators (common correlated effects mean group - CCEMG and augmented mean group - AMG) which consider both endogeneity, slope heterogeneity and cross-section dependency problems. In addition, these estimators have the advantage of considering structural breaks and shocks.