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HOW DO DIGITAL TECHNOLOGIES DRIVE GREECE'S ECONOMIC GROWTH? OPPORTUNITIES AND CHALLENGES

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ABSTRACT

Digital transformation is a driver of economic growth by improving labour productivity, increasing competitiveness and exploiting the potential of e-commerce. Digital revolution is "a game changer" as it reshapes the way production, distribution and consumption are organised within firms and across industries and markets, thus making traditional production models obsolete. By leveraging its human capital stock, Greece can catch up with the other EU-28 countries and gain multiple advantages from digital technologies, such as higher total factor productivity, enhanced competitiveness and increased extroversion. The end result will be sustainable growth. This paper aims to present the digital performance of the Greek economy and society and discusses how digital technologies can contribute to Greece's economic growth, with a particular focus on jobs, skills and the learning ecosystem. Given that FinTech is a driver of financial sector development, we also explore the implications of digitalisation for the Greek financial system. To this end, specific policy recommendations covering five policy areas are set out with a view to harnessing the emerging opportunities and ensuring that the benefits are shared by all.

Keywords: 4IR, digital technology and growth, education and skills, FinTech, Greece

JEL classification: O31, O33, L25

ΠΩΣ ΜΠΟΡΟΥΝ ΟΙ ΨΗΦΙΑΚΕΣ ΤΕΧΝΟΛΟΓΙΕΣ ΝΑ ΑΠΟΤΕΛΕΣΟΥΝ ΑΝΑΠΤΥΞΙΑΚΟ ΜΟΧΛΟ ΓΙΑ ΤΗΝ ΕΛΛΗΝΙΚΗ ΟΙΚΟΝΟΜΙΑ; ΕΥΚΑΙΡΙΕΣ ΚΑΙ ΠΡΟΚΛΗΣΕΙΣ

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ΠΕΡΙΛΗΨΗ

Ο ψηφιακός μετασχηματισμός προσφέρει ευκαιρίες δυναμικής ανάπτυξης μέσω της βελτίωσης της παραγωγικότητας της εργασίας, της ενίσχυσης της ανταγωνιστικότητας και της εκμετάλλευσης των δυνατοτήτων του ηλεκτρονικού εμπορίου. Η ψηφιακή επανάσταση αφορά μια διαδικασία συνεχών αλλαγών στο επιχειρείν, το εμπόριο και την καταναλωτική συμπεριφορά, με αποτέλεσμα η προσκόλληση στα παραδοσιακά πρότυπα παραγωγής να έχει φθίνουσα χρησιμότητα. Η Ελλάδα, αξιοποιώντας κατάλληλα το πλούσιο ανθρώπινο κεφάλαιο που διαθέτει, μπορεί να μειώσει το χάσμα σε σχέση με τις άλλες χώρες της ΕΕ-28 και να αποκομίσει σημαντικά οφέλη από τον ψηφιακό μετασχηματισμό της οικονομίας και της κοινωνίας της, όπως αύξηση της συνολικής παραγωγικότητας μέσω της γνώσης, βελτίωση της ανταγωνιστικότητας και ενίσχυση της εξωστρέφειας. Το τελικό αποτέλεσμα είναι η διατηρήσιμη ανάπτυξη. Το παρόν άρθρο παρουσιάζει την πρόοδο της ελληνικής οικονομίας όσον αφορά τον ψηφιακό μετασχηματισμό της και εξετάζει τον τρόπο με τον οποίο η διείσδυση των ψηφιακών τεχνολογιών μπορεί να αποτελέσει βασικό αναπτυξιακό μοχλό. Έμφαση δίνεται στις αλλαγές στην αγορά εργασίας και τη σύνθεση της απασχόλησης και τονίζεται η ανάγκη απόκτησης κατάλληλων δεξιοτήτων μέσω της γνώσης, της διά βίου εκπαίδευσης και της επαγγελματικής κατάρτισης. Καθώς η υιοθέτηση των νέων τεχνολογιών μεταβάλλει το χρηματοπιστωτικό τοπίο, αναλύονται επίσης οι επιπτώσεις τους στον εγχώριο χρηματοπιστωτικό τομέα. Τέλος, προτείνονται συγκεκριμένες παρεμβάσεις πολιτικής που καλύπτουν πέντε κρίσιμους τομείς και οι οποίες κρίνονται αναγκαίες για την επιτάχυνση της διαδικασίας ψηφιοποίησης της ελληνικής οικονομίας και τη διάχυση των ωφελειών στην κοινωνία.

HOW DO DIGITAL TECHNOLOGIES DRIVE GREECE'S ECONOMIC GROWTH? OPPORTUNITIES AND CHALLENGES[1]

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1 INTRODUCTION

"In the beginning, there was data".[2] Machines can better deal with a "vast amount of data which is organized and ... crunched at blazingly fast speeds".[3] These words eloquently describe the automation and robot takeover. Thanks to artificial intelligence, machines can perform tasks that seem "intelligent" but they lack empathy and emotional intelligence. In fact, this is not actually *intelligence* but perfect memorisation and blazing first recall, meaning that in the digital world human resource is the most valuable asset of an organisation and the ultimate generator of value added (Martinez 2019). In this light, the fourth industrial revolution (4IR) does not promise the omnipotence of machines, but multifaceted human-machine interactions aimed to make human life easier, with human skills development remaining key.

The first industrial revolution was about harnessing steam power so that muscle power could be replaced by machines, the second was driven by electricity, the third was based on digital technology, personal computing and the internet, while the fourth has been shaped by a new wave of innovations such as "smart" devices and materials that compete with human intelligence in creativity, ingenuity and imagination (McAfee and Brynjolfsson 2017).

Digital revolution is a supply shock which encompasses the diffusion of information and communication technology (ICT), the growth and usage of internet-based services and more recently artificial intelligence (AI), automation and the Internet of Things (IoT). To a large extent, this evolution is driven by a huge expansion in computing power combined with lower costs. Digital revolution has already started becoming the most important source of opportunity and disruption, impacting established technologies, goods and services, and business models. Innovations such as distributed ledger technology (DLT), AI, extended reality and quantum computing[4] are revolutionising the way of doing business, opening up vast possibilities where businesses can deliver almost anything, anywhere and instantly. Technical progress in the generation of digital products leads to new, better and cheaper products and thus to direct productivity benefits. At the same time, new ICT applications facilitate production and organisational processes and/or new business models (for example, the sharing economy and the gig economy). The impact of digitalisation on economic outcomes is pervasive and stands out as a megatrend, introducing varying levels of disruption in most industries and changing the competitive environment. Technology is creating a world of customised and on-demand services, and companies must reinvent their organisation so as to view each opportunity that comes as if it were an individual market, i.e. a momentary one.

1 The views expressed in this article are those of the authors and do not necessarily reflect those of the Bank of Greece. Special thanks are due to George Hondroyiannis, Stavroula Kampouridou and Alexandros Kaliontzoglou for their comments and suggestions.
2 Whittaker, J. (2018), *Little Book of the Future*, CreateSpace Independent Publishing Platform, p. 1.
3 Whittaker, J. (2015), "Rise of the machines and the future of humanity", *Medium*, 24 June.
4 Accenture (2019a) calls all these technologies DARQ technologies.

While no part of the economy is likely to be impervious to changes by digitalisation, further efforts have to be made to better understand and measure its impact on the macroeconomy, so as to improve the monitoring of technological change and provide appropriate policy suggestions. There are widely different beliefs about what digitalisation truly means[5] and considerable intense debate remains about what policies are required to fully reap the potential gains of digitalisation, while helping workers adjust to and benefit from ongoing structural and technological changes. Research has gone deep in examining what will be the impact of rapid advances in technology on the economy and society.

In economic terms, human capital, defined as a stock of knowledge, skills and personal attributes, becomes the key factor of production. By leveraging its human capital stock, Greece can catch up with the other EU countries and gain multiple advantages from digital technologies, such as: (i) higher total factor productivity through knowledge; (ii) higher competitiveness, as transparent and fast decision-making reduces the operating cost of businesses; and (iii) increased extroversion by a shift to innovative products as a source of comparative advantage and to innovative methods of production. The end result will be sustainable growth in the medium-to-long term.

Automation and AI do not only provide opportunities, but also pose significant challenges related to changes in the labour market and in employment composition, aimed at moving from workforce planning to work planning. In particular: (a) high demand for soft skills (i.e. social and communication skills, emotional intelligence, ability to work in a team) alongside hard skills (i.e. digital skills); (b) an appreciation of the value of lifelong learning (Stournaras 2017); and (c) the necessity of social care for low-skilled and low-paid workers (see European Commission 2018c).[6]

This paper aims to present the digital performance of the Greek economy and society and discusses how digital technologies can drive Greece's economic growth in the current macroeconomic conjuncture, with a particular focus on jobs, skills and the learning ecosystem, as digitalisation is changing the task content of a large number of jobs. Given that financial technology (FinTech) and technological advances in general are drivers of financial sector development, we also explore the implications of digitalisation for the Greek financial system.

The remainder of the paper is structured as follows: Section 2 addresses the performance of Greece's ICT sector over the past few years, as well as the country's ranking in the Digital Economy and Society Index. It also discusses the impact of new technologies on the country's key macroeconomic variables. Section 3 highlights the key role of education and the learning ecosystem in achieving a well-balanced labour market capable of matching the supply of and demand for skills in an environment of rapidly changing technology, while promoting economic and social development. Section 4 focuses on the FinTech sector in Greece and discusses how new technologies not only create business opportunities but also pose challenges for the traditional players in the sector. Finally, Section 5 sets out specific policy recommendations covering five policy areas with a view to harnessing the opportunities and ensuring that the benefits are shared by all.

2 INFORMATION AND COMMUNICATION TECHNOLOGY (ICT): DIGITAL TECHNOLOGIES AS AN OPPORTUNITY FOR RESTARTING THE ECONOMY

The diffusion of digital technologies in EU economies is one of the ten key policy prior-

5 The European Commission defines digital transformation as "a fusion of advanced technologies and the integration of physical and digital systems, the predominance of innovative business models and new processes, and the creation of smart products and services": https://ec.europa.eu/growth/industry/policy/digital-transformation_en.

6 According to the European Commission (2018a), "47% of the EU population is not properly digitally skilled, yet in the near future, 90% of jobs will require some level of digital skills".

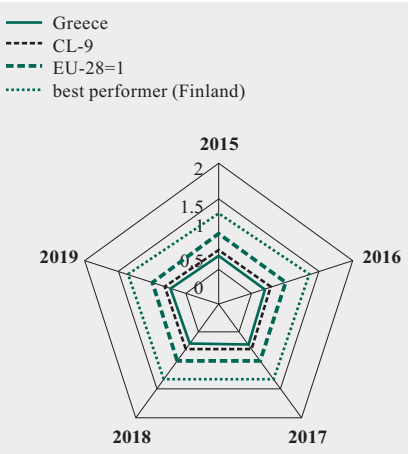
ities of the European Commission.[7] Digital transformation, as part of the 4IR, is a driver of economic growth by improving labour productivity, increasing competitiveness and exploiting the potential of e-commerce. For the laggards, the risk of marginalisation and stagnation is visible. Regarding Greece, the integration of digital technologies, as measured by the Digital Economy and Society Index (DESI), showed slow progress between 2015 and 2019, and Greece, along with Romania and Bulgaria, ranked last among the worst performers in the EU (CL-9), with its DESI score being far below the EU-28 average (see Chart 1).

ICT has been at the forefront of the 4IR. The term ICT encompasses technologies such as: two-sided platforms, the mobile and the app economy, the internet and social media, "smart" devices, AI, electric and self-driving cars, augmented reality (AR) and virtual reality (VR) platforms, interface, the IoT, big data analytics, 5G, cloud computing and blockchain, crowdsourcing, cryptocurrencies and cryptoassets, voice payments, personalised medicine and implantable drug-making cells, neuroengineering, gene drive, new home assistants (Amazon Echo, Google Home) and digital helpers (Alexa, Siri Google Assistant), 3D printing and quantum software algorithms (World Economic Forum 2018).

According to estimates from the European Commission's 2018 Predict Dataset, the value added of the ICT sector was €581 billion in 2015, accounting for 3.9% of the total value added in the EU economy; the sector also had a share of 2.5% in total employment and 15.7% in total Research and Development (R&D) business spending.[8] ICT in digitally mature markets contributes by over one-fifth to world GDP and is expected to reach one-fourth by the end of this century (Knickrehm et al. 2016).

Technological advances, with the main focus on technical interoperability at different levels of the manufacturing ecosystem and mass customisation, offer a unique opportunity for the

Chart 1 The Digital Economy and Society Index (DESI)-Greece's score versus EU-28 (2015-2019)



Source: European Commission, Digital Scoreboard, and authors' own calculations.
Notes: DESI is a composite index summarising 30 relevant indicators and measuring a country's digital performance on a scale from 0 to 100 with respect to five main areas, as shown in Chart 4. Higher scores denote better performance. CL-9: Group of nine countries (Bulgaria, Croatia, Romania, Cyprus, Slovakia, Greece, Poland, Italy and Hungary) with a lower DESI score than the EU average. The chart measures the distance to the EU average for Greece, CL-9 and the best performer (Finland). The index is based on EU-28 average = 1.

Greek economy to return to a sustainable path of growth, income and wealth generation. According to the European IT Observatory (EITO), the value of the Greek ICT market in 2018 is estimated to have grown by a marginal 0.3% to €5.5 billion, following four consecutive years of decline. In 2017, it accounted for 3.1% of Greece's GDP. ICT is emerging as a strategic driving force for restarting the economy.

Specifically:

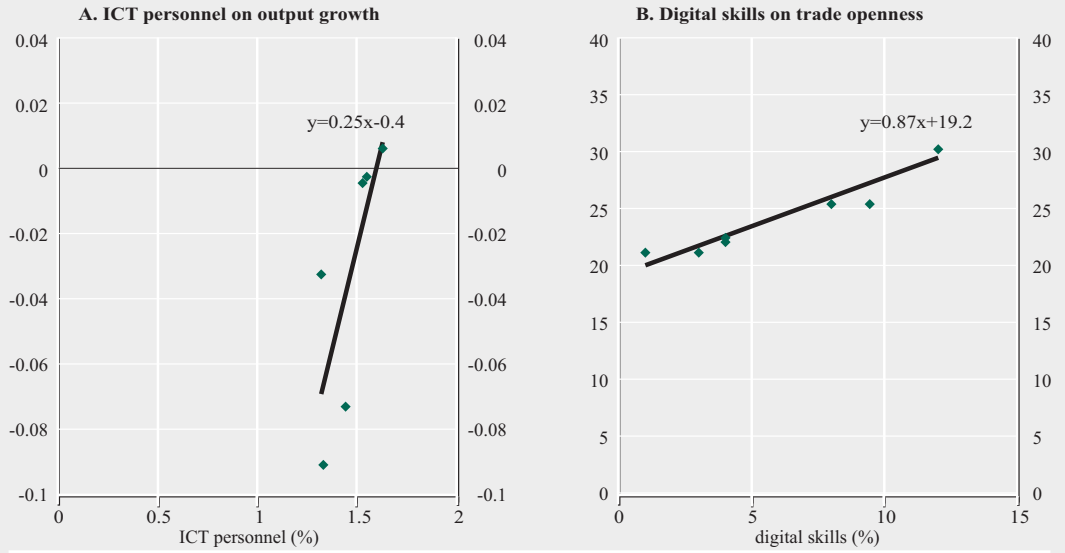
First, ICT brings about transformative changes in the behaviour of economic agents, thereby

7 Since 2015 the European Commission has included in its ten key policy priorities the creation of a Digital Single Market, with a view to removing all regulatory barriers and ensuring a level playing field, reforming the industrial sector, creating new goods, services and processes, boosting employment and increasing cybersecurity.

8 By far the largest contribution comes from the ICT services subsector. By 2020, Europe's data economy will reach €700 billion, accounting for 4% of the EU economy, and by 2025 the Digital Single Market could contribute by €415 billion annually in terms of output and create 1.3 million new jobs (European Commission 2017 and 2018f).

Chart 2 The macroeconomic impact of digital technologies: Greece

(real GDP growth rate %, vertical axis) (trade openness %, vertical axis)



Source: Eurostat and authors' own calculations.
Notes: In Chart 2A, y is the real GDP growth rate and x is the share of ICT personnel as a percentage of total employment. In Chart 2B, y is the share of exports and imports as a percentage of GDP and x is the number of individuals with advanced digital skills, i.e. those who have carried out 5 or 6 of the related internet activities, as a percentage of total population aged 16-74. Available data refer to 2005-2013 for ICT personnel, to 2005-2016 for advanced digital skills and to 2005-2018 for output growth and for exports and imports.

reshaping the way production, distribution and consumption are organised within firms and across industries and markets (Agrawal et al. 2018). Digitalisation involves a process of continuous change in business activity, commerce, consumer patterns, communication, learning and information, thus making traditional production models increasingly irrelevant. In fact, with the exponential pace of innovation as a result of emerging technologies, we are now moving towards a post-digital era, in which a firm's competitive advantage is not only determined by the degree of digitalisation of its production lines, known as SMAC practice,[9] but mainly by the availability and extensive use of digital process tools enabling it to identify early and accurately the fast-changing consumer needs and market conditions and to respond rapidly and flexibly (Accenture 2019a).

Second, the effective use of ICT requires policies that promote continuous professional development and training, adoption of innovative products and startup entrepreneurship.

Third, ICT development enables investment opportunities and, to a large extent, helps unlock the growth potential.

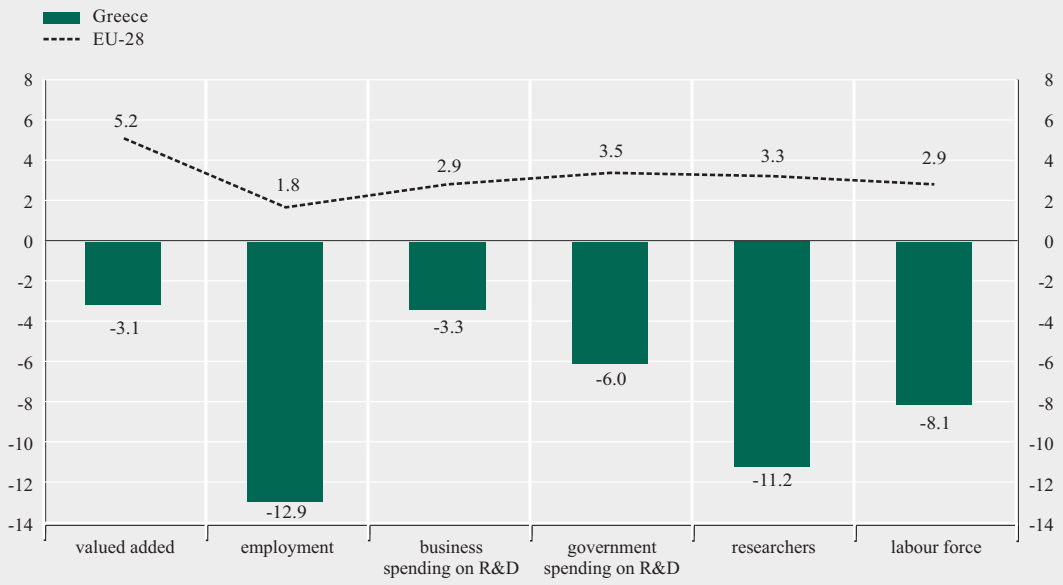
Fourth, as the scaling advantages of new technologies increase and costs in the public sector and throughout the economy are reduced, private investment initiatives are promoted as part of a national growth agenda (Elding and Morris 2018).

A first picture of the macroeconomic impact of digital technologies on the Greek economy can be drawn by simply analysing the relationship between new technologies and the country's key macroeconomic variables. As shown in Chart 2 (A, B), the relationship between digital technologies and real output growth as well as trade openness is positive. It should be stressed that the estimation of the binary relationship covers a very short period and moreover it excludes many other variables that

9 Social, mobile, analytics and cloud (SMAC).

Chart 3 ICT's performance in Greece versus EU-28 (2015)

(annual percentage change %)



Source: European Commission, *The 2018 PREDICT Key Facts Report*, and authors' own calculations.
Notes: The ICT sector includes the subsectors 261-264, 582, 61, 62, 631, 951 (NACE Rev. 2). The latest observations refer to the year 2015.

determine the trend line of real output growth. However, it may provide some evidence of how an improvement in digital skills could favourably affect the country's economic activity, which is useful for our analysis. In particular, the estimation results indicate that an increase in ICT personnel as a share of total employment by one percentage point is associated ceteris paribus with an increase in real output growth by 1/4 percentage point. Similarly, an increase in the country's population with advanced digital skills by one percentage point is ceteris paribus associated with an increase in exports and imports of goods and services as a percentage of GDP by almost one percentage point.[10,11]

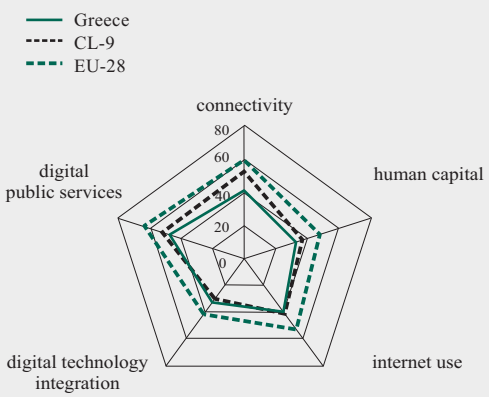
Although the economic footprint of ICT in the EU-28 is visible, the digital transformation of the Greek economy remains sluggish. As a result, the country is digitally immature, as reflected in its low position in international rankings on the basis of relevant indicators. According to the European Commission, in 2015 Greece was the only country in the EU-28 with a negative rate of change in: the value added of the ICT sector; employment; the number of ICT researchers and specialists; and business and public spending on R&D (see Chart 3). At the same time, according to the Digital Transformation Scoreboard, Greece is below the European average based on the indicator of ICT startups. However, although the share of the Greek ICT sector in GDP remains the smallest among EU countries, it shows a positive, albeit weak, trend.

On the basis of the DESI (see Chart 4), which combines quantitative data and qualitative information on five areas (connectivity,

10 We also analyse the impact of ICT personnel and digital skills on new business creation, labour productivity and compensation of employees. However, it appears to be insignificant. This might be explained by the fact that the economic crisis effect dominated in determining the variables' trend lines.

11 Given the weak growth rates and the low digital adoption rates, Accenture (2019b) provides empirical evidence on how AI can be a key transformation accelerator and a new driver of growth for Greece. It identifies three main challenges that slow down Greek entrepreneurs' AI efforts: limited skills for implementing and using AI, insufficient IT performance and low data quality. See also KPMG (2019).

Chart 4 A comparative analysis of the DESI 2019



Source: European Commission, Digital Scoreboard, and authors' own calculations.

human capital, internet use, digital technology integration and digital public services), Greece ranks third to last in the EU-28 for 2019. In almost all areas, it lags significantly behind the average of the group of the nine worst-performing countries (CL-9).

Furthermore: (i) Greece ranks fourth to last in the digital performance of its human resources, with 7 in 10 citizens being regular internet users (EU average: almost 9 in 10), while more than 4 in 10 have never used the internet. (ii) Although Greek businesses use social media extensively, the use of cloud computing and e-invoicing and e-commerce turnover remain at extremely low levels. (iii) Greece's performance in the area of digital public services remains particularly low. Finally, (iv) the country recorded a low score on the Accenture Digital Density Index, which measures the breadth and depth of the integration of new technologies into the market, businesses, production factors and society.

Based on these scores, we may draw the following conclusion about the current state of digital transformation in Greece: the digital gap of public administration discourages private investment, while low digital literacy implies failure to support businesses' digital strategies.[12] Thus, at a time of increasingly digital-led globalisation, Greece lags behind with low digitalisation and weakened momentum, which limits ceteris paribus the potential for a fragile economic recovery to translate into strong growth over the medium-to-long term.

3 JOBS, SKILLS AND THE LEARNING ECOSYSTEM

Technological progress and automation are often seen as posing a risk by making existing jobs redundant and causing unemployment. But while academic work has identified that a significant proportion of jobs will be automated making them redundant (see, for example, Brynjolfsson and McAfee 2011, Frey and Osborne 2017),[13] past experience demonstrates the opposite. Chart 5 provides supportive evidence. By looking at historical data for the US spanning two hundred years, we see that technology has led to higher job creation and has made employment more productive and efficient, resulting in better quality of consumer goods, increased leisure time and higher standards of living.

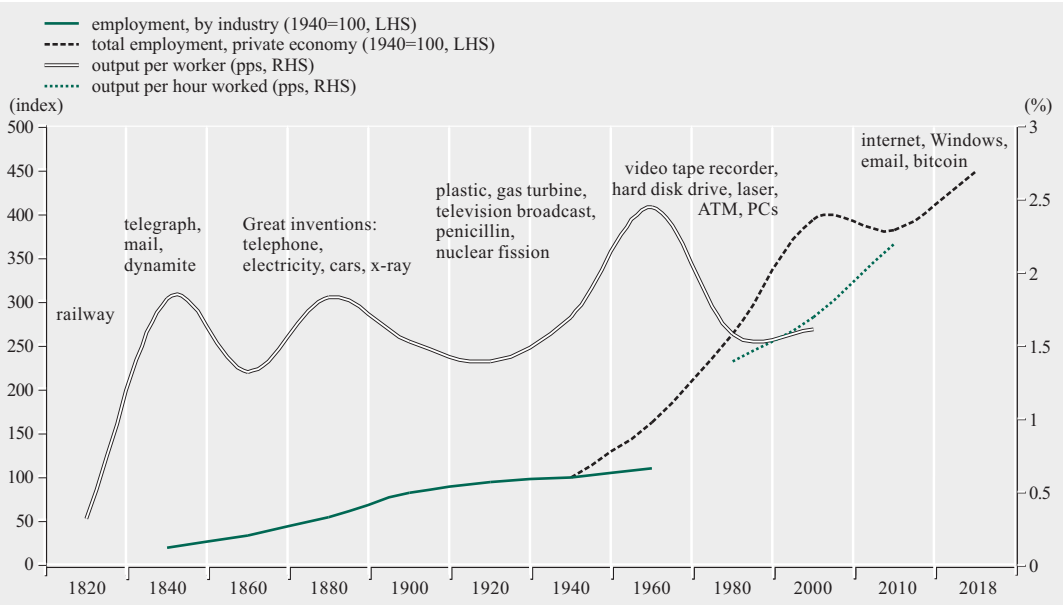
Technological progress has not only created new jobs but has also expanded possibilities for workers to engage in more interesting, productive and non-routine tasks. What is true is that besides perceived risks of future technological unemployment, automation anxiety and dominance of the substitution effect, it is most likely that digitalisation and automation will not eliminate jobs on aggregate but will rather change the task content of a large proportion of jobs.[14] In this context, Nedelkoska and Quintini

12 Regarding the digital maturity of the utilities industry, Greece ranks last in a sample of 21 countries, scoring 17.8/100 (Accenture 2017). Generally, based on a sample of 33 countries, a positive and statistically significant relationship has been found to exist between the digital maturity index and total productivity (Macchi et al. 2015).

13 Frey and Osborne (2017) examined 702 occupations in the US in 2010 and estimated that 47% of jobs are at a high risk of being automated in one or two decades. Employment is distinguished according to low, medium and high probability of computerisation.

14 Acemoglu and Restrepo (2018) point out that "similar claims have been made, but have not always come true, about previous waves of new technologies", quoting pessimistic views of some of the most prominent 20th century economists like Keynes and Leontief.

Chart 5 Technology evolves, employment and labour productivity rise: the US long record (1820-2018)



Sources: Lebergott (1966), Bureau of Labour Statistics Data Series, OECD data, and Mourmouras and Rangazas (2007). Authors' own calculations.
Notes: Labour productivity is measured as output per worker from 1820 to 2000 and as output per hour worked (total economy) from 2000 onwards. Both series refer to annualised growth rates over the previous 20-year period and are presented in percentage points. From 1840 to 1960, employment data refer to employment by industry (agriculture, fishing, mining, construction, cotton textiles, trade, railway and ocean transport) and thereafter to total employment in the private economy (annual data). Both series are indices (1940=100).

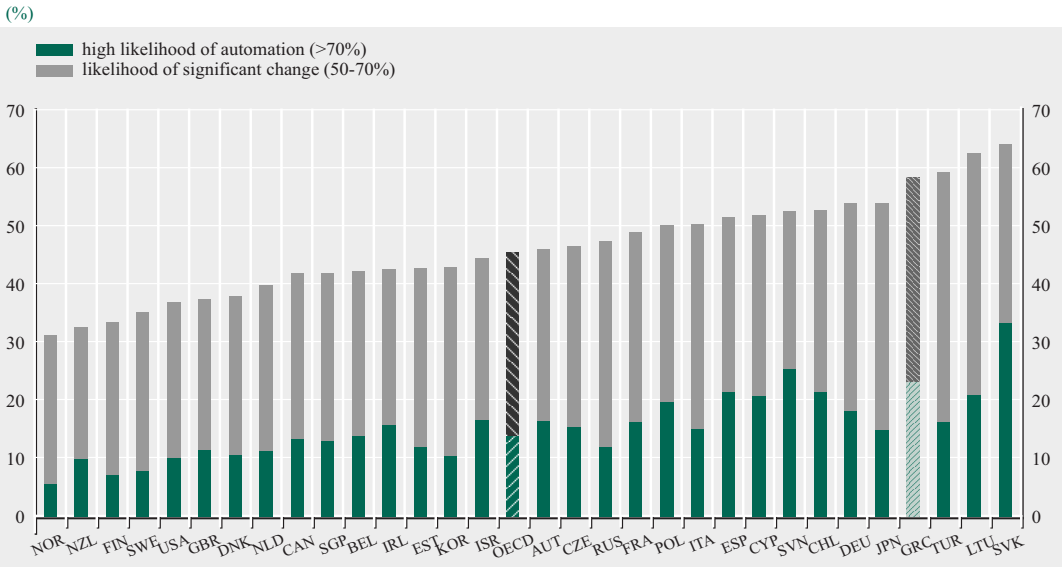
(2018) exploiting the Survey of Adult Skills[15] estimate that 14% of jobs has a probability of automation of over 70%, while another 32% of jobs has a likelihood between 50% and 70% to be automated, thereby changing the skills requirements for these jobs (see Chart 6). For Greece, these estimates are higher than the OECD average (23% and 35%, respectively).

Technological progress causes job displacement, but markets and people do adjust. Yet, in contrast with the past, adoption lags in digital revolution have considerably narrowed (see Chart 7), leading to much faster innovation cycles and increasing the importance of adjustment speed. Innovations used to take a long time from conception to commercial use, but over the last 200 years adoption lags have shortened (Comin and Mestieri 2018).

The accelerating pace of technological changes has resulted in skill-intensive jobs and has spurred a debate about the so-called "digital divide". Lower educated or lower skilled workers who are not able to adapt to the new technologies are left behind, while those that manage to adjust may capture immense opportunities. The implications of the development in AI and machine learning for jobs and skills have indeed dominated studies over the last years, and concerns about widening inequalities remain strong. It has been argued that robots tend to work in a complementary way with skilled workers, while they tend to substitute for the unskilled ones (Autor 2015), leading to job/wage polarisation. Technology can replace workers in routine tasks that are easy to automate and complement workers in non-routine tasks that require ICT-intensive

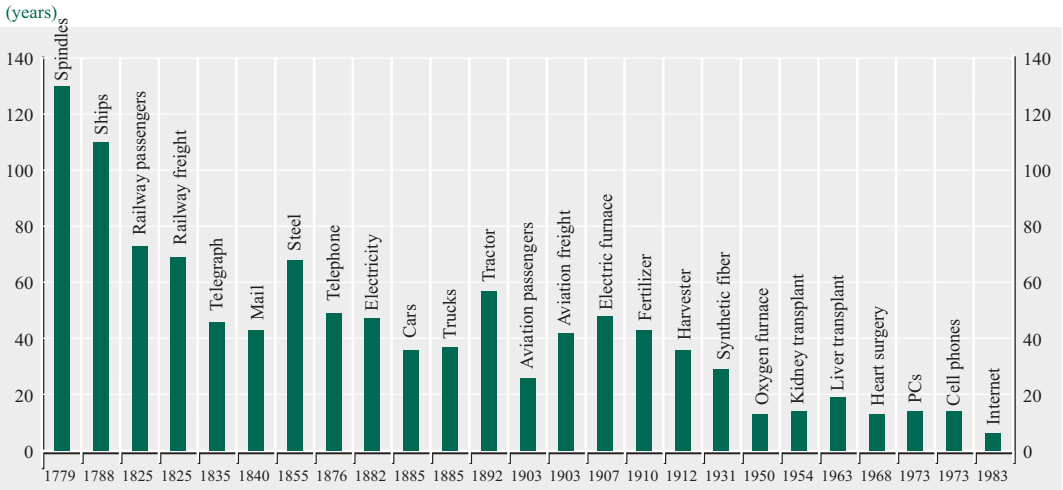
15 The Survey of Adult Skills is the major survey conducted as part of the OECD Programme for the International Assessment of Adult Competencies (PIAAC) measuring adults' proficiency in key information-processing skills – literacy, numeracy and problem solving – and gathers information and data on how adults use their skills at home, at work and in the wider economy.

Chart 6 Likelihood of automation or significant change in task content (2012 or 2015)



Source: Nedelkoska and Quintini (2018).
Notes: Jobs are at high risk of automation if their likelihood of being automated is at least 70%. Jobs at risk of significant change are those with a likelihood of being automated estimated at between 50% and 70%. The data for the following countries refer to the year 2012: Australia, Austria, Belgium (Flanders), Canada, Czech Repubic, Denmark, Estonia, Finland, France, Germany, Ireland, Italy, Japan, Korea, the Netherlands, Norway, Poland, the Russian Federation (excluding Moscow), Slovak Republic, Spain, Sweden, the United Kingdom (England and Northern Ireland) and the United States. Data for the remaining countries refer to 2015 and are sourced from the second round of the first wave of the Survey of Adult Skills.

Chart 7 Mean time of adoption of technologies



Source: Comin and Mestieri (2018).
Notes: The sample covers 25 technologies for 139 countries over 200 years. The chart shows estimates of mean adoption lags for each technology using the estimation procedure described in Comin and Mestieri (2018). The range of average adoption lags by technology goes from 6 years for the internet to 130 years for spindles.

skills as well as cognitive skills. However, robotisation is also creeping into high-skilled occupations and non-routine tasks. According to Cedefop's (2018a) European skills and jobs

survey (ESJS),[16] 47% of adult employees in the EU-28 has already seen changes in working methods or practices, while the ICT sector has seen the largest changes in technologies used in the workplace over the past five years (57% of adult employees). At the same time, as workers perform non-routine tasks more frequently, general cognitive skills (such as reading, writing and numeracy) are increasingly needed, suggesting that there are large complementarities between workers and technology (OECD 2019).

The prevailing implications of new technologies will finally depend on whether the workforce is adequately prepared for the 4IR. First, although the pace of the digital transformation and innovation of the economy and society cannot be accurately predicted, economic performance and employment opportunities largely depend on the digital skills and competence of the labour force.[17] Certain skills and qualifications, such as STEM (science, technology, engineering, mathematics) and ICT, are critical to innovation and creation of a competitive edge in knowledge-intensive economies (see, inter alia, Stournaras 2019). Demand for these skills is anticipated to increase in the short-to-medium term, since ICT is profoundly changing the skills profile of jobs. According to the Survey of Adult Skills, higher proficiency in literacy, numeracy and problem solving increases the chances of getting a job and earning a higher wage (controlling for other factors).[18]

Second, as machines increasingly take over not only routine tasks, as was the case in the past, but also non-routine tasks, e.g. financial market analyses, future jobs require not only high digital skills but also other complementary soft skills ranging from cognitive skills (such as critical thinking and good numeracy skills) through to the right socio-emotional skills (such as team work and problem solving). These soft skills make workers more resilient to change and more willing to experiment, learn quickly and work collaboratively and flexibly in fast-evolving workplaces.[19]

Acquiring skills is a lifelong process, both formal and informal, and starts at a very young age. Cognitive and socio-emotional skills are formed during the very early childhood initial learning (pre-school, primary and secondary education), while high-quality early education is the foundation for the subsequent acquisition of more complex technical skills (OECD 2019).

Reaping the full benefits of digitalisation and successfully implementing a national strategy for the digitalisation of the Greek economy and society will crucially depend on the ability to address the digital skills gap and develop a set of policies that help workers adapt to changes. In Greece, only 46% of the individuals aged 16-74 in 2017 had basic or above basic overall digital skills (EU-28: 57%).[20] Moreover, Greece shows proficiency significantly below the OECD average in all three key information-processing skills (literacy, numeracy and problem solving).[21]

16 Conducted in 2014, the ESJS collected information of about 49,000 adult workers across the EU-28 examining drivers of skills development and dynamic evolution of skills mismatch in relation to changing complexity of tasks and skills needs in jobs: http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey.

17 For the positive correlation between digitalisation and productivity, see the speech by the Vice-President of the ECB Luis de Guindos, entitled "Investment, technological transformation and skills", at the joint EIB-ECB conference on investment, digital transformation and skills, Luxembourg, 28.11.2018.

18 For example, across the 33 countries that participated in the survey, an adult who scores one standard deviation higher than another on the literacy scale is 0.8 percentage point more likely to be employed than unemployed, on average, after accounting for other factors, including education attainment. And an increase of one standard deviation in literacy proficiency is associated with a 6% increase in wages, on average, across the participating countries.

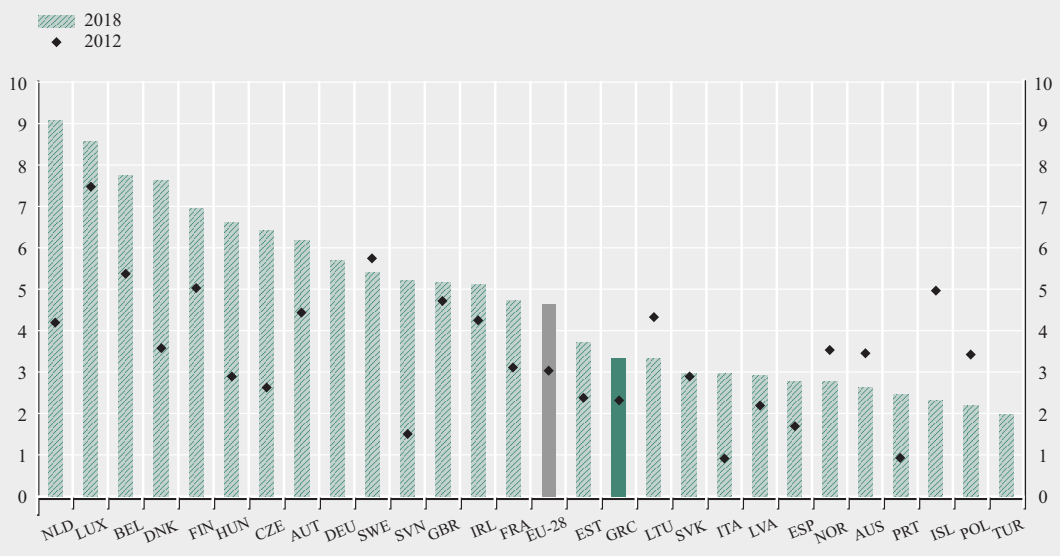
19 The World Economic Forum (2016) estimates that 65% of children entering primary school today will ultimately end up working in completely new types of jobs that do not exist yet.

20 The basic or above basic overall digital skills represent the two highest levels of the overall digital skills indicator, which is a composite indicator based on selected activities performed by individuals aged 16-74 on the internet in four specific areas (information, communication, problem solving, content creation). It is assumed that individuals having performed certain activities have the corresponding skills; therefore, the indicator can be considered as a proxy for the digital competences and skills of individuals. The indicator is based on the EU survey on the ICT usage in households and by individuals.

21 Only about one in 20 adults in Greece attains the highest levels of proficiency in literacy, compared with around one in 10 adults on average across the OECD countries that participated in the survey. 5.6% of adults in Greece attains the highest levels in numeracy, i.e. below the OECD average of 11.2%. Only 2.5% of adults in Greece attains the highest proficiency level in problem solving in technology-rich environments, i.e. below the OECD average of 5.4%.

Chart 8 Enterprises that reported hard-to-fill vacancies for ICT specialists (2018 versus 2012)

(% of all enterprises)



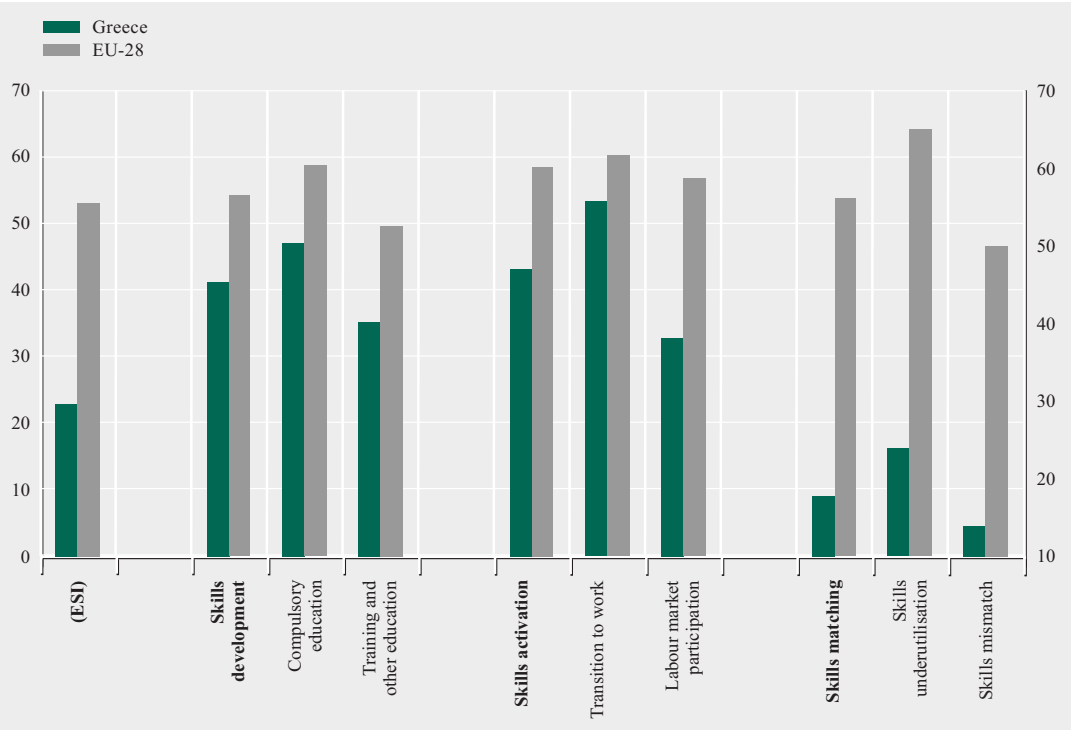
Source: OECD (2018c) and authors' own calculations.
Notes: For Australia, data refer to the fiscal year 2015/16 ending on 30 June; for Iceland, to 2017 instead of 2018; for Portugal, to 2014 instead of 2012.

Greece needs digitally "smart" people who are able not only to use, but also to lead in the usage of, new technologies.[22] In 2015, 29.2% of total enterprises in Greece reported general IT skills (EU-28: 20.8%) and 18% reported professional IT skills (EU-28: 11.5%) as the main skills needed for the development of the enterprise, according to the 2015 Eurostat Continuing Vocational Training Survey. In the Global Talent Competitiveness Index (GTCI) 2019, Greece ranks 44th among 125 countries. Specifically, Greece is a top performer (2nd) with respect to tertiary enrolment. Meanwhile, it registers the worst performance in the relevance of the education system to the economy (99th), lifelong learning (77th) and skills matching with tertiary education (48th), suggesting that, although there is a fairly good pool of graduates, there is ample room for improvement in matching labour market demand and workforce supply.

Specifically, to add to the above, according to Cedefop (2018b), in Greece the share of labour force with high-level qualifications is expected to continue increasing over the period up to 2030 (from 31% in 2016 to 41% in 2030), while the share of labour force with medium- and low-level qualifications is expected to decrease slightly (from 41% to 35% and from 28% to 24%, respectively). However, the supply of high-qualified workers is expected to exceed the corresponding demand, while the opposite is expected to hold for the medium-qualified workers, giving rise to further skills mismatch. Furthermore, the number of businesses having difficulties in filling ICT specialist roles as a percentage of all businesses increased to 3.3% in 2018 (EU-28: 4.6%) from 2.3% in 2012 (EU-28 average: 3%) (see Chart 8). According to the European Skills Index (ESI), a composite indicator that measures the performance of EU countries as regards skills and which consists of

22 In June 2016, the New Skills Agenda, adopted by the Commission, launched ten actions to make the right training, skills and support available to people in the EU: Upskilling pathways: new opportunities for adults; European qualifications framework; Digital skills and jobs coalition; Blueprint for sectoral cooperation on skills; EU Skills profile tool kit for third-country nationals; Vocational education and training (VET); Key competences; Europass; Graduate tracking; Analysing and sharing of best practice on brain flows. See https://ec.europa.eu/social/ main.jsp?catId=1223.

Chart 9 European Skills Index (ESI): Greece (2016)



Source: Cedefop and authors' own calculations.
Notes: The European Skills Index (ESI) is a composite indicator scaled between 0 and 100 which measures the performance of each country in three pillars, each of which measures a different aspect of a skills system: Skills development (Compulsory education and Training and other education), Skills activation (Transition to work and Labour market participation) and Skills matching (Skills underutilisation and Skills mismatching). A score of 100 corresponds to achieving the "frontier" and a score of 0 corresponds to a lowest-case performance. The difference between the score achieved by each country and 100 shows the remaining distance to cover until the best performance is reached.

three pillars (skills development, activation, and matching), Greece ranked 27th among the EU-28 countries in 2016, registering low performance in all three pillars and featuring last in the skills matching pillar (see Chart 9).

The continuum of skills required by digitilisation makes both upskilling and reskilling today's adult workforce far more challenging. In Greece, 56.6% of adult employees participating in the ESJS reported that it is likely to see several of their skills become outdated in the next five years (EU-28: 48.3%). This means that lifelong learning and continuous skills development are becoming even more important as the acceleration of technological change makes specific skills redundant at an even faster pace and poses the challenge of switching multiple job positions in mid-life. However, according to the results of the 2015 Eurostat Continuing Vocational Training Survey, Greek enterprises show poor performance: 21.7% of the respondents (EU-28: 72.6%) provided continuing vocational training (CVT), 15.3% had a CVT plan (EU-28: 47%) and 23.5% (EU-28: 66.6%) reported CVT of current staff as their usual practice to adapt to future skills needs.[23] As for the continuous development of ICT skills, 14% of enterprises provided training in

23 Continuing vocational training (CVT) are training measures or activities which have as their primary objectives the acquisition of new competences or the development and improvement of existing ones and which must be financed at least partly by the enterprises for their persons employed who either have a working contract or who benefit directly from their work for the enterprise such as unpaid family workers and casual workers. Planning of CVT in an enterprise is defined as having a person or unit responsible for organising CVT or having a training plan or budget including CVT.

2018 (EU-28: 23%).[24] Statistics thus show that there is a need for a more systematic replenishment of knowledge throughout working life and for continuous and on-the-job learning to become a more standard work practice.

4 FINANCIAL TECHNOLOGY (FINTECH) AND DIGITALISATION OF THE BANKING SECTOR

Financial technology (FinTech) is a broad term and refers to "firms that use technology-based systems either to provide financial services or products directly or to try to make the financial system more efficient" (see Karakas and Stamegna 2017).[25] The linkage of finance and technology is not a new phenomenon. FinTech and technological advances in general are drivers of financial sector development and there are huge opportunities in terms of access to finance, operational efficiency, cost saving and competition.

The term FinTech has exploded in popularity over the last years and is used as an "umbrella" to describe a range of innovations in the provision of financial services. There is no consensus on a standard classification of FinTech services. According to the OECD (2018a), the applications of digital technologies in financial services may be classified into eight distinct categories: payments, planning, lending and funding, trading and investment, insurance, cybersecurity, operations, and communications.[26] FinTech is a dynamic and rapidly growing sector: global investment in FinTech companies more than doubled and reached $111.8 billion in 2018, while investment in FinTech companies in Europe alone rose to $34.2 billion.[27]

In Greece, the FinTech sector is mainly concentrated on payment services. According to the Bank of Greece online lists (registered tables),[28] there are currently nine payment institutions and two electronic money institutions authorised in Greece, while there is a significant number of foreign institutions that have notified of their intention to provide services in Greece (on the basis of the "EU passport"[29]).

Banking and the provision of financial services are being reshaped by expanding customer expectations for convenience and personalisation. The FinTech revolution presents challenges and opportunities for both incumbents and startups. On the one hand, FinTech firms are earning a reputation for customer-centricity, as they leverage emerging technologies and volumes of customer data to both understand and predict behaviours and needs. New entrants are characterised by greater agility and may be subject to relatively weaker regulatory oversight. On the other hand, banks are increasingly confronted with the need to take advantage of new technologies in order to meet the evolution of their clients' expectations and to innovate with new products and services, while maintaining compliance. Incumbents usually count on brand visibility, size, scale and trust as advantages. The digital re-design of financial services ultimately brews uncertainty for all stakeholders in the ecosystem. The impact of FinTech on traditional players remains uncertain,[30] while, as evidenced by Chart 10, partnering with FinTechs is consid-

24 The indicator is based on the EU survey on the ICT usage and e-commerce in enterprises.

25 The Financial Stability Board (2017) uses an alternative definition for FinTech as "technology-enabled innovation in financial services that could result in new business models, applications, processes or products with an associated material effect on the provision of financial services".

26 It should be noted that this list is not exhaustive. Technologies cannot be studied separately since there are interdependencies among them.

27 However, quantifying the size of the market is quite challenging, given the difficulty to define the exact scope of FinTech services.

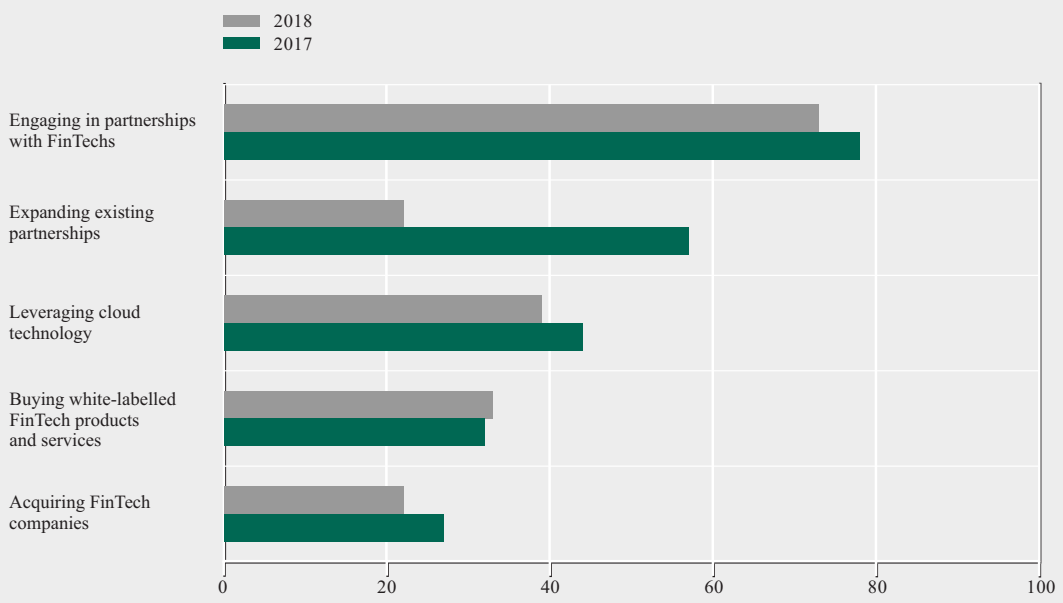
28 https://www.bankofgreece.gr/Pages/en/Supervision/SupervisedInstitutions/default.aspx.

29 The "EU passport", i.e. the freedom to provide services within the EU, with or without establishment, is based on the harmonised supervisory framework applied in each EU Member State.

30 The BIS (2017) analysed five scenarios and assessed their potential impact on the banking industry. Under the first scenario ("the better bank"), incumbent banks digitise and modernise themselves to retain the customer relationship and core banking services, leveraging enabling technologies to change their current business models. Under the second scenario ("the new bank"), incumbents cannot survive the wave of technology-enabled disruption and are replaced by new technology-driven banks. Under the third scenario ("the distributed bank"), financial services become increasingly modularised, but incumbents can carve out enough of a niche to survive. Under the fourth scenario ("the relegated bank"), incumbent banks become commoditised service providers and cede the direct customer relationship to other financial services providers, such as FinTech and BigTech companies. Under the fifth scenario ("the disintermediated bank"), incumbent banks are no longer a significant player and banks are displaced by more agile platforms and technologies which ensure a direct matching of final consumers depending on their financial needs. Under all scenarios, the current position of incumbent banks will be challenged.

Chart 10 How FinTech can help banks meet their goals (2018 versus 2017)

(% of respondents)



Source: MagnaCarta (2018).

ered as the most favourable way to meet banks' goals (see also EBA 2018).

The emergence of the internet and the use of ICT have enabled banks to offer online services. By 2018, 27% of individuals in Greece had used internet banking (EU-28: 54%), i.e. more than six times higher than in 2007 when it was only 4% (EU-28: 25%), albeit with substantial differences across age and education level.[31] Europe's Digital Economy and Society Index (DESI) provides a sub-indicator of particular relevance to financial digitalisation, namely tracking the percentage of the population using online banking services. Greece's score on this sub-indicator increased from 36% in 2017 to 38% in 2018. Nevertheless, it continues to lag behind the European average (64%). According to data from the Hellenic Bank Association, in the first quarter of 2019 more than 7 million physical and legal entities were subscribed internet banking users (compared with around 3 million subscribed users in the first quarter of 2013).[32]

All banks in Greece have largely acknowledged the need to invest in innovation and have now embarked on a digital transformation process. Besides their homeground innovation strategies (adoption of new IT architectures offering a more digital experience to customers, dealing with cybersecurity, etc.), they are using incubators and accelerators to capitalise on FinTech and are promoting an open innovation strategy. For the most part, however, banks do not appear to have optimised their innovation strategies as yet.[33]

31 Internet banking is more popular among individuals aged 25-34 (41%) and the use of internet banking tends to increase with the education level of the user, irrespective of the age group or the gender.

32 However, for the same period, the number of physical and legal entities that were subscribed mobile banking users was 2.2 million, which is lower compared with the first quarter of 2013 (around 2.5 million subscribed users).

33 According to the results of a survey on "Fintech in Greece" that was conducted by the National Bank of Greece (and presented in the 5th Digital Banking Forum) in a sample of 55 FinTech experts in Greece, the majority (35%) of the participants in the survey replied that although there was an initial interest, over the last three years FinTech in Greece did not evolve as initially expected, while 84% of them are relatively optimistic stating that they expect that in the next five years FinTech will grow in Greece, although the sector will still lag behind the EU average. The two areas reported to have seen the most important FinTech developments are Payments (91% of replies) and Blockchain and cryptocurrencies (42% of replies).

The FinTech sector could play a key role in Greece's economic growth. Digital technology can be deployed to make existing ways of finance provision more efficient. For example, the use of "open Application Programming Interfaces (APIs)" facilitates payment service improvements (Ogden 2016).[34] The rapid adoption of new technologies results in lower entry barriers and fosters competition, leading to the emergence of new business models such as P2P lending and crowdfunding. It may create more investment opportunities for smaller players and facilitate access to finance using e.g. mobile devices. A key benefit to the economy is catering to the investment needs of small and medium-sized enterprises (SMEs), contributing ultimately to higher productivity growth for the whole economy (Anyfantaki 2016). Overall, FinTech services offer potential benefits to Greek consumers, such as cost reduction, improvements in efficiency, greater transparency and increased financial inclusion. On the other hand, the main risks arise in the areas of cybersecurity, the use and control of data, consumer protection and money laundering. However, one should also consider the positive impact stemming from the activity of foreign FinTech firms in Greece and the resulting increased attraction of foreign direct investment (FDI).[35]

5 SPECIFIC POLICY RECOMMENDATIONS

Key factors increasing the risk of Greece lagging behind in the digital transformation process are: low digital literacy, insufficient digitalisation of the public sector, the long adoption time of new technologies in the domestic production structure, the small size and family character of Greek businesses which act as a disincentive for investment in new technologies and, finally, the high non-wage cost of skilled labour.[36] To address these challenges, policy interventions are needed under a framework that is aligned with the objectives of the European digital agenda.[37] In particular, these interventions concern five key areas:

Education: The response to the changes brought about by new technologies and the speed of adjustment will influence the structure of the labour market and the task content of jobs. Although the fear of technological unemployment is to some extent justified, as several low-skilled jobs will be automated, new technologies can generate employment opportunities, provided that labour can rapidly adjust to a human-centred work environment, in which knowledge, skills, personal initiative, mobility, flexibility and cooperation will play a key role.

Whether robots finally take over jobs or job creation keeps pace with job destruction will crucially depend on the policy responses. Skills development policies need to be overhauled to reduce the risk of increased unemployment and growing inequality. The aim is twofold: (i) matching the education system with the labour market needs and (ii) encouraging businesses to implement programmes for: continuous learning and lifelong training; apprenticeship to link work with education; and mobility and flexibility, such as telework and collaborative work. In this context, the reform agenda entails rethinking the way education is organised inside and outside the classroom as well as the need to readjust to changing labour demand. While skills supply is crucial to firms, more education is not necessarily the answer. Instead, there is a need that education and skills are in

34 Greek banks have already taken steps towards the implementation of open banking in line with PSD2 requirements. For details, see https://www.bankofgreece.gr/Pages/en/Supervision/PSD2info.aspx.

35 For Greece, Kourouthanassis and Doukidis (2018) estimate the value added to GDP from an increase of FinTech-provided services (these include B2C and B2B transactions) towards their EU average to be approximately 0.6%. This percentage is estimated to be even higher if Greece becomes a regional FinTech hub in South-east Europe.

36 In 2016, Greece was the only country in the EU-28 to show a negative net change in the active population of high-tech and knowledge-intensive enterprises. See National Documentation Centre (2018). It should also be stressed that the Greek brain drain was led by IT specialists.

37 The National Digital Strategy 2016-2021 (December 2016) outlines seven areas of intervention: (1) developing next generation national connectivity infrastructures (NGA Plan); (2) accelerating the digitalisation of the economy; (3) promoting the ICT industry in order to develop digital economy and employment; (4) empowering human resources with digital skills; (5) a radical review of the way Digital Public Services are provided; (6) eliminating exclusion and disseminating the benefits of digital economy; and (7) enhancing security and trust.

immediate demand in the labour market so as to improve the matching between vacancies and jobseekers. In order to equip workers with the right skills, education policy should be up-to-date. To thrive in the digital economy, ICT skills will not be enough and other complementary skills will be needed. STEM disciplines will increasingly need to converge with social sciences, since job positions will need more staff with knowledge across disciplines such as ethics, psychology, business and economics. Policy makers should encourage innovation in teaching methods, classroom practices and curricula to skill up the future workforce. The massive open online courses (MOOCs) are probably the most relevant example of how digital technology has been used to improve the accessibility and provision of education. By the end of 2018, MOOC students had reached a total of 101 million and over 800 universities around the world had announced or launched 11.4 thousand courses.[38]

Funding: A financing tool to support the digital transformation of the domestic economy is Community funding under the two new instruments envisaged in the EU's long-term budget for the period 2021-2027. These are (i) the Digital Europe programme, with a total budget of €9.2 billion, supporting the completion of the Digital Single Market, and (ii) the renewed Connecting Europe Facility, with an increased amount of €3 billion earmarked to support investments in digital connectivity and very high capacity infrastructures (see European Commission 2018d).[39] Meanwhile, the fast-developing FinTech industry is changing the face of banking and finance and may contribute in multiple ways, by offering new integrated customer-centred services that improve the access of SMEs to finance and alternative funding options such as crowdfunding, microfinance and P2P lending. In addition, in the context of the Equifund investment platform, a new financial instrument is provided, aimed to support innovation by SMEs.

Public administration: The integration of all government bodies and agencies into a single Geographic Information System (GIS) is necessary, as it will help to attract investment, by ensuring the fast approval of investment projects, transparent selection and respect for entrepreneurship.[40] The introduction of an integrated digital identification and electronic signature system (see Berryhill et al. 2018) would simplify government-citizen interaction and alleviate the administrative burden on businesses. The digitalisation of justice would contribute in the same direction, by shortening the delays in the resolution of disputes.

Taxation: The rapid expansion of digital businesses (e.g. co-operative platforms, social networking companies and internet content providers) has triggered discussions on the tax treatment of the digital economy, with the dual goal of ensuring fair corporate taxation and avoiding public revenue losses (see OECD 2018c and EY 2018). Indeed, the corporate tax rules currently applicable in the EU, which are designed for brick-and-mortar businesses, have become outdated and, as a result, conventional businesses are taxed at twice the average rate (23.2%) applicable to digital businesses (9.5%). This implies not only an uneven distribution of the tax burden, but also location-taxation mismatches, resulting in public revenue losses, as well as poten-

38 The term "open educational resources" was coined at UNESCO's 2002 Forum on Open Courseware and designates "teaching, learning and research materials in any medium, digital or otherwise, that reside in the public domain or have been released under an open license that permits no-cost access, use, adaptation and redistribution by others with no or limited restrictions. Open licensing is built within the existing framework of intellectual property rights as defined by relevant international conventions and respects the authorship of the work". In 2008, the "Connectivism and Connective Knowledge" (CCK08), led by George Siemens of Athabasca University and Stephens Downes of the National Research Council, was the first to incorporate open learning with distributed content, making it the first MOOC. Subsequently, several MOOCs were developed. The top five MOOCs provided by registered users are Coursera, edX, XuetangX, Udacity and FutureLearn. See https://www.classcentral.com/report/moocs-stats-and-trends-2018/.

39 At the same time, under the National Competitiveness, Entrepreneurship and Innovation Programme, Digital Leap and Digital Steps, totalling €100 million, provide SMEs with up to 50% of their digital upgrading costs.

40 Delays in the approval and licensing of investment projects are due to a number of obstacles, mainly related to spatial planning, urban planning, environmental and archaeological regulations. A first effort to reduce these obstacles was made by Law 4014/2011 on Environmental Licensing and Law 4269/2014 on the establishment of a single geographic information system. Since then, the effort has stalled.

tial tax competition that could jeopardise the Digital Single Market.[41]

Regulation – Security: In order to alleviate concerns arising from the use of artificial intelligence, a sound regulatory framework should be established (see Scientific Advice Mechanism 2017), ensuring the human-centred character of AI and its harmonisation with moral and legal standards and values.[42] In addition, serious security and trust challenges are posed by the collection and use of personal data. The new EU regulation (GDPR), which was implemented by Greek law in May 2018, is the first step towards protecting citizens' data privacy. Greece has yet to enact an implementing law to specify certain details of the Regulation, including the sanction framework. Similarly, the regulatory framework for the free flow of non-personal data within the EU-28[43] eliminates geographical, legal or other obstacles to the movement of non-personal data and opens up new business opportunities for startups and SMEs through data-driven innovation across borders.

41 See European Commission (2018e).
42 Although several frameworks for cybersecurity and e-identity have been established in the EU, they have not yet been adopted or fully rolled out in Member States including Greece, such as TIBER-EU (Threat Intelligence-Based Ethical Red Teaming), the NIS (Network and Information Security) Directive (2016/1148/EU) and the elDAS Regulation (EU) No 910/2014.
43 Regulation (EU) 2018/1807 of the European Parliament and of the Council of 14 November 2018 on a framework for the free flow of non-personal data in the European Union, Official Journal of the European Union, L 303/59.

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