



A digital reboot for the Greek economy

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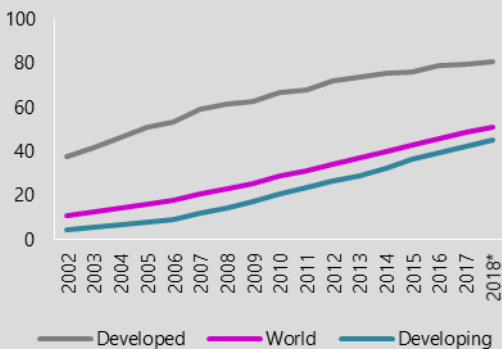
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- Leveraging on the emergence of a digitalized global economy and its human capital advantage (albeit largely unexploited), Greece could be transformed into a highly digitized economy and a regional ICT hub.
- The use of internet has skyrocketed globally, with the number of users increasing by 260 per cent during the past 15 years. Moreover, with the continuous advancement of technology, more sophisticated digital systems have been developed (such as industrial robots and big data analytics), while this upward trend is expected to continue (as “machine-to-machine” connections are expected to reach 4bn in 2021, up from 1.8bn in 2018).
- Countries have benefited from this trend to different degrees. NBG Research has constructed a Business Digitalization Index (BDI) to measure the digital competitiveness of each country. Our estimates suggest that the key determining factors are (i) the business environment (i.e. institutional framework and infrastructure) and (ii) the “digital quality” of human capital. Greece ranks low in the BDI, mainly due to legal/judicial deficits and low internet speed.
- Our analysis also revealed that Greece has an unexploited pool of ICT human capital, which however is mainly inexperienced, as Greece’s ICT sector (the main on-the-job training provider) is less than half the EU relative size (1.9 per cent of GDP, vs 4.4 per cent). Also note that Greek businesses appear eager to acquire more ICT services and/or employ more ICT specialists.
- Based on our estimates, a convergence to the institutional standards of the most digitally advanced Balkan country (i.e. Slovenia) would boost the ICT sector size and increase the share of ICT specialists to 2.3 per cent of total employment (from 1.8 per cent in 2018) – thus, generating extra value added of €1.1bn. Moreover, under a scenario of both institutional and infrastructure upgrade (i.e. converging to Slovenia’s standards), the positive effect to the economy would almost double. In particular, the following steps could be considered:
 - ✓ Foster a speedy network upgrade (5G and fiber).
 - ✓ Establish a coherent national strategy for public sector digitalization.
 - ✓ Upgrade the legal framework for entrepreneurship and the judicial procedures that safeguard it.
 - ✓ Introduce policies and incentives for digital training.
- Apart from the direct effect of turning Greece into a digitized economy, such reforms could transform the Greek growth model by providing a “digital reboot”, and according to our estimates from the NBG Digital Growth Model, boost annual GDP growth during a course of 5 years by 2.6 percentage points under the institutional-reform scenario, and by 6.4 percentage points under the parallel infrastructure-upgrade scenario. Also note that these estimates underestimate the total benefit, as this transformation would probably also attract physical investment – thus boosting growth further.

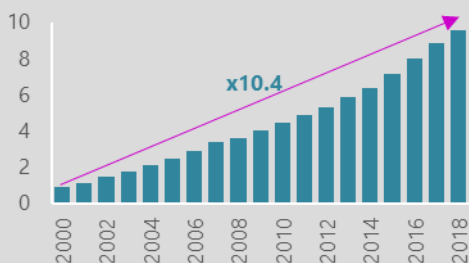
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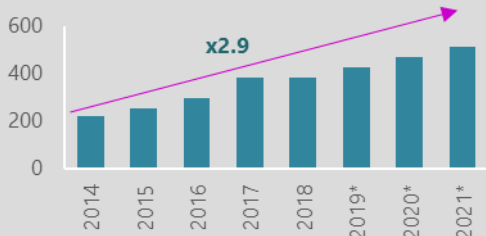
Individuals using the internet (per 100 inhabitants)



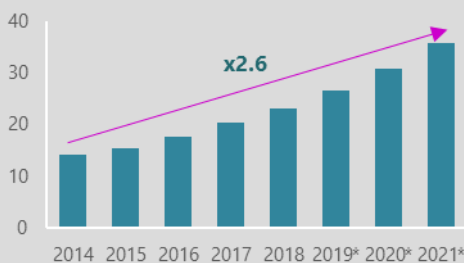
E-commerce penetration (% sales)



Supply of industrial robots (thousand units)



Internet of Things (billion connections)



*estimates

Sources: ITU statistics, www.statista.com, NBG estimates

In the aftermath of a prolonged recession, Greece urgently needs a catalyst to reboot its economy. Moreover, recent international research has identified that prompt and efficient digitalization will be the key attribute of enterprises (and countries) playing a leading role in the global markets over the next decade. In the new Digital Era, new players will emerge as global champions, while increased interconnections between people and machines are going to reshape sectors, economies and societies. Against this background, the key question is: Can Greece exploit the new rules of the game, transform itself to a digitalized economy and gain competitive advantage in the international market?

In the following analysis, we examine the global framework of business digitalization as well as Greece's relative position. We focus on the key factors that determine the digital sophistication of each country's business sector. We also derive estimates for the potential long-term boost to the Greek economy in the event Greece enacts the necessary reforms and undertakes the necessary infrastructure projects for becoming a regional ICT hub.

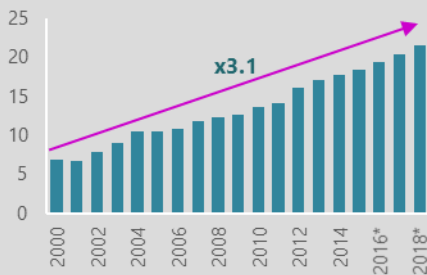
THE RISE OF THE DIGITAL ERA...

The use of internet has skyrocketed during the past 15 years, with the number of Internet users globally increasing by 260 per cent (51.2 per cent of the population in 2018, up from 14.1 per cent in 2002¹). The expansion of internet usage was followed by a boost in online transactions, with e-commerce covering 10 per cent of retail trade in 2018 compared to less than 1 per cent in 2000.

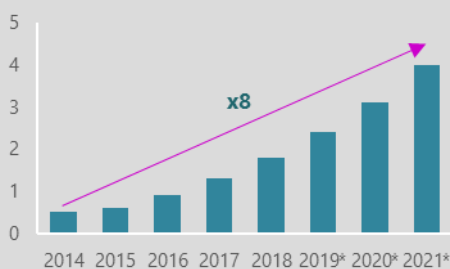
With the continuous advancement of technology, more sophisticated digital uses and systems have been developed. The new technology products such as Industrial Robots and Internet of Things (posting increases of 74 per cent and 65 per cent, respectively, during the last 4 years) are indicative of the fast

¹ Despite the impressive rise of internet users in developing countries (10.4 per 100 inhabitants in 2018 from 0.4 in 2002), their low starting position does not allow them to close the gap with developed ones (32.7 per 100 inhabitants in 2018 from 3.9 in 2002).

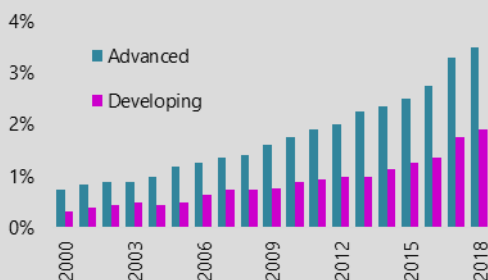
Patents in Artificial Intelligence
(thousands)



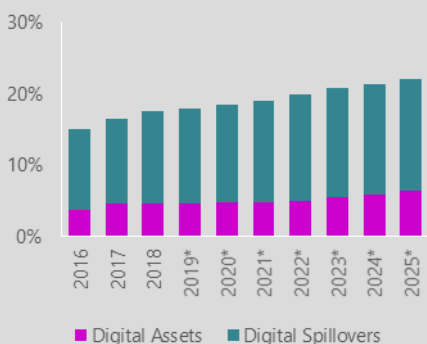
Machine to machine
(billions connections)



Digital Investment
(% GDP)



Economic benefits by digital Economy⁴
(%GDP)



*estimates

Sources: Eurostat, WEF, IFR World Robotics, OECD, Oxford Economics, ITU statistics, Statista, European Commission (Digital Agenda Scoreboard-DES), NBG estimates

progress of digitalization. On the same note, it is worth mentioning that AI patents have increased about 51 per cent during the last decade. This upward trend is expected to continue as the number of “machine to machine” connections is estimated to reach 4 bn connections in 2021 (up from 1.8 bn in 2018).

... AND THE EMERGENCE OF THE DIGITAL ECONOMY

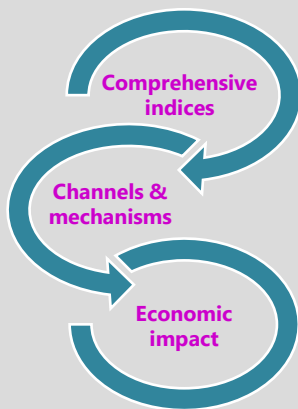
Against this background, enterprises and governments worldwide have placed digital transformation high on their agendas as a means of boosting economic growth and facilitating job creation.

While it is difficult to quantify the economic impact of digitalization, there are two main approaches followed by the existing research on this issue:

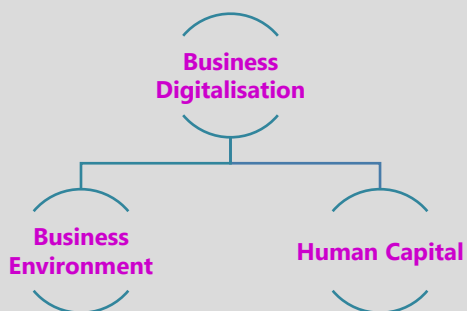
- ✓ **The Digital Assets approach:** Global digital investment has reached 3.5 per cent of GDP for advanced economies (up from 0.8 per cent in 2000) and 1.9 per cent for developing countries (up from 0.3 per cent in 2000). Based on estimates for digital assets combined with their spillover effects, the digital economy² is estimated to currently cover 18 per cent of world GDP (and is expected to reach 22 per cent by 2025).
- ✓ **The GDP Boost approach:** According to World Bank estimates, a 10 per cent increase in digital penetration is estimated to provide a growth stimulus of 1-2 percentage points (1.2 percentage points in average for developed countries, and 1.4 percentage points on average for developing countries). According to a GSMA report, 5G will contribute about \$ 2.1 trillion to the world economy by 2034. Several sectors will experience a significant boost (e.g. consumer industries by \$5 trillion during the next decade),

² Digital Economy is defined as the sum of Digital Assets (hardware, software and telecoms equipment) and Digital Spillovers (with a multiplier of 3.5 over digital assets)

A 3-steps approach



Measuring the digitalization of business sector



mainly through cost savings and productivity improvements³.

With a view to understand the complexities and intricacies of the digitalization process and its effect on the national economies, NBG Research formulated a 3-step approach. In particular:

- ✓ We have constructed comprehensive indices measuring the whole spectrum of the business digitalization phenomenon– that is, both its drivers and its outputs.
- ✓ We have identified the channels and the mechanisms that Greece can utilize to digitally upgrade its economy.
- ✓ We have estimated the boost to the Greek economy, in the event of Greece capitalizing on its strengths.

STEP1: MEASURING THE DIGITALIZATION OF THE BUSINESS SECTOR

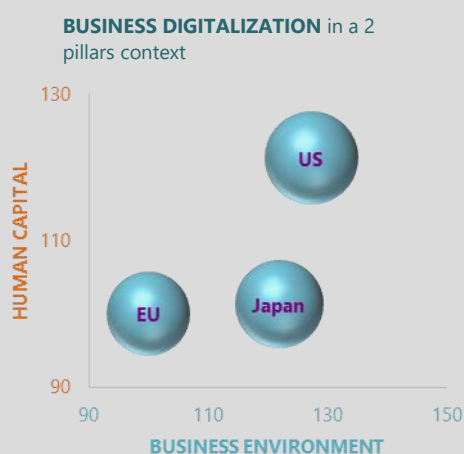
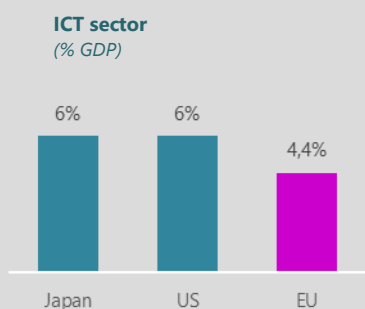
With business digitalization becoming a key competitive advantage for the next decade, it is important to evaluate the positioning of each country in the global digital landscape. Under this goal, we will first assess the EU position in the global context (i.e. versus US and Japan), and then Greece’s position in the European context (i.e. versus other EU countries).

In order to gain a clear picture of the current state of business digitalization in each country, we have constructed a **Business Digitalization Index (BDI)**, comprising of three main axes (see Annex for a detailed analysis):

- ✓ a. Adoption of digital tools (e.g. e-commerce, ERP)
- ✓ b. Adoption of digital culture
- ✓ c. Employment of ICT specialists

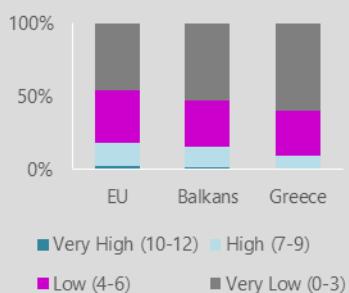
Taking the analysis one step further, we have grouped the main determinants of the digital level (as captured by Business

³ “Digital Transformation of Industries Demystifying Digital and Securing \$100 Trillion for Society and Industry by 2025”, WEF 2016



* The size of the bubbles depicts the BUSINESS DIGITALIZATION INDEX

Digital Intensity Index 2018
(% of enterprises by level, based on number of digital tools)



Sources: Eurostat, World Bank, WEF, OECD, Oxford Economics, European Commission (DESI), NBG estimates

Digitalization Index) into two Pillar Indices (see Annex for a detailed analysis):

- ✓ **Pillar 1: Business Environment Index**, with 2 sub-indices:
 - a. Institutional framework, and
 - b. Infrastructure
- ✓ **Pillar 2: Human Capital Index**, with 2 sub-indices:
 - a. Labor force, and
 - b. Individuals

Therefore, as the Business Digitalization Index offers us the “what” of the current digital position of each country, the two Pillar Indices provide us with the “why”.

A. The EU in the global context

A first glance at the data reveals a significant digital lag of the EU region vs the US and Japan (see Box 1). At the core of the digital economy of each country is its ICT sector. Therefore, a simple digitalization measure is the relative size of the ICT sector, the fact that it covers just 4.4 per cent of the EU GDP compared to 6 per cent in Japan and the US provides a first indication of a significant gap.

In fact, by applying our analytical model of the Business Digitalization Index and its two Pillar Indices, we get a clearer indication of the EU digital gap. In particular, the BDI of EU is 24 points lower than the US index and 12 points lower than the Japan index. By depicting this comparison in a scatter graph (with the axes being the 2 Pillars), we observe that both the Business Environment (x-axis) as well the Human Capital Index (y-axis) are significantly lower in the EU vs the US and Japan. Therefore, the estimated EU digital gap (as captured by the BDI) appears consistent with the prevailing conditions in the continent (as captured by the 2 Pillar Indices).

B. Greece in the EU context

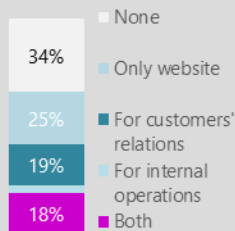
Turning to the Greek business sector, we observe that it exhibits several manifestations of low digitalization compared with the EU average. First, its “core sector” (i.e. the ICT sector) in Greece is less than half of the EU relative size (covering 1.9 per cent of GDP in Greece, versus an EU average of 4.4 per cent of GDP).

Our BDI analysis verifies the low level of digitalization in the Greek business sector. In fact, we estimate that Greece has a BDI gap of 37 points versus the EU average and, more worryingly, it also has a gap of 14 points versus the Balkans average.

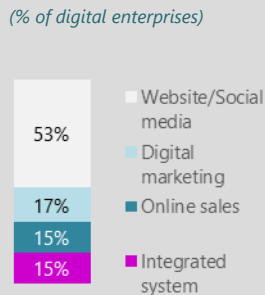
We also notice that there are significant differences between the levels of the three BDI sub-components in Greece. At one end of the spectrum is the relatively good performance of “Culture” (exhibiting an EU gap of 21 points) - mainly boosted by the eagerness of enterprises to recruit ICT specialists (with 22 per cent of Greek enterprises having an ICT specialist, vs 20 per cent in the EU). At the other end of the spectrum is the relatively weak performance of “Employees” (exhibiting an EU gap of 51 points) – mainly restricted by the number of ICT specialists (1.8 per cent of employment in Greece, vs 3.9 per cent in the EU), which in turn mainly reflects the relatively small ICT sector (as the majority of ICT specialists are working or have worked in the ICT sector). This disparity (i.e. many enterprises recruiting few specialists) appears at first counterintuitive. A deeper dive in the data reveals that the ICT departments of the Greek enterprises are generally understaffed, as only 45 per cent of the enterprises with ICT specialists state that their ICT needs are mainly covered by their employees (versus a share of 80 per cent in the EU).

Regarding the third subcomponent, “Tools”, its performance falls somewhere in between – exhibiting an EU gap of 36 points. Specifically, just 10 per cent of the Greek enterprises use more than 7 digital tools in their operations, compared with 18 per cent in the EU (and about 14 per cent in Balkans). Furthermore, Greek enterprises have mainly opted for a superficial use of digital

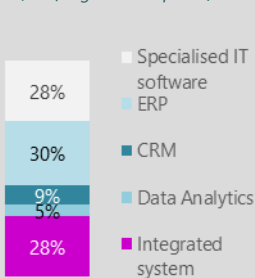
Greek SMEs: Digital tools (% of enterprises)



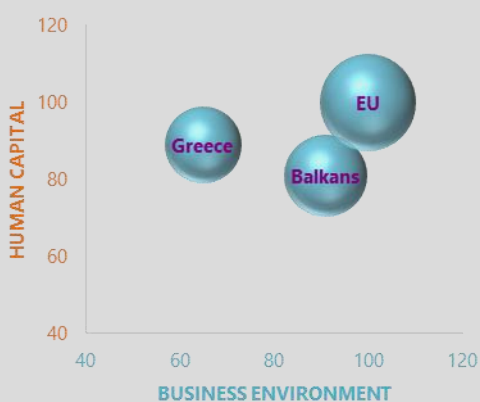
i. tools for customers' relations (% of digital enterprises)



ii. tools for internal operations (% of digital enterprises)



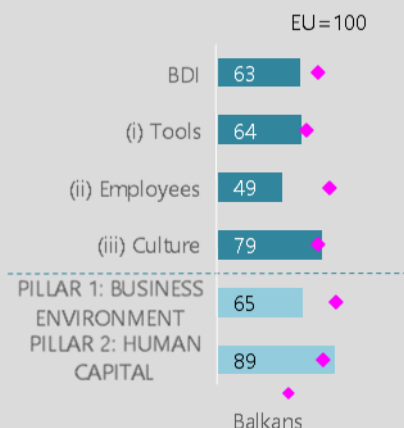
BUSINESS DIGITALIZATION in a 2 pillars context



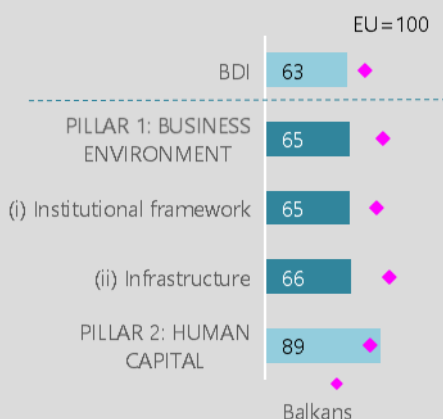
* The size of the bubbles depicts the degree of BUSINESS DIGITALIZATION

Sources: NBG SMEs survey, Eurostat, WEF, European Commission (Digital Agenda Scoreboard-DESI)

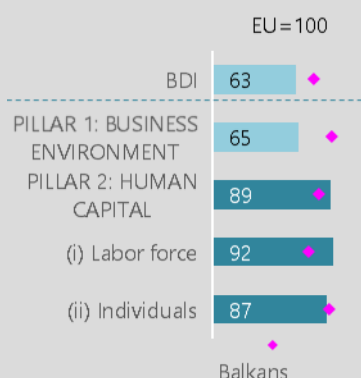
BUSINESS DIGITALISATION INDEX (BDI)



PILLAR 1: Business Environment



PILLAR 2: Human capital



*The indices have been expressed relative to the EU average=100. The highest the index the positive the effects.

Sources: WEF, European Commission (Digital Agenda Scoreboard-Desi), OECD, Eurostat, NBG estimates

technology, as it appears that there is a clear preference for adopting simple applications (like basic digital tools and web sites) and a general reluctance to adopt integrated systems (comprised by e-commerce and other advanced digital tools). Similar results were drawn from a recent NBG survey on Greek SMEs, showing

- ✓ a high share of SMEs (34 per cent) with no digital tool,
- ✓ a low share of digital SMEs having an integrated digital system either for customers (15 per cent) or for internal operations (28 per cent).

By applying our model of the BDI and its two Pillars, the main culprit of the digital gap appears to be the Business Environment (which is less competitive even in comparison with the Balkans average), while the quality of Human Capital is close to the EU average (and superior to the Balkans average). In particular, our 2 Pillars Analytical Framework suggests that:

- Business Environment Index reveals a significant gap of 35 points (and 26 points versus the Balkans average), reflecting both
 - ✓ Institutional deficits (mainly in terms of judicial/legal efficiency and support to digitalization), and
 - ✓ Infrastructure deficits (mainly in terms of low network speed).
- Human Capital Index is relatively close to the EU average (i.e. exhibiting a 10-points gap) and it over-performs the Balkans average, as
 - ✓ The digital quality of the labor force is boosted by the abundance of Programmers (with 6 per cent of individuals having written a computer program using a specialized programming language, versus 3 per cent in the Balkans and 6 per cent in the EU).
 - ✓ On the other hand, as in the case of enterprises' digital usage, the individuals' usage is skewed

towards simple tasks (such as news update and social media) and less towards advanced tasks (such as online shopping).

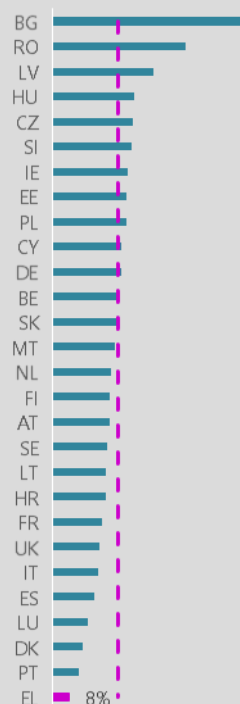
STEP2: IDENTIFYING THE MISSING LINK

Based on our BDI framework, the key fact standing out is that Greece appears to be in a peculiar situation, where (i) there are enterprises willing to hire ICT specialists and (ii) many graduates with ICT and programming skills, but we lack the intermediate on-the-job training which could turn the inexperienced programmers to ICT professionals. As the pool of ICT experts is directly linked to the job positions provided by the ICT sector (see scatter), the missing link is an adequately sized ICT sector.

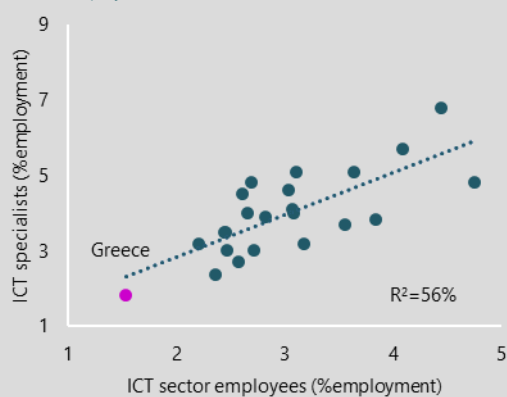
Therefore, the key question becomes if Greece could attract global ICT companies and support the creation of domestic ICT clusters. The potential human capital exists, as ICT graduates and programmers cover a share in the population as high as the EU average. Moreover, Greece's attractiveness for ICT companies is reinforced by the relatively low wages of developers in Greece (with the average wage of developers in Greece standing at €15,000-20,000 per year, vs a global average of €45,000-50,000⁴). Furthermore, Greek businesses appear eager to absorb more ICT services, as 1/2 of them use external providers for covering their ICT needs (a share that is similar to the EU average).

So, why this potential has materialized so far? It appears that the problem lies in the business environment in Greece (as it is evident by the large gap vs EU of the Business Environment Index). To test this hypothesis, NBG Economic Analysis Department has constructed a cross-sectional econometric model, using a sample of 25 EU countries, aiming to estimate the size of the ICT sector⁵ based on the Business Environment Digital Index (i.e. reflecting the quality of the institutions and infrastructure). Having established a statistically

ICT Specialists
(% programmers)



ICT employment and ICT specialists
(%employment)



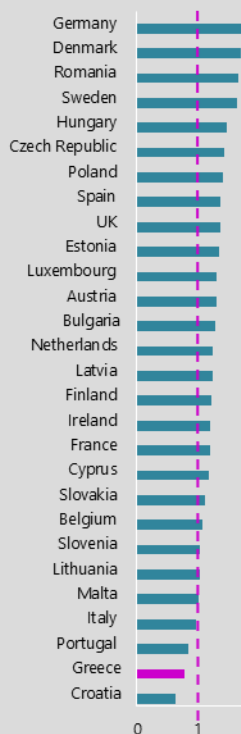
* The programmers are measured as the percentage of the population.

Sources: Eurostat, WEF, European Commission (Digital Agenda Scoreboard-DESI), www.numbeo.com, NBG estimates

⁴ www.payscale.com, www.daxx.com

⁵ As proxied by the share of ICT specialists in total employment.

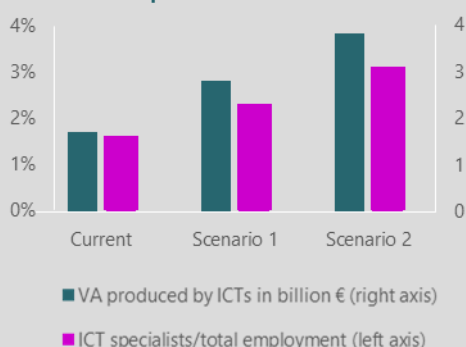
Programmer's wages vs Cost of living (index, EU=1)



Direct effect: Assumptions

	Current	Scenario 1	Scenario 2
Institutional Framework Index	65	96	96
Infrastructure	66	66	91

Direct effect: Output estimates



Scenario 1: Change in institutional framework
Scenario 2: Change institutional framework and infrastructure

Sources: Eurostat, WEF, European Commission (Digital Agenda Scoreboard-DESI), speedtest, www.numbeo.com, NBG estimates

significant relationship (see Appendix), we have examined two possible scenarios based on the hypothesis that Greece closes the business environment gap versus the most digitally advanced Balkan country (i.e. Slovenia, a country with a BDI close to the EU average, see Box 3):

- ✓ Under a scenario of institutional reform (i.e. converging to Slovenia's standards), the estimated larger ICT sector will increase the ICT specialists share in total employment to 2.3 per cent, up from 1.8 per cent in 2018.
- ✓ Under a scenario of both institutional and digital infrastructure upgrade (i.e. converging to Slovenia's standards), the estimated even larger ICT sector will increase the ICT specialists share in total employment to 3.1 per cent, up from 1.8 per cent in 2018.

STEP3: ESTIMATING THE BOOST TO THE GREEK ECONOMY

A. Direct effect

Based on the labor productivity of ICT specialists, the direct economic effect (in value-added terms) of the larger ICT sector is estimated in the range of €1.1 bn to €2.1 bn, depending on the depth and the extent of the reform agenda (i.e. from an institutional reform to a complete plan for institutional and digital infrastructure upgrade, converging to Slovenia's standards).

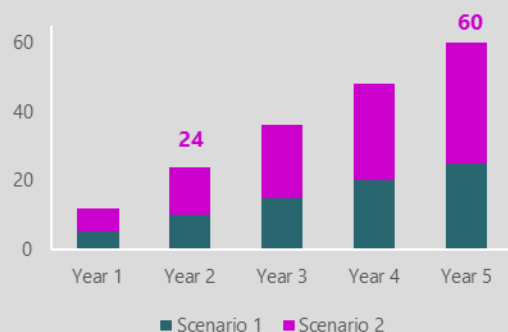
B. Long-run impact

Apart from the direct impact, digitalization benefits the economy through multiple externalities. In fact, a substantial literature has emerged during the past decades highlighting how structural endogenous factors can create long-term sustainable growth. Drawing on this literature strand, NBG Research has constructed a long-run growth model (in the lines of the augmented Solow growth

Long-run impact: Assumptions

	Current	Scenario 1	Scenario 2
FDI (%GDP)	9.16%	9.16%	9.16%
Business Digitalization	63	78	90

Long-run impact: Output estimates



Scenario 1: Change in institutional framework

Scenario 2: Change in institutional framework and infrastructure

Sources: Eurostat, WEF, European Commission (Digital Agenda Scoreboard-DESI), speedtest, NBG estimates

model⁶) providing the fundamental level of production per employee by considering physical and digital capital as its main determinants.

Specifically, based on a panel sample of 19 European countries and with the scope of finding the drivers of GDP per employee, we have included in our model two main parameters:

- ✓ Physical capital, as proxied by the FDI-to-GDP ratio, and
- ✓ Digital capital, as proxied by our Business Digitalization Index.

This model – the NBG Digital Growth Model – explains 2/3 of the growth differentials between European countries during the past decade.

According to our model estimates, in the event Greece gradually converges to the Slovenian institutional standards, GDP growth could be boosted by about €25 bn. Note that if this reform materialized during a course of 5 years, the annual boost to the GDP growth will be in the range of 2.6 percentage points.

More importantly, a parallel upgrade of Greece’s digital infrastructure to achieve Slovenia’s standards would provide an even bigger GDP boost, totaling to around €60 bn. In case this scenario also materialized during a course of 5 years, the total annual boost to the GDP growth will be in the range of 6.4 percentage points.

Note that these estimates continue to underestimate the total effect on the economy, as we have assumed that the business investment trend will not be affected. In reality, the aforementioned structural improvements of the Greek economy will also attract high quality investment – thus further boosting its growth potential.

⁶ Mankiw, G., D. Romer, and D. Weil (1992), “A contribution to the empirics of economic growth”, Quarterly Journal of Economics, 107, 407-437.



KEY POLICIES FOR THE “DIGITAL JUMP” TO BE MATERIALIZED

a. Infrastructure priority: High-speed internet network

The adherence to past technology networks supporting low speed is the main barrier to infrastructure improvement⁷ (see Box 2).

5G technology is necessary for a high-speed mobile network. As Greece ranks low in the 5G Readiness index (47/100 versus an EU of 58/100), it is critical to move fast. A key issue to consider is that over-taxation restricts and delays 5G penetration. In fact, over-taxation of digital providers is one of the most important reasons for the low investment in the field (as it restricts market penetration and thus expected ROI). For example, 3G penetration growth in 2013 was slower in countries with a higher tax burden. Against this background, it is important to keep in mind that in case 5G licenses would be proven very costly (as in Italy), the subsequent investment plans will be more restricted (and with a lower ROI). However, in case “cheap” 5G licenses (as in Finland) could be combined with bidding investment plans, a speedy and high-ROI network upgrade could be achieved. Moreover, note that investment delays could be also caused by the lack of a clear and coherent regulation framework regarding the 5G network.

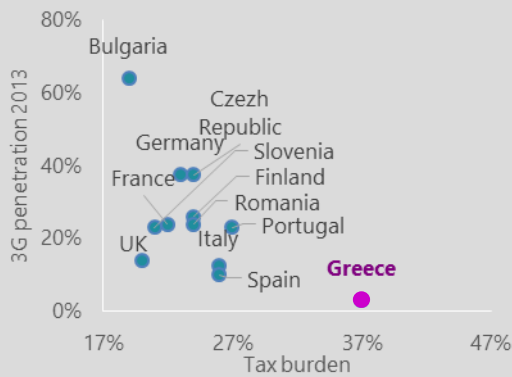
Another infrastructure, which is of equal importance, is the fiber optics (which are also used to support the 5G network, especially regarding the transfer of real time data). Greece ranks in the last position in fiber optics among the OECD countries⁸, as the percentage of fiber connections in total broadband is only 0.16 per cent for Greece (versus an OECD average of 26.8 per cent). In order to speed up the process, we need coordinated actions by three agents:

- ✓ Telecom companies to prioritize network investment

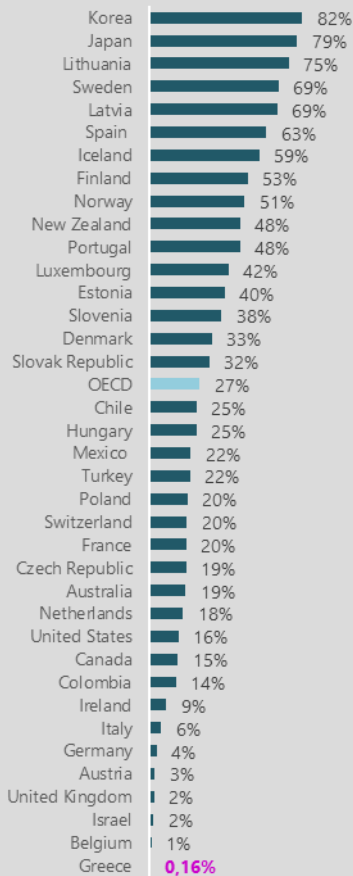
⁷ Note that the Balkan region ranks even higher than the EU in terms of internet speed, with Romania in the leading position.

⁸ Note that Asian countries such as Korea and Japan maintain the first two positions with 81.6 and 79 per cent, respectively.

Wireless mobile penetration vs tax burden



Percentage of fiber connections in total broadband



Sources: Eurostat, Wireless Intelligence, Operators, regulators, Light Reading, WEF, European Commission (Digital Agenda Scoreboard-DESI), speedtest, NBS estimates

- ✓ Telecom users (enterprises and households) to demand higher speed and be ready to pay an extra premium
- ✓ Government to solve any legal complexities as well as provide incentives for enterprises to invest and for users to acquire the upgraded services.

In this context, it is important to underline that the European Commission has recognized the need for digital advancement and, thus, has formed a Digital Agenda for 2025, targeting:

- ✓ Access to connectivity of at least 1 Gbit/sec for all major socio-economic drivers (schools, transport hubs, public services, digitalized companies)
- ✓ Uninterrupted 5G coverage (5th generation of mobile telecoms) in all urban areas and major transport paths
- ✓ Access to internet connectivity of at least 100 Mbit/sec (upgradable to Gbit speed) for all households

It is estimated that for those targets to be met the investment needs for digital infrastructure amount to €500 billion (that is, €150 billion over and above the current trend). However, the available budget for digital investment under the EU programming for 2021-2027 is just €12 billion (of which €3 billion for digital infrastructure) – thus leaving private investors and banks to fill in the lion's share.

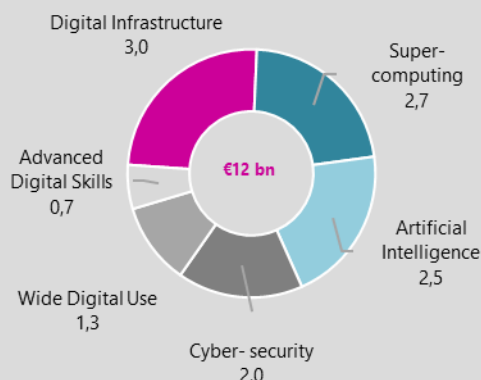
Against this background, the investment needs for digital infrastructure in Greece are in the range of €6 billion (based on the Greek share in European GDP). Under a more ambitious plan to close the current gap with Slovenia, Greek investment needs would reach €15 billion⁹.

b. Institutional priorities: An enabler (legal/judicial reform) and a catalyst (public sector digitalization)

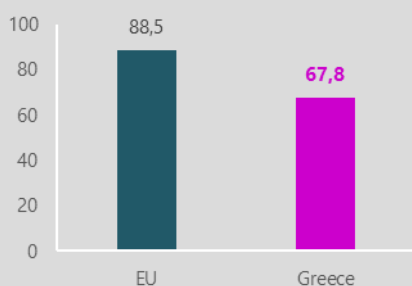
Countries with large ICT sectors have adopted a number of policies to attract such firms and boost their growth – from tax incentives

⁹ Estimate based on the gap in terms of NGA

EU digital budget for 2021-2027
(billion €)



Digital public services for businesses
(index 0-100)



Sources: Wireless Intelligence, Operators, regulators, Light Reading, Eurostat, WEF, OECD, European Commission (Digital Agenda Scoreboard-DESI), speedtest, Ministry of Digital Policy, Telecommunications and Media, NBG estimates

(e.g. Dublin) to the issue of business visas (e.g. London). Given the limited ability to provide incentives entailing fiscal cost, we suggest prioritizing the upgrade of the legal framework for entrepreneurship and the judicial procedures that safeguard it. For example, the settlement of business contract litigations requires 4.5 years in Greece (3 times the average time in the EU). Against this backdrop and on the basis of international ratings, the domestic judicial system in terms of procedural efficiency and process speed lags behind the European average by 25 per cent.

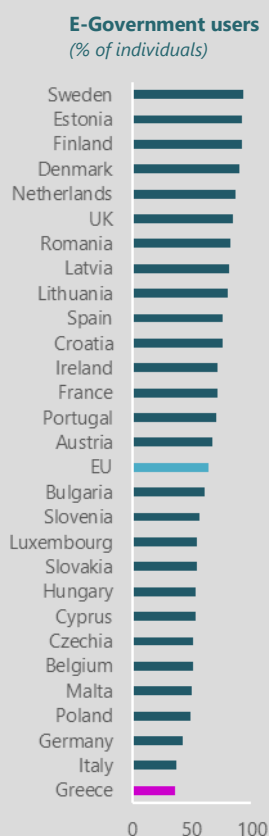
Strong empirical evidence¹⁰ highlights the importance of effective support from the legal and judicial system, so that the business sector can feel that it operates under the rule of law and that its cases are promptly processed. In this light, it is important to focus on: (i) drafting a comprehensive and consistent legal framework for entrepreneurship and (ii) upgrading and speeding-up judicial services to the business sector.

Bureaucracy is further intensified due to the poor digital infrastructures in respect of management of court case files and the linkup of courts with the public (60 per cent lag versus Europe). This point brings us to the second institutional priority: The digitalization of the public sector can act both as a necessary platform and as a critical catalyst for igniting the digital transformation of the business sector.

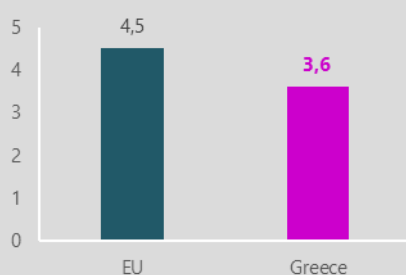
Greece ranks low among the EU countries in terms of the provision of digital public services. In particular, Greece has the lowest population share of e-Government users in the EU (36.2 per cent, versus an EU average of 64.3 per cent). Moreover, Greece scores just 68/100 in terms of the DESI index measuring the provision of digital public services for businesses (versus 89/100 in the EU).

Against these challenges, the Greek government (i) has set digitalization high on its policy agenda, (ii) has already established

¹⁰ Alesina, A., Perotti, R., 1994. The political economy of growth: a critical survey of the recent literature. The World Bank Economic Review, vol.8, no. 3.
Scully, G. W., 1988. The institutional framework and economic development. Journal of Political Economy 96, no. 3.
Lorizio M., Gurrien A., 2014. Efficiency of justice and economic systems. Economics and Finance, 17, 104-122.



Extent of staff training
(index 1-7)



Sources: EU Commission, Digital Single Market, Ministry of Digital Policy, Telecommunications and Media, NBG estimates

a new Ministry for Digital Governance, and (iii) has announced a number of relevant initiatives, such as:

- ✓ the “gov.gr”, a web portal that will be the single point of access for all digital government services
- ✓ the AFM (Tax Identification Number) will gradually become the single identification number across all government services for citizens and businesses alike
- ✓ the cloud nodes of the General Secretariat of Information Systems and the Information Society have been consolidated as part of the government’s strategy of bringing all information systems of individual Public Administration entities into a single G-cloud.

c. Human capital priority: Digital training

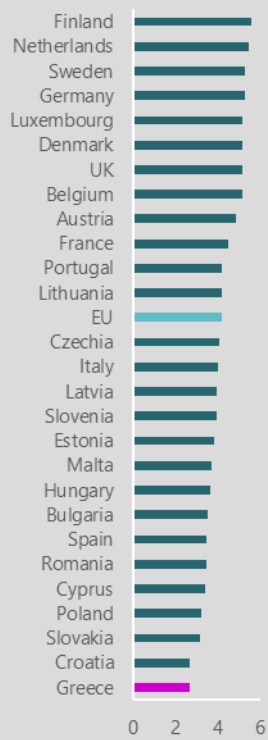
Apart from the training and development of ICT specialists, almost all employees should acquire basic digital skills. For this condition to be realized, Greece must overcome two critical obstacles:

- ✓ Greek businesses exhibit low interest in investing in their human capital. Based on the relevant GCI component, Greece ranks low in terms of companies offering training to their employees (with a value of 3.6 on a scale of 1 to 7, compared with an EU average of 4.5). As a result, just 30 per cent of Greek employees have been digitally trained (versus 60 per cent in the EU).
- ✓ Greek universities have a very limited collaboration with the business sector. In fact, based on the relevant GCI component, Greece ranks last among its EU peers in terms of universities collaboration with the business sector (with a value of 2.7 on a scale of 1 to 7, compared with an EU average of 4.3).

Summing up, Greece needs (i) more involvement of stakeholders (employees, the state¹¹, and businesses) through sectoral digital skill

¹¹ The Greek government has recently announced a remote training program (€180mn) in order to support 166,000 scientists to develop their digital skills.

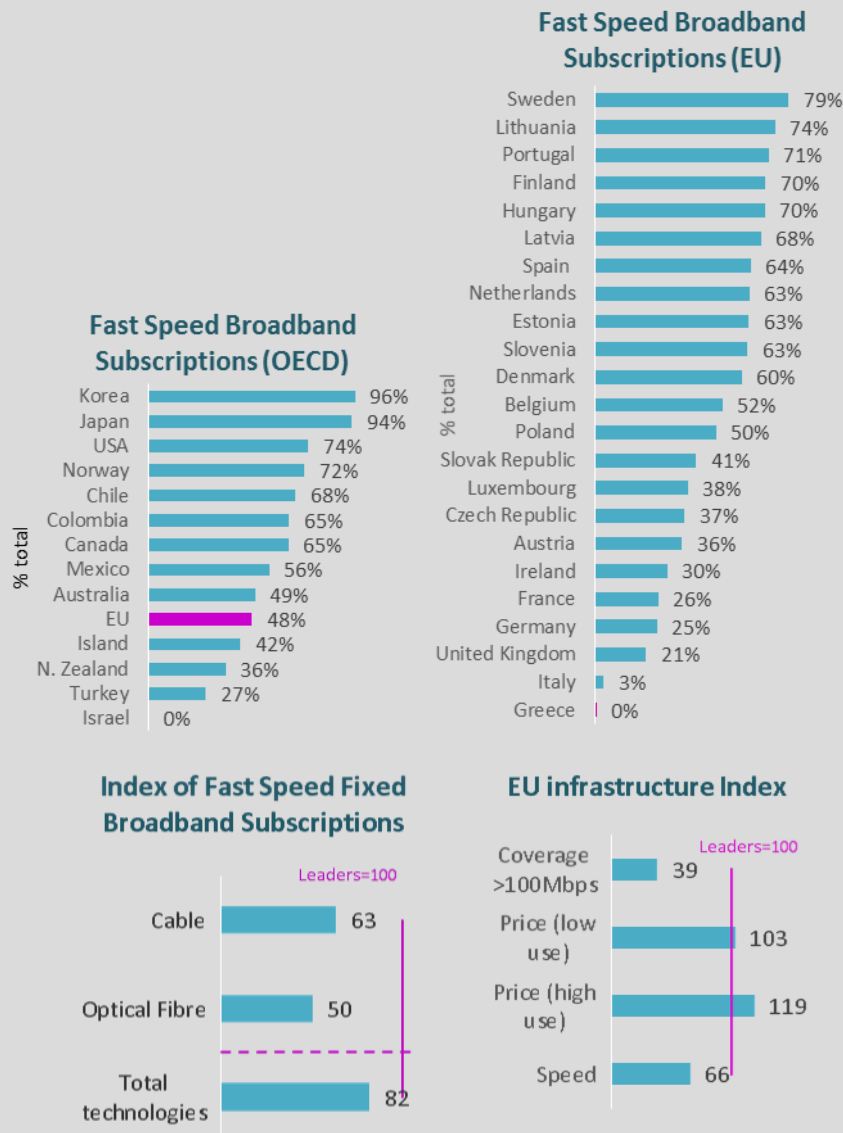
University and industry collaboration in R and D
(index 1-7)



Sources: DESI, GCI, NBG estimates

councils, (ii) reform of vocational training programs, and (iii) stronger linkages of education with the digital needs of the labor market.

BOX 1: Reasons for EU digital infrastructure lagging



*The Indices of the Fast Speed Fixed Broadband Subscriptions and EU Infrastructure have been constructed with leaders as a base (leaders=100) where they consist of Korea, Japan and USA. The highest the index, the positive the effects.

Sources: OECD, European Commission (Digital Agenda Scoreboard-DESI), NBG estimates

In a digital challenging environment however, there is insufficient progress in the EU compared to the US and Asia. The expansion of digital infrastructure in the EU has been carried out slowly and not comprehensively. Indicative is that Europe lags behind in terms of 5G deployment in comparison to Asia or North America.

It is obvious that while all EU broadband subscriptions appear to be similar to those of Japan and the USA (EU: 33 subscriptions/100 inhabitants, Japan: 31, USA: 34), fast-track technology subscriptions (cable and optical fibre) lag significantly (48 per cent vs. Japan: 94 per cent and US: 74 per cent).

It is worth mentioning that Greece (like Israel), despite of the fact that it is a developed country, remains in the 0 per cent of the use of fast speed technologies.

There are a lot of reasons for the insufficient progress with digital infrastructure improvements.

- ✓ A significant reason for the low progress of the fast infrastructures in countries like them based on the disadvantage of the small countries. Specifically, rolling out the networks and activating fast speed technologies is far more expensive and less cost-effective than originally thought, due in part to relatively small population of those countries. For the cities with bigger population like London and New York, which could have thousands of customers per building, the effort and expense are more worthwhile. This is also an explanation for the progress in the fast speed infrastructure of countries with bigger population (USA, Japan).
- ✓ The low demand for fast internet connections especially in rural areas which makes investments unattractive. According to the European Investment Bank (EIB), 50 per cent of the expenditure which would be necessary to reach the broadband targets for 2020 would have to be spent in rural areas, where, however, only 20 per cent of the population live.
- ✓ Many and small companies in Europe where the excessive regulation and bureaucratic procedures in Brussels have created a fragmented market. Specifically, according to OECD data, the ICT SMEs in the USA approximate 4 ml. against the EU where reach 20 ml..

Moreover, there are some potential market failures that justify policies to intervene and support the digitalization of industry in Europe:

- ✓ The lack of digital skills, as the EU spent 5% of GDP on education in 2013, less than the 6.2% spent by the US, the 5.9% by South Korea, and even the OECD average of 5.2% (OECD, 2015).
- ✓ The lack of sufficient banks financing in digitalization. Digitalization financing face constrains by the banks. According to the 2018 EIB Investment survey, more than 60% of SME External financing comes from banks. The high risk profile of the digital companies and the complexity of their innovative business model consist the main obstacles for the funding through banks. Alternative financing methods (fintechs and crowdfunding platforms) and risk sharing arrangements or co-financing schemes are needed in order to finance born digital companies.

As a result, the inadequate digital infrastructure put EU companies at a disadvantage versus US competitors and Chinese players. Thus, the European technology and telecoms companies will start to be redeemed by American and Asian ones. It is possible that European companies may be attacked, overtaken or squeezed out of the market even in sectors where they are currently in a good or leading position, such as robotics and automation, industry 4.0, networked mobility and smart energy networks.

However, there are some signs of progress in the market via a new EU investment plan (see Box 2).

BOX 2: European and Greek investment plans for the development of infrastructure

EU plan: Digital infrastructure is a necessary condition for the development for digital markets and applications. The European Commission believes that EUR 515 bl. will need to be invested over ten years to achieve the targets for 2025¹²:

- ✓ All major socio-economic drivers (such as schools, transport hubs, the main providers of public services or highly digitalized companies) should have access to connectivity of at least 1 gigabit/second.
- ✓ All urban areas and all major terrestrial transport paths should have uninterrupted 5G coverage
- ✓ All European households should have access to internet connectivity of at least 100 Mbit/s, which is upgradable to gigabit speed

Despite of the above, under InvestEU, which will run between 2021 and 2027, are planned investments in digital initiatives with the total cost approximates €11.25 bn..¹³ Moreover, the eGovernment Action Plan for 2016-2020 targets to the fast and easy access to and use of public services¹⁴. However, the EC's proposals for the European financial framework for the next seven years (2021-2027) foresee only 1 per cent of the total budget spending on digital transformation and infrastructure compared to 60 per cent for agriculture policy.

Greek plan¹⁵: It has recently been announced the launch of an investment plan co-financed by ESPA and private companies to develop an extensive fiber optic network to achieve high speed. Funding is estimated around €870ml (including value added taxes) and it is the biggest jointly funded project for the development of broadband infrastructure in the European Union. The Ultrafast Broadband project (UFBB) is aim to cover over 98 per cent of the areas with a service of at least 100 Mbps (Class B) and to cover as much as possible the population of the areas with a service of at least 100 Mbps upgraded to 1 Gbps (Class A) (>65 per cent of active connections). The public tender for the project has been conducted. A total of 10 investors have expressed non-binding interest in the project, including one from abroad. The other nine interested parties are Greek enterprises, led by telecommunications giants, two energy companies and four construction.

Recently has been finalized the decision about the legitimation of the Mobile Virtual Network Operator (MVNOs). Greece was the only EU country without any form of virtual provider. The leaders of Greek telecommunications believe that there was not enough profit margin in the market for the entrance of this kind of firms. European Commission is now responsible for the final decision about the relative regulation. The decision of the National Commission for Telecommunications and Post, following the approval of the European Commission, states the context and the prices at which mobile operators are obliged to offer wholesale services to mobile virtual providers (MVNOs).

¹² European Commission (2016), Connectivity for a Competitive Digital Single Market Towards a European Gigabit Society

¹³ European Commission - Fact Sheet, The InvestEU Programme: Questions and Answers

¹⁴ European Commission, Strategy, Digital Single Market, Policy, European eGovernment Action Plan 2016-2020

¹⁵ The plan has been announced from the previous government. The new government is expected to announce its new plan until the end of the year.

BOX 3: Best practices of Slovenia



Slovenia has been extremely successful in the field of artificial intelligence and big data in the public. Slovenia has the largest number of AI and robotics researchers per capita in the world (approx. one researcher per 7.000 inhabitants). It is ranked among the world's leading developers in the field of "blockchain technology" the global business value of which is expected at 2 trl by 2030. The ICT sector in Slovenia employs today more than 20,000 people. Slovenia is home to a series of well-developed IT companies with established services and research projects. In 2016, Slovenian startups have raised their funding with EUR 310 million. The majority of funds came from venture capital (EUR 260 million) followed by Slovenian state funds. According to Slovenia's Statistical Office, one in four enterprises provided training to develop e-skills. Slovenia's Ministry of Public Administration in 2017 has allocated EUR 38 million for a cloud computing which is expected to create 3,000 new IT jobs.

In November 2016, the Slovenian government established Digital Coalition - A Strategy for the Development of Information Society by 2020 and other sector specific economic development strategies. The Coalition serves as a coordinated and consultative non-discriminatory open forum with the objective to foster the development of the digital economy, the creation of digital jobs as well as the exploitation of opportunities closely linked to the development of ICT and the internet.

It set up three main national challenges to be tackled by experts from the working groups. The three working groups were focusing on:

- ✓ Digital Competences and Education
- ✓ Digital Environment and regulatory measures
- ✓ Digitization of industry and cooperation

So far, the crucial success factor has proven to be cooperation on common objectives. The cooperation of every diverse stakeholders from the private and public sector and civil society shows how diverging approaches can be successfully overcome. Moreover, all stakeholders involved in the Slovenian Digital coalition recognized the need to establish a single digitization ecosystem, in which the main focus is on the citizen and digital society as a whole.

APPENDIX: Econometric models

A. NBG Digital Economy model

NBG Research estimated a digital economy model in order to assess the underlying potential of Greece's economy digitalization via the increase of ICT employees in the country. The model is based on cross-section data for the EU countries.

Our sample consists of 25 countries (Slovak Republic, Bulgaria and Luxemburg are excluded due to the missing variables). In order to account for the effect of the different size of each country, our dependent variable (the ICT employees) is estimated as the percentage of total employment. The explanatory variables for each country is an approximation of the NBG Index for the B1 Institutional Framework and an approximation of the B2 Infrastructure Index.

Our model explains 71 per cent of the total variation of the dependent variable. Based on the estimated coefficients, we have constructed the NBG Digital Economy model.

$$ICT_i = 0.73 \text{ BusEnv}_i + 0.25 \text{ Infr}_i - 8.30$$

(2.75) (3.03) (3.55)

$$R^2 = 0.71, DW = 2.03$$

where:

ICT_i: ICT employees as the percentage of the total employment for the country *i* (source: European Commission (Digital Agenda Scoreboard-DESI)),

BusEnv_i: Approximation of the NBG Index for B1 Institutional Framework of country *i* (source: WEF, Ease of Doing Business)

Infr_i: Approximation of the NBG Index for B2 Infrastructure based on Actual Mobile Speed and Household broadband connections of country *i* (source: European Commission (Digital Agenda Scoreboard-DESI), speedtest)

T-statistics in parentheses below coefficient estimates.

*The model has been estimated using White robust standard errors (Heteroscedasticity consistent)

** The model has been estimated using the raw data of the indices, not EU standardized

In order to confirm the validity of the above relation over the years, we checked it with the construction of a panel data model which takes into account both the country and time dimension. Using the same variables, we construct a model based on the EU countries (N=19) for the time period 2008-2016. For the estimation we used fixed effects method after conducting Hausman test for the best estimation. Our model explains 66 per cent of the total variation of the dependent variable.

$$ICT_{it} = 0.011 \text{ BusEnv}_{it} + 0.028 \text{ Infr}_{it} + 1.503$$

(2.03) (7.06) (2.45)

$$R^2 = 0.66, DW = 1.46$$

where:

ICT_{it}: ICT employees as the percentage of the total employment for the country i in time t (source: European Commission (Digital Agenda Scoreboard-DESI))

BusEnv_i: Approximation of NBG Index for B1 Institutional Framework of country i in time t (source: WEF, Ease of Doing Business)

Infr_i: Approximation of the NBG Index for Infrastructure based on Actual Mobile Speed and Households broadband connections of country i in time t (source: European Commission (Digital Agenda Scoreboard-DESI), speedtest)

T-statistics in parentheses below coefficient estimates.

** The model has been estimated using the raw data of the indices, not EU standardized

B. NBG Digital Growth Model

NBG Research estimated a digital growth model in order to calculate the multiple effect of the digital upgrading in all other sectors of the economy. The model is based on panel data for the EU countries.

Our sample consists of 19 countries with annual data for the period 2008-2015. With the dependent variable being the GDP per employee and the explanatory variables used is an approximation of A. Business Digitalization Index and the FDI stock as a percentage of GDP.

$$GDP_{it} = 93.48 \text{ BusDig}_{it} + 167.41 \text{ FDI}_{it} + 34.777$$

(9.60) (20.24) (9.04)

$$R^2 = 0.60$$

where:

GDP_{it}: GDP per employee for the country i in time t (source: OECD)

BusDig_{it}: is an approximation of NBG A. Business Digitalization Index based on ICT employees and Enterprises fixed broadband connection in country i in time t (source: European Commission (Digital Agenda Scoreboard-DESI)),

FDI_{it}: The stock of FDI as a percentage of GDP in country i in time t (Source: OECD)

T-statistics in parentheses below coefficient estimates.

*The estimation was conducted using feasible GLS estimator with Cross Section Weights and White robust standard errors assuming the presence of cross-section heteroscedasticity.

** The model has been estimated using the raw data of the indices, not EU standardized

ANNEX

Pillars	Sub-Pillars	Components	Indices	Source		
B.BUSINESS ENVIRONMENT	B1. Institutional Framework	Legal support to digitalization	Legal framework's adaptability to digital business models	WEF		
		Venture capital	Venture capital	WEF		
		General conditions	Judicial independence	WEF		
			Efficiency of legal system in settling disputes	WEF		
			Efficiency of legal system in challenging regs	WEF		
			No. days to enforce a contract	Ease of Doing Business		
			Total tax rate, % profits	Ease of Doing Business		
			No. days to start a business	WEF		
			No. procedures to start a business	Ease of Doing Business		
			Competition in network services	WEF		
			B2. Infrastructure	Coverage	NGA	DESI
				Fixed broadband coverage	DESI	
		4G mobile broadband coverage	DESI			
		Speed	Actual fixed broadband speed	speedtest		
			Share of fixed subscriptions (>=30 Mbps)	DESI		
		Price	Fixed BB price	DESI		
C.HUMAN CAPITAL	C1. Labor Force	Basic digital skills	Basic digital skills (% indiv)	DESI		
		Advanced digital skills	Master ICT (%pop)	DESI		
			ICT graduates (%pop)	DESI		
		Programmers	Having written a programming language (%indiv)	DESI		
		C2. Individuals	Technological equipment	Individuals using Internet, (%pop)	DESI	
				Households w/ personal computer, (% total households)	DESI	
			Simple use	Reading, playing, tel-video calls	DESI	
		Advanced use	E-banking, ordering goods, interacting online with public services	DESI		
A.BUSINESS DIGITALISATION	A1. Tools	Web tools	Persons employed with pc and web access	DESI		
			Enterprise with website	DESI		
			Use any social media	DESI		
		Basic digital applications	ERP	DESI		
			CRM	DESI		
		Advanced digital applications	Cloud computing	DESI		
			Big data	DESI		
			3D printing	DESI		
			Robotics	DESI		

Pillars	Sub-Pillars	Components	Indices	Source
		E-commerce	E-commerce sales	DESI
	A2. Culture		Companies embracing disruptive ideas	WEF
			Enterprises with ICT specialist	DESI
			Enterprises that provide ICT training to their personnel	DESI
	A3. Employees		ICT specialists (%employ)	DESI
			ICT functions performed by own employees	DESI

SECTORAL REPORT

April 2020



NATIONAL BANK OF GREECE

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