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Enhancing digital diffusion for higher productivity in Spain

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ENHANCING DIGITAL DIFFUSION FOR HIGHER PRODUCTIVITY IN SPAIN

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By Yosuke Jin

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Abstract/Résumé

Enhancing digital diffusion for higher productivity in Spain

The increased adoption of digital technologies has been transforming the Spanish economy. The COVID-19 crisis is expected to speed up this process. The new digital strategy, 'Digital Spain 2025', features a number of ambitious objectives in a timely manner. There is a need to promote digital diffusion across the country by developing communication infrastructure further, while addressing the digital divide across regions and ensuring digital security. Addressing key bottlenecks, such as people's skills, through education policies at every level, would enable the use of digital technologies and boost productivity growth. This would help in particular laggard firms and low-skilled people, making the benefits of digitalisation shared by all. In parallel, R&D should be enhanced to lift the capacity of firms to adopt and use digital technologies effectively, resulting in improving their business models and products. Finally, business dynamism should be revitalised to encourage risk taking among firms, thus facilitating digital diffusion, while ensuring an efficient allocation of capital.

This Working Paper relates to the 2021 OECD Economic Survey of Spain.
http://www.oecd.org/economy/spain-economic-snapshot/
Keywords: Digitalisation, productivity, skills, intangible assets, business environment, risk capital
JEL Classification: L1, L2, O1

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Améliorer la diffusion numérique pour élever la productivité en Espagne

L'adoption croissante des technologies numériques a transformé l'économie espagnole. La crise du COVID-19 devrait accélérer ce processus. La nouvelle stratégie numérique, 'Digital Spain 2025', présente un certain nombre d'objectifs ambitieux en temps opportun. Il est nécessaire de promouvoir la diffusion numérique à travers le pays en développant davantage les infrastructures de communication, tout en comblant la fracture numérique entre les régions et en garantissant la sécurité numérique. Remédier aux principaux goulots d'étranglement, tels que les compétences des individus, par le biais de politiques d'éducation à tous les niveaux, permettrait l'utilisation des technologies numériques et stimulerait la croissance de la productivité. Cela aiderait en particulier les entreprises retardataires et les individus peu qualifiés, rendant les bénéfices de la numérisation partagés par tous. Parallèlement, la R&D doit être renforcée pour accroître la capacité des entreprises à adopter et à utiliser efficacement les technologies numériques, ce qui se traduit par une amélioration de leurs modèles d'affaires et de leurs produits. Enfin, le dynamisme des entreprises doit être revitalisé pour encourager la prise de risque entre les entreprises, facilitant ainsi la diffusion numérique, tout en assurant une allocation efficace du capital.

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http://www.oecd.org/fr/economie/espagne-en-un-coup-d-oeil/
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Classification JEL : L1, L2, O1

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Enhancing digital diffusion for higher productivity in Spain

By Yosuke Jin[1]

Digitalisation is transforming the Spanish economy, changing the way firms operate, with positive implications for productivity. However, these changes are not evenly shared between highly productive and less productive firms. This is partly due to the difference in their capabilities to adopt digital technologies effectively, underpinned by intangible capital and ICT skills of workers, with which digital technologies raise productivity effectively. Looking ahead, the existing productivity gap across firms in Spain may in itself fuel a further productivity dispersion as digital technologies disproportionately favour high productivity firms. This productivity gap has also affected earnings disparity due to wage premiums attributed to firm productivity as well as excess returns to skills arising from the scarcity of skilled workers.

Spain still has considerable scope to reap the benefits of the adoption of digital technologies and, perhaps more importantly, their effective use to produce new business models and products. The issue will bear more importance as the digital transformation of the economy is accelerating due to the COVID-19 crisis. Broad-based policies should promote digitalisation, ensuring communication infrastructure and services, sharpening firms' incentives and enhancing their capabilities to make the most out of new technologies. These policies should be accompanied by efforts to remove barriers to laggard firms, improving their access to capital and incentivising them to boost their underlying capabilities including, among others, intangible capital and the skills of workers. Enhancing skills would entail a double dividend, as job training for low-skilled workers is found to be particularly effective to increase digital adoption by firms while it can help workers to find higher quality jobs, alleviating earnings disparities.

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Digitalisation offers new opportunities and challenges

Spanish firms still have significant scope to adopt and use digital technologies

Digitalisation is defined as the use of digital technologies and data as well as their interconnection that results in new activities or changes to existing activities (OECD, 2019[1]). For example, it enables firms to buy and sell online, to digitalise business processes, and to create digital products or digitise existing ones. There are various digital technologies (Box 1), including:

- e-purchases, e-sales and customer relationship management software, allowing for deeper digital market integration;
- Enterprise resource planning software, cloud computing and supply-chain management software, allowing for digitalising business processes and firm re-organisation;
- Radio-frequency identification, leveraging a host of new business models, applications and services.

Box 1. Some ground-breaking digital technologies for efficiency and value creation

Internet of Things (IoT): It enables a host of new business models, applications and services based on data collected from devices and objects, including those that sense and interface with the physical world. The IoT includes automations from smart home devices and appliances, wearables and health monitors, to advanced applications like connected and fully automated vehicles (OECD, 2018[2]).

5G, Next-generation wireless networks: It is the first generation of wireless networks in which tens of billions of devices and sensors are connected to the Internet. Apart from higher speeds and faster data transfer, a major difference with 5G is that it is designed to connect not just people, but also things (for example, communication between self-driving vehicles, roads and traffic lights) (OECD, 2019[3]).

Artificial intelligence (AI): It is the ability of machines and systems to acquire and apply knowledge, including by performing a broad variety of cognitive tasks, e.g. sensing, processing language, pattern recognition, learning, and making decisions and predictions (OECD, 2019[1]).

Source: (OECD, 2018[2]); (OECD, 2019[3]); (OECD, 2019[1]).

The adoption rate of these technologies in Spain is close to the OECD average, but is far below the best performer countries in some cases (Figure 1; Panel A). There is a large gap in the adoption rates between small and large firms (Figure 1; Panel B). However, this gap seems to be smaller than in other OECD countries in many cases, with the exception of cloud computing which is particularly useful for small businesses as it helps them to scale up without incurring a lot of investment in their own equipment. At the sector level, the adoption rates are close to the OECD average (Figure 1; Panel C), but seem to be somewhat lower in high value-added sectors, such as professional and scientific activities, and higher in the hospitality sector, possibly reflecting the comparative advantage of the Spanish industry characterised by the high weight of tourism.

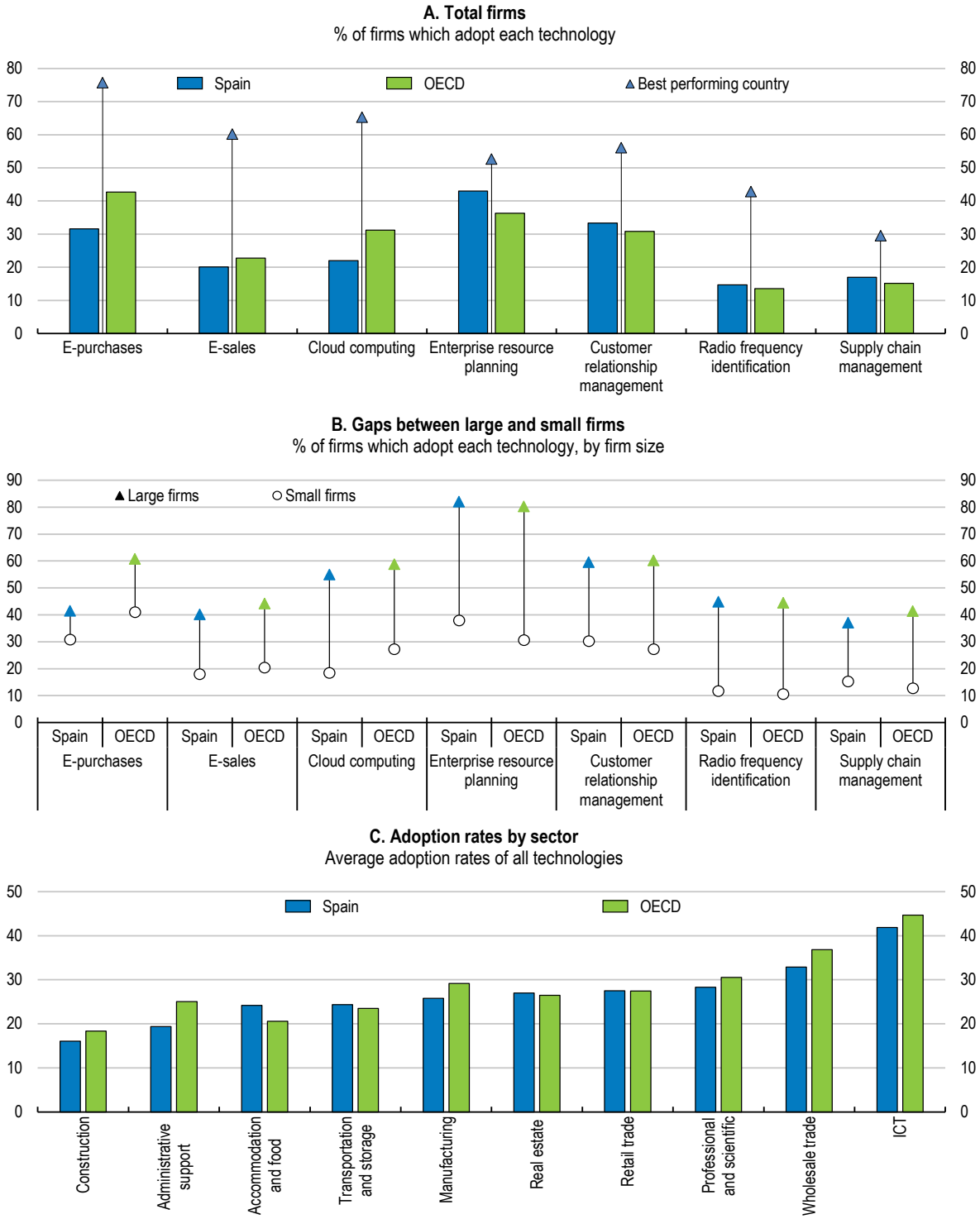
In the context of digitalisation, firms are able to and encouraged to implement new business and organisational models. Thanks to digital technologies, information is categorised, coded and stored in standardised digital forms, which allows for reducing business costs. Firms can scale up easily, as marginal costs of selling digital products are low or close to zero. The time necessary to bring a product to market and to sell it diminishes and markets clear faster. Therefore, digital technologies expand business opportunities for individual firms, but they also heighten competitive pressures in the market to reduce costs and adopt new business models, thus shaking up traditional businesses to reinvent themselves.

An increase in e-commerce sales is one such example of changing business models, which contributed to support economic activity during the COVID-19 crisis. E-commerce sales have grown over the past decade, and accounted for 18% of total sales in 2019 in Spain, up from 11% in 2010. The share is slightly lower than the EU average and lags significantly behind a number of other European countries (Figure 2; Panel A). The share of e-commerce sales varies significantly across sectors, as their business models differ, and it is the accommodation sector where it is by far the highest, followed by manufacturing (Figure 2; Panel B). The way firms sell their products electronically also differs considerably, as simple web sales are dominant in the accommodation sector, while the intercompany communication of business documents in a standard format (electronic data interchange) is frequent in manufacturing firms.

The adoption of teleworking is another example of changing business organisations, which made firms resilient against the negative impacts of the COVID-19 crisis. The extent of teleworking has been limited in Spain compared with other European economies (Figure 3; Panel A). Only 8.4% of workers actually teleworked at least occasionally in 2019 according to the Labour Force Survey, although it increased from 6% in 2009. Several factors explain the extension of teleworking. In particular, the industrial structure influences the number of occupations adapted to teleworking. Taking account of the intrinsic characteristics of each occupation, approximately 30% of the employed persons can telework at least occasionally ((Bank of Spain, 2020[4]); Figure 3; Panel B). There are also other factors which determine the extent of telework, such as digital infrastructures, managerial capacities and skills of workers (OECD, 2020[5]).

The COVID-19 crisis has accelerated the digital transformation of the economy. When affected directly by confinement measures, many firms were ‘restricted’ to increase on-line sales and to shift to full teleworking (Box 2). Some of these changes could have been specific to the confinement period as, for instance, full teleworking will not be obliged once confinement measures are lifted. The authorities introduced a new teleworking law in September 2020 to regulate this instrument in the post-confinement period. However, an increase in teleworking to some extent can be a permanent feature, along with other changes after the crisis. For instance, all the activities affected by physical distancing requirements may be permanently smaller after the crisis. Such permanent changes arising from the modification of people’s behaviour, such as consumer preferences, imply an acceleration of the digital transformation of the economy. In this context, firms that can effectively leverage the diffusion of digital technologies will grow faster.

Figure 1.The adoption of digital technologies has scope to increase



Note: In the figure, data for e-purchases, supply-chain management, and radio frequency identification relate to 2017; data for cloud computing and e-sales relate to 2018; data for enterprise resource planning and customer relationship management relate to 2019. In the figure, "OECD average" is the average across all OECD countries for which data are available. In Panel B, "Small firms" stands for small enterprises with 10-49 employees, while "Large firms" stands for large enterprises with 250 employees and more. In Panel C, the average of the adoption rates for 7 digital technologies is taken for each sector.

Source: OECD, ICT Access and Usage by Businesses (database).

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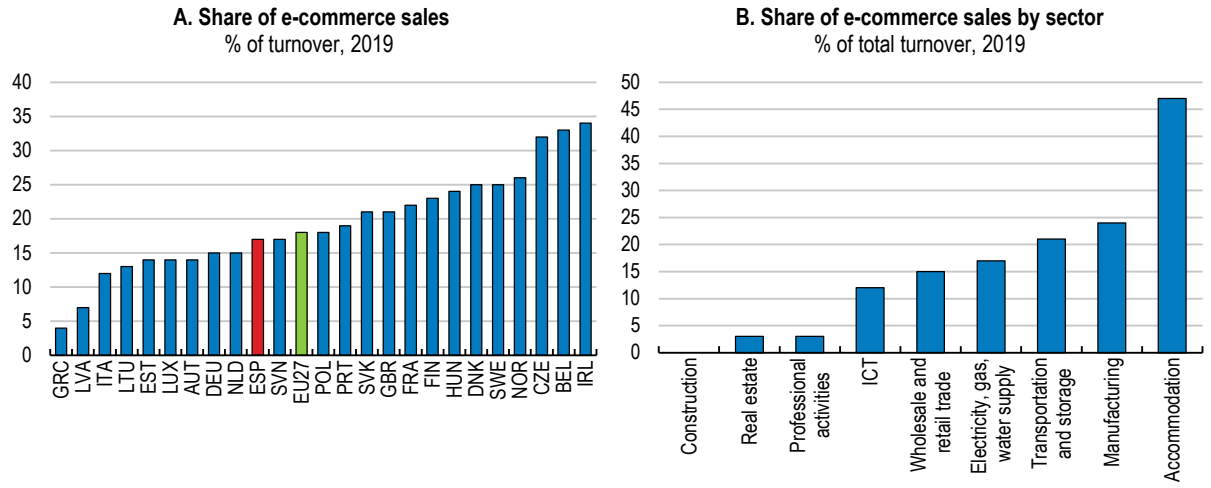
Figure 2. E-commerce sales are likely to accelerate further



Note: Data refer to firms with 10 employees or more.
Source: Eurostat.

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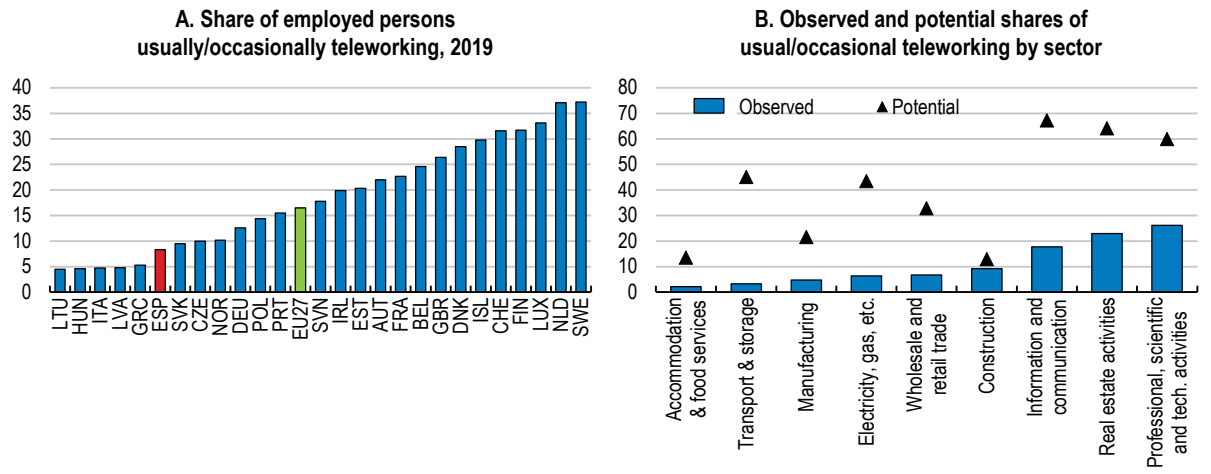
Figure 3. Teleworking has scope to develop further



Source: Eurostat, Labour Force survey (database), and the Bank of Spain.

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Box 2. Digitalisation based business processes prompted by the COVID-19 crisis

E-commerce sales

The generalised confinement measures in place in 2020 due to the outbreak of COVID-19 required closing shops with only some exceptions, which increased the utilisation of e-commerce sales. According to the National Commission of Markets and Competition (CNMC), e-commerce sales recorded a year-on-year growth of 11.6% in the first quarter of 2020, which moderated to 0.2% in the second quarter. Such effects differ across sectors, as some had already been adapted to e-commerce sales, they may have been more strongly affected by the generalised confinement and faced a significant contraction of demand (e.g. shops were closed and travels were prohibited, etc.). There is no comprehensive and standardised data, but growth in the sales of companies whose main activity is internet retail trade peaked in May 2020 (growing by 70% on a year-on-year basis), which declined during the summer, but began to increase again, reaching to slightly below 60% in November according to the INE.

Teleworking

The generalised confinement measures also promoted an increasing use of teleworking, which was an obligation for firms to continue their activity (i.e. firms were shut down unless workers could telework). According to the Bank of Spain survey conducted in the first week of April 2020, 80% of the firms stated that teleworking was proving an essential tool in tackling the crisis. However, the extent to which firms could switch to teleworking varies significantly across sectors and among firms within a given sector. For instance, there is a very limited possibility of teleworking in some sectors, such as construction, hotels and restaurants (Figure 3; Panel B). In other sectors, where teleworking can be more widespread potentially (Figure 3; Panel B), a large number of firms have likely faced difficulties in introducing this working style immediately if they had not been well prepared in advance.

In order to take full advantage of digitalisation, digital technologies should be effectively used to produce efficient business processes and better products. However, despite high digital adoption rates, many Spanish firms are lagging behind in this respect. For example, the share of innovative firms that introduced new products, new business processes, and/or new business organisation, which digital technologies are supposed to prompt, remains very low in Spain, with a large gap between small and large firms (Figure 4; Panels A and C). Furthermore, the share of firms that implemented innovation activities, such as R&D, is the lowest among European countries for which data are available, with also a large gap between small and large firms (Figure 4; Panels B and D). The number of patents, the results of ground-breaking innovations, is low with respect to the size of the economy and the share of ICT-related patents is also very low in Spain (Figure 5).

Figure 4. The adoption of digital technologies has not helped to change business models

2016

1. "Innovative firms" are those which introduced at least one of the 4 types of innovation, product, business process, business organisation and marketing during the period 2014-16.
2. "Innovation activities" are those which implemented product and/or process innovation and implemented at least one of innovation activities, such as R&D and acquisition of equipment or software, during the period 2014-16.
Source: OECD, Innovation indicators; Eurostat, the Community Innovation Survey.

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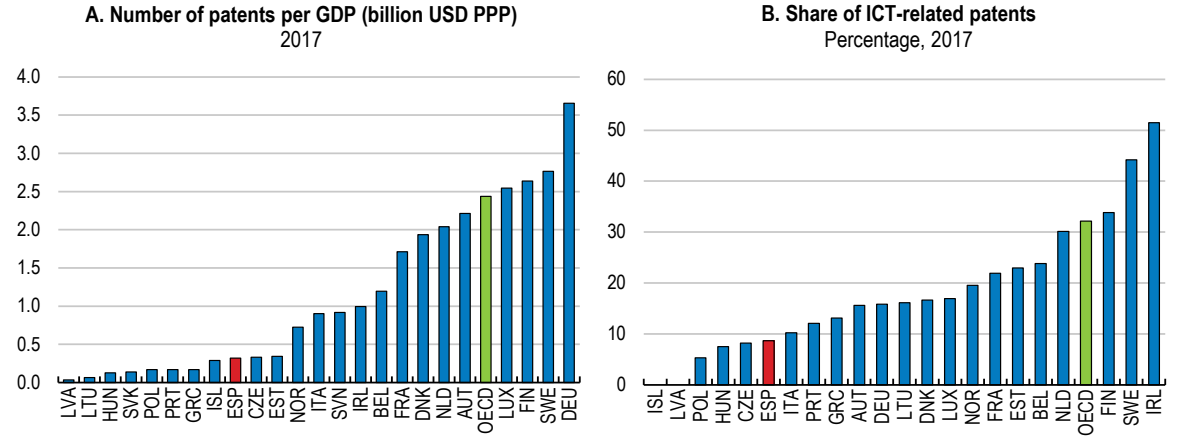
Figure 5. Invention has been very limited



Source: OECD Patents Statistics (database).

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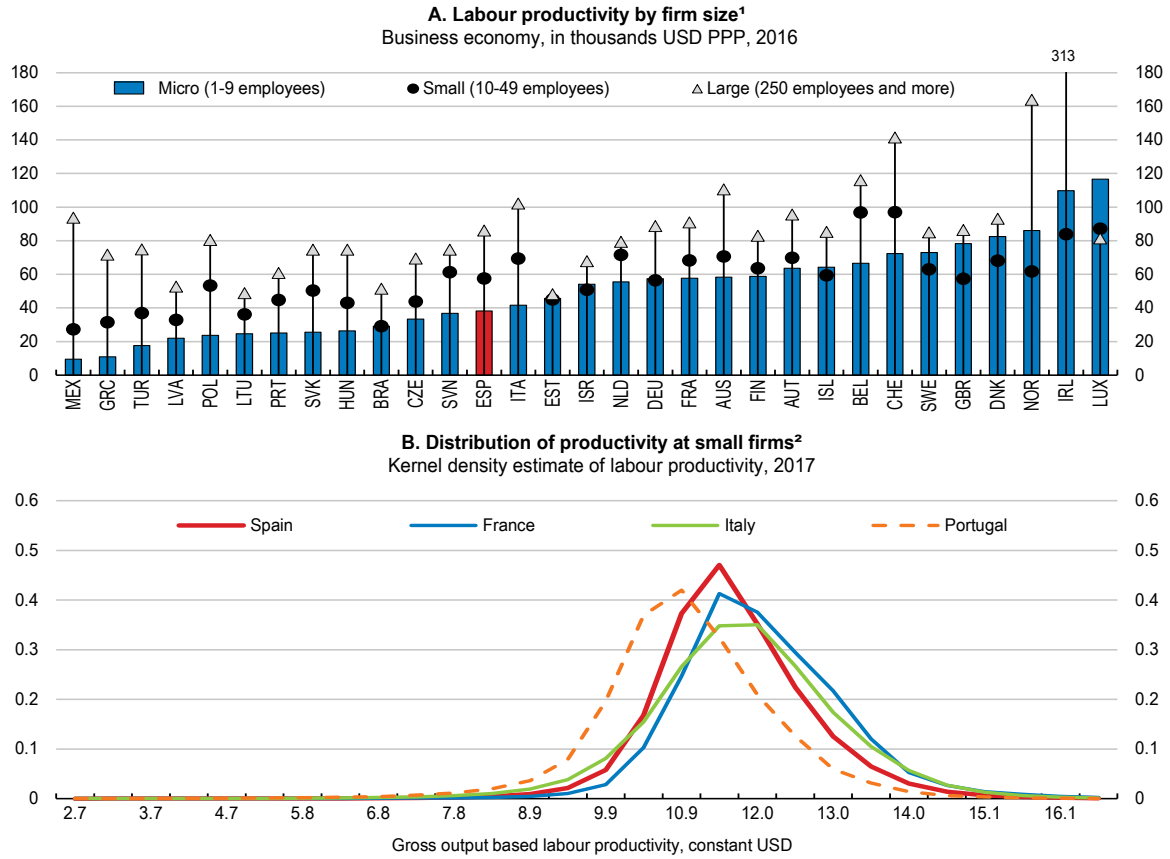
Insufficient intangible capital and low skills impede taking full advantage of digitalisation

Spain faces a dual challenge as productivity growth has stagnated over the past two decades and productivity dispersion across firm size is large (Figure 6; Panel A). Cross-country evidence shows that there is a productivity divergence between global best-performing firms and less productive (laggard) firms (Andrews, Criscuolo and Gal, 2019[6]). This can be partly explained by an uneven uptake and diffusion of innovations in the vast majority of firms due to a lack of capabilities and/or incentives for adopting new technologies and best practices (Andrews, Criscuolo and Gal, 2016[7]). The weakness of laggards among small firms (the concentration of firms towards the low end of the productivity distribution) prevails in Spain as in some other European countries (Figure 6; Panel B).

The diffusion of digital technologies raises productivity but such positive effects are uneven across firms (e.g. (Gal et al., 2019[8]); Box 3). The productivity effects of technology adoption are larger for highly-productive firms in general (i.e. productivity effects are stronger even if the adoption rate is identical across all the firms), which would accelerate productivity dispersion across firms all else equal. The analysis also suggests that the firms that suffer from skills shortages, are penalised in terms of productivity enhancement from technology adoption, which is particularly the case for low productive firms (Gal et al., 2019[8]). These findings show the importance of other complementary factors that determine actual productivity developments jointly with technology adoption.

Figure 6. Spanish firms, especially small ones, have low productivity



1. Labour productivity is measured as value added per person employed.
2. Small firms are defined as those with less than 50 employees and productivity is measured in industry-level purchasing power parities (PPP).
Source: OECD (2019), Compendium Productivity, Secretariat's calculations based on the ORBIS database.

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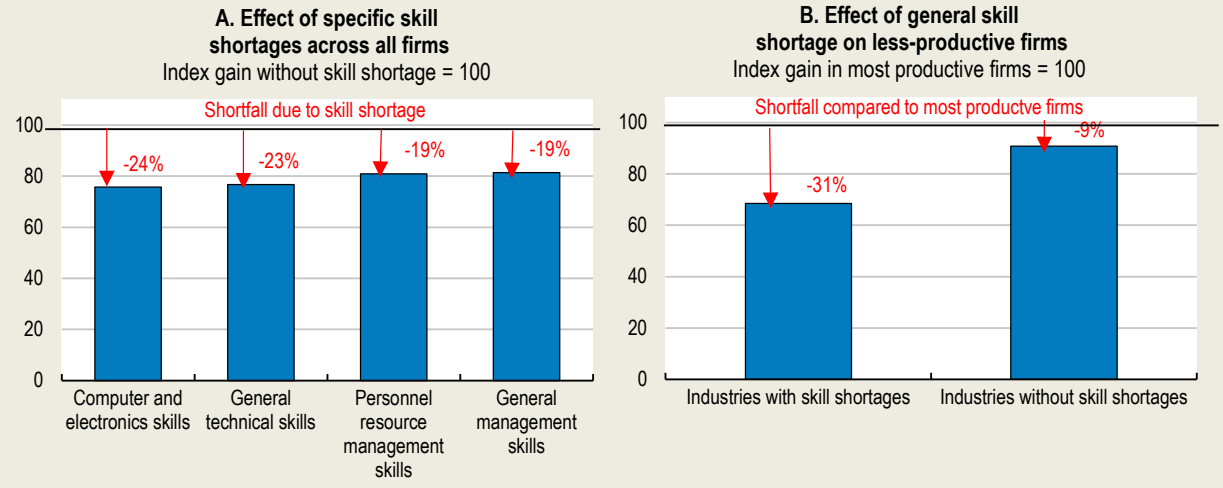
Box 3. Productivity effects of digital technologies

According to (Gal et al., 2019[8]) which investigated the impact of digital adoption on productivity at firm level across selected OECD countries, a 10 percentage point increase in the adoption of high-speed broadband would translate into an instantaneous increase in MFP growth by 1.4 percentage points. Similar effects were found for the adoption of other digital technologies, such as cloud computing, enterprise resource planning, and customer relationship management. However, the productivity effects differ depending on firms' capabilities. For instance, when there are significant skills shortages (defined as the value at the 75th percentile in the distribution of skill shortage, as measured by the OECD Skills for Jobs database), positive productivity gains would be 24% less than if there were no skill shortages (defined as the value at the 25th percentile in the same database) for the case of computer and electronics skills (Figure 7; Panel A).

The gains from adopting digital technologies differ also depending on firms' productivity level. For instance, if there are no skills shortages, the productivity gain due to digital adoption for less productive firms (defined as those in the third quartile) is 9% lower than that for the 25% most productive firms (the first quartile). Comparing these two categories of firms, when they face skills shortages (defined as above, but measured by a broad indicator of skills, including all the skills covered in Panel A), the productivity gain for less productive firms would be 31% less than that for the 25% most productive firms (Figure 7; Panel B).

Figure 7. Productivity effects of digital technologies vary by firm characteristics and skill shortages



Note: The estimated equation in Panel A is:

$$\Delta MFP_{f.s.c.t} = \alpha_1 \Delta MFP_{Frontier\ s.t} + \alpha_2 Gap_{f.s.c.t-1} + \alpha_3 [Dig\_Adopt_{s.c.\bar{t}} \times Shortage_{s.c.t}] + \gamma X_{f.s.c.t} + \delta_{c.t} + \delta_s + \varepsilon_{c.t}$$

where $\Delta MFP_{f.s.c.t}$ is the change in the logarithm of multi-factor productivity (MFP) of firm f, which operates in sector s and country c, in year t. $Dig\_Adopt_{s.c.\bar{t}}$ represents the share of firms in sector s and country c that report using high-speed broadband internet connection. The equation includes an interaction term $Dig\_Adopt_{s.c.\bar{t}} \times Shortage_{s.c.t}$, where technology adoption at sector level in a given country ($Dig\_Adopt_{s.c.\bar{t}}$) is considered jointly with the ICT related skill shortage at sector level in a given country and sector ($Shortage_{s.c.t}$), taken from the OECD Skills for Jobs database. Panel A illustrates how productivity gains differ when there is no significant shortage in each of specific skills (for e.g. computer and electronic skills) which is measured at the 25th percentile of the distribution of skills shortages across sectors and countries, and when there is significant shortage in each of specific skills which is measured at the 75th percentile of the same distribution.

The estimated equation in Panel B is:

$$\Delta MFP_{f,s,c,t} = \alpha_1 \Delta MFP_{Frontier\ s,t} + \alpha_2 Gap_{f,s,c,t-1} + \alpha_3 [Dig\_Adopt_{s,c,\bar{t}} \times Pdty\_Quartile_{f,s,c,t}] + \alpha_4 [Dig\_Adopt_{s,c,\bar{t}} \times Pdty\_Quartile_{f,s,c,t} \times Shortage_{s,c,t}] + \gamma X_{f,s,c,t} + \delta_{c,t} + \delta_s + \varepsilon_{c,t}$$

which includes an interaction term $Dig\_Adopt_{s,c,\bar{t}} \times Pdty\_Quartile_{f,s,c,t} \times Shortage_{s,c,t}$ where technology adoption at sector level in a given country ($Dig\_Adopt_{s,c,\bar{t}}$) is considered jointly with the productivity level of firms, classified into 4 levels ($Pdty\_Quartile_{f,s,c,t}$). Panel B illustrates how productivity gains differ when there is no significant skill shortage, which is measured here by a broad indicator including specific skills covered in Panel A, and when there is significant skill shortage, and compares how this difference is important between productive firms, defined as the 25% most productive firms, and non-productive firms, defined as those between the 50th and the 75th percentile of productivity distribution. All results are based on the estimated link between the adoption of a mix of selected technologies (high-speed internet, cloud computing, ERP and CRM software) and multifactor productivity among EU firms over 2010-15 in Gal et al. (2019). For more details, see Gal et al. (2019).

Source: OECD (2019), "Economic Outlook: May 2019" and Gal et al. (2019), "Digitalisation and productivity: In search of the holy grail: Firm-level empirical evidence from European countries".

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These complementary factors are those related to the effective use of digital technologies leading to new products and/or business models. These complementary factors include, among others:

- Organisational capital and management skills (e.g. (Brynjolfsson and Hitt, 2000[9]); (Bloom, Sadun and Van Reenen, 2012[10]); (Aral, Brynjolfsson and Wu, 2012[11]); (Schivardi and Schmitz, 2019[12]) for European countries including Spain);
- R&D investments (e.g. (Corrado, Haskel and Jona-Lasinio, 2017[13]); (Mohnen, Polder and Van Leeuwen, 2018[14]);
- Human capital and ICT-related skills (e.g. (Cuadrado, Moral-Benito and Solera, 2020[15]) for Spain).

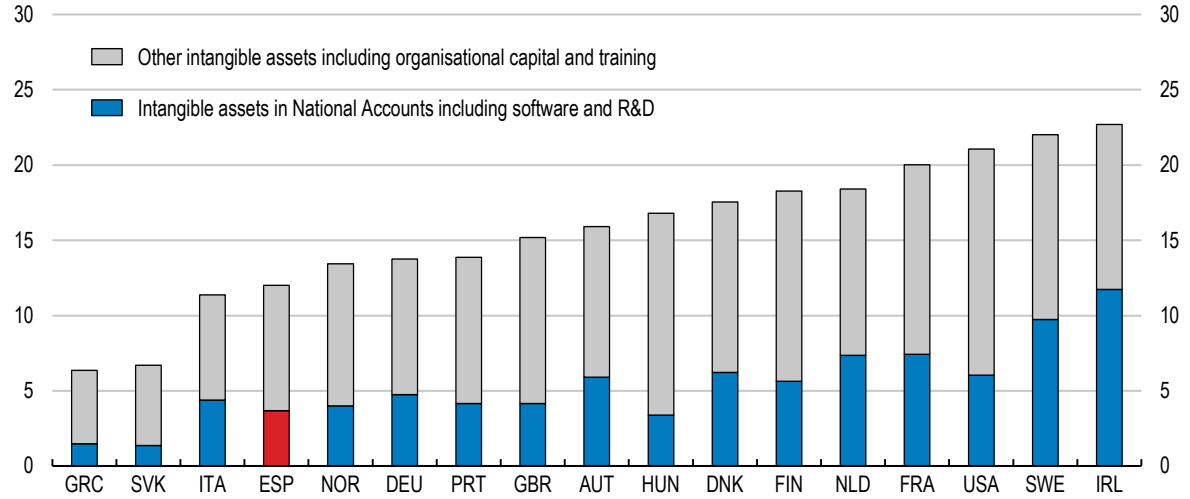
These factors raise productivity themselves as well as through complementarities with digital technologies.

Intangible capital is comparatively low in Spain, both in terms of organisational capital and R&D (Figure 8), which hampers technology diffusion. Organisational capital consists of knowledge, know-how and business practices, and is embodied in a firm's management (Squicciarini and Le Mouel, 2012[16]). High-quality management capacity is essential to set up business strategies to take full advantage of digital technologies. R&D is required to make the best use of digital technologies with a view to developing firms' own products and business models. These factors determine the channels through which digital technologies affect the efficiency and productivity of firms effectively.

ICT skills, which are an important part of the mix of skills required in the digital society (see below), are low for low-educated and older people (Figure 9). The lack of ICT related skills also hampers the benefits of technology diffusion in Spain (Cuadrado, Moral-Benito and Solera, 2020[15]). In this context, not only narrowly defined ICT specialists, who deploy and manage digital technologies, but also more broadly diffused generic ICT-related skills among people matter, in order to keep up with the changing technological environment. ICT skills among workers who use digital technologies on the ground are essential to reap the benefits from changing business practices and activities prompted by these technologies. ICT skills will be demanded more than ever, as the process of digital transformation and the associated reallocation of jobs are likely to accelerate following the COVID-19 crisis. This would require strengthening policy support in job training for the unemployed (see the *2021 Economic Survey of Spain*) and life-long learning (see below).

Figure 8. Investment in intangible assets is low

Investment in intangible assets as a percentage of business sector's GVA, 2015



Note: Intangible assets in National Accounts include intellectual property products, such as R&D, computer software and databases; other intangible assets include a range of knowledge assets that may have no intellectual property rights, such as organisational capital that is measured by means of the value of the inputs devoted to the building up of such assets.
Source: OECD Productivity Indicators (database), and OECD (2017), Science, Technology and Industry Scoreboard 2017: The digital transformation.

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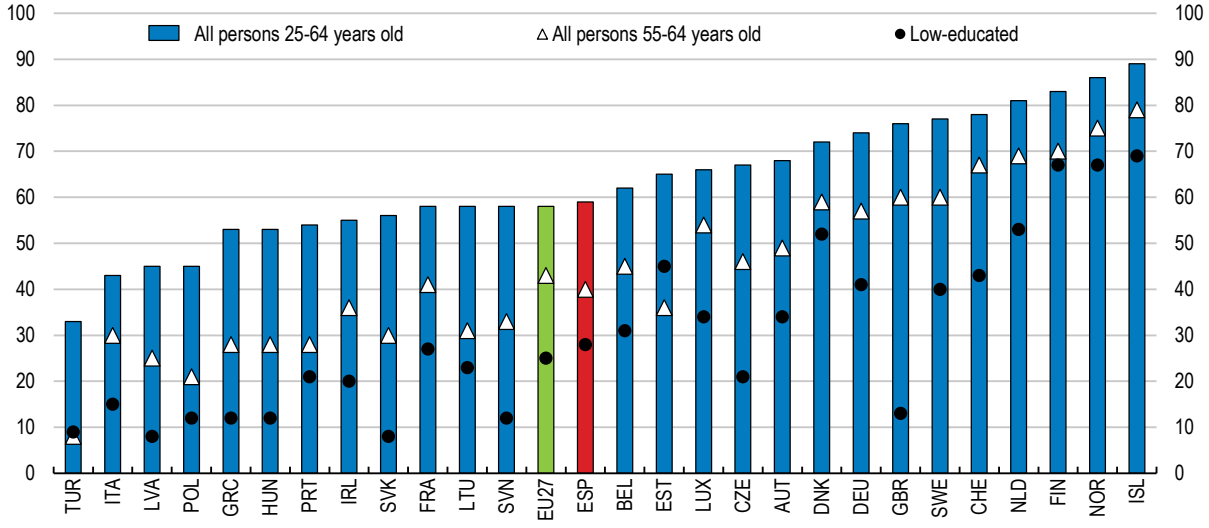
Figure 9. There is room to develop digital skills

Percentage of respondents claiming to have basic digital skills, 2019



Source: Eurostat, Digital skills (database).

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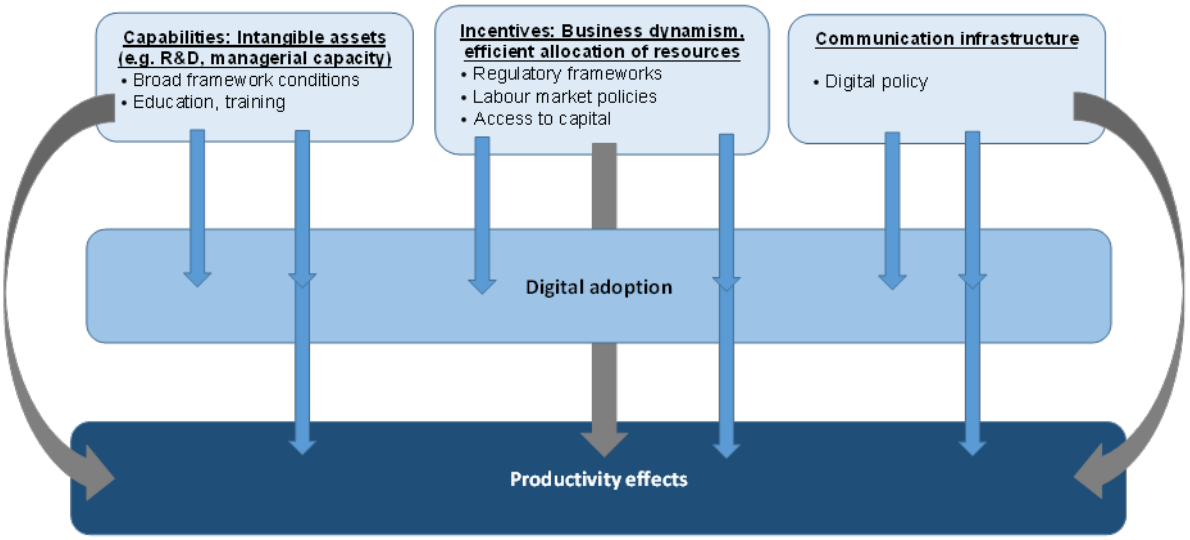
Policy reforms can boost productivity through digital diffusion

There are a number of identified drivers of technology diffusion (Figure 10; (Andrews, Nicoletti and Timiliotis, 2018[17])). Among such drivers, communications infrastructure is prerequisite to adopt and use digital technologies, which is more directly affected by policy through, for instance, outright broadband roll-out schemes. This should be supported by other policies, which raise competitive pressures and sharpen incentives to better use digital technologies, such as further regulatory reforms, including labour market policies, insolvency regimes, and better access to finance. These will strengthen firms' capabilities through improving managerial capacity and incentivising intangible investment. Finally, there are policy actions that can more directly enhance their capabilities, such as knowledge transfer and job training of workers.

Figure 10. Determinants of digital diffusion and productivity effects



Source: The Secretariat's elaboration based on Andrews et al. (2018), "Digital technology diffusion: a matter of capabilities, incentives or both?".

Against this background, this chapter explores the three driving forces to promote digitalisation, taking account of policy initiatives, such as the new digital strategy "*Digital Spain 2025*" and its associated plans (Box 4). First, it examines the coverage and quality of communication infrastructure, which the new digital strategy aims to enhance. Then, the chapter discusses the capabilities of firms and people to take full advantage of digitalisation, taking account of the simultaneous initiatives by the Spanish government, such as the new *Strategy for Science, Technology and Innovation*, *the National Plan for Digital Skills*, and the *Modernisation Plan for Vocational Training*. Finally, the chapter discusses the business environment, which has an influence on incentives for making use of digital technologies, taking stock of recent policy actions, such as comprehensive product market ("the Market Unity Law") and insolvency regime reforms.

Box 4. The new digital strategy: "Digital Spain 2025" and associated plans

The new strategy "Digital Spain 2025", which renews the previous Digital Agenda adopted in 2013, consists of a wide range of measures, reforms and investments, organised around 10 strategic axes. The actions contained in the strategy aim to promote a sustainable and inclusive form of growth, to reach the whole society and to reconcile new opportunities provided by digitalisation. Following this new strategy, new plans for the promotion of broadband connectivity and 5G will be adopted soon.

The 2025 goals are:

i) broadband coverage of all the population with a contract speed of 100Mbps or more;

ii) 100% of the radio spectrum for 5G to be assigned;

iii) 80% of people having basic digital skills;

iv) 20 000 new specialists in cybersecurity, artificial intelligence (AI) and data;

v) 50% of public services available on mobile apps;

vi) 25% of SME business volume generated by e-commerce;

vii) 10% reduction in CO_2 emissions through digitalisation;

viii) 30% increase in audio-visual production;

ix) 25% of firms using AI and big data; and

x) a national charter of digital rights.

This strategy is associated with a number of national plans with concrete priorities and investments to be made in the years to come. These include:

- The Plan for the Promotion of Broadband Connectivity and 5G;
- The National Strategy on Artificial Intelligence;
- The National Plan for the Digitalisation of Public Administrations;
- The National Plan for the Digitalisation of SMEs;
- The Audiovisual Sector Plan;
- The National Plan for Digital Skills.

Source: The Government of Spain.

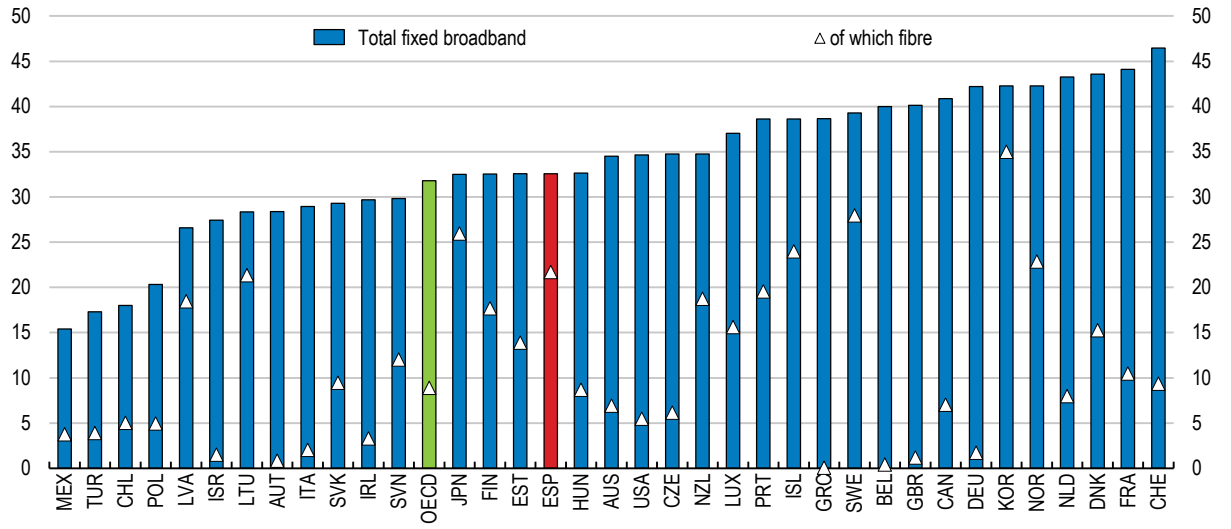
Ensuring communication infrastructure for all

Communication infrastructure underpins the adoption and use of digital technologies. Broadband has emerged as a modular general-purpose technology that supports a variety of traffic types, applications and devices, including transformative technologies like cloud computing and the Internet of Things (Box 1) (OECD, 2019[1]). Cross-country evidence finds a strongly significant and positive association of high-speed broadband penetration with the adoption rate of digital technologies (Andrews, Nicoletti and Timiliotis, 2018[17]). This underscores the need for ubiquitous broadband deployment, in order to ensure a level playing field for all. One of the major objectives of the new digital strategy "Digital Spain 2025" is to ensure high-quality broadband connectivity with a contract speed of 100Mbps or more for all the population by 2025. The national recovery plan allocates EUR 13 billion to promoting sustainable, safe and connected mobility.

Spain performs well in terms of connectivity, based on broadband developments, according to the Digital Economy and Society Index by the European Commission and OECD indicators. The number of broadband subscriptions in Spain is close to the OECD average, but the share of fibre networks in total broadband subscriptions is higher than in many other countries (Figure 11). Indeed, the deployment of high-speed broadband connections distinguishes Spanish communication infrastructures from other EU countries. The take-up rate of broadband connections of at least 100 Mbps among Spanish households has reached 52.9% in 2019, which is well above the EU average.

Figure 11. The share of fibre in total fixed broadband subscriptions is high

Fixed broadband subscriptions per 100 inhabitants by technology, 2019



Source: OECD Broadband Database.

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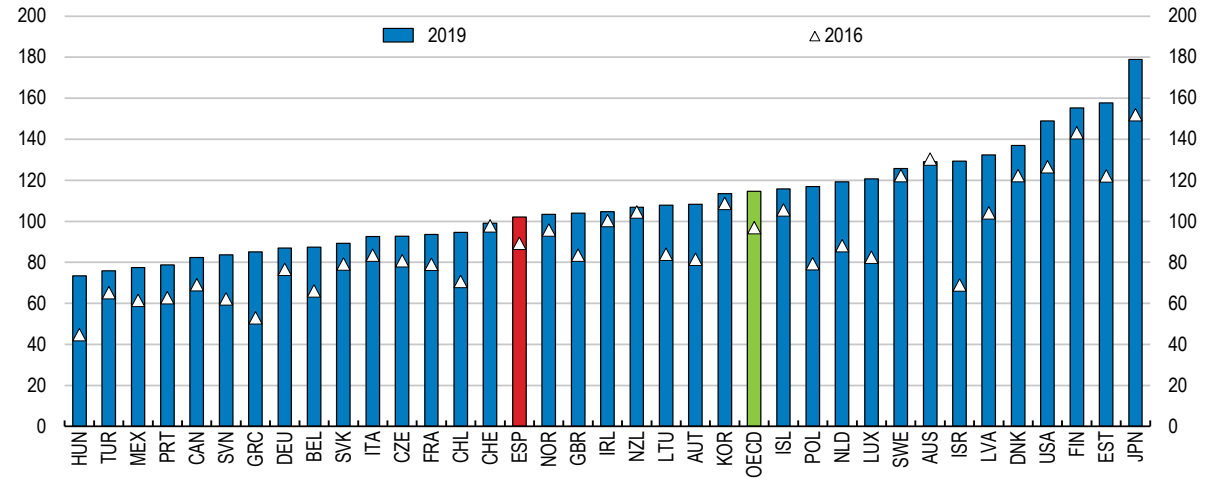
The number of mobile broadband subscriptions has increased over the past years so that it surpassed the number of inhabitants (Figure 12). Simultaneously, the deployment of 5G networks is currently underway, which enables new business cases to emerge. In Spain, the deployment of 5G networks is facilitated by the widespread fibre networks, which offload mobile traffics into fixed networks. For instance, around 60% of data uploaded and downloaded on devices such as smartphones used fixed networks through Wi-Fi (OECD, 2018[2]). Efficient spectrum management is also essential for the development of 5G wireless networks (OECD, 2019[3]). In Spain, 45% of the spectrum (which meets the technical conditions specified by EU law) has already been assigned for 5G use, which is well advanced compared with other EU countries (European Commission, 2020[18]). The four main communication operators (i.e. Vodafone, Telefónica, Orange and Másmóvil) are already offering 5G commercial services.

The share of individuals using the Internet is high in Spain (Figure 13), on the back of advanced broadband networks. The shares of Internet users performing relatively more complex activities, such as online purchases, e-banking, and use of government services, are close to the OECD average (OECD, 2020[19]). The extent to which people perform these activities depends on various factors, such as people's ICT skills and their trust in digital security. It also depends on the availability of services, underpinned by the development of high-quality communication infrastructures, such as the availability of digital government services and commercial products sold on-line. Policies to promote the use of digital technologies in households and by individuals are usually related to wider issues, such as ICT education, digital skills and literacy, communication infrastructure, cybersecurity and trust, and e-government efficiency (OECD, 2020[19]).

Figure 12. Mobile broadband subscriptions have increased

Mobile broadband subscriptions per 100 inhabitants



Source: OECD Broadband Database.

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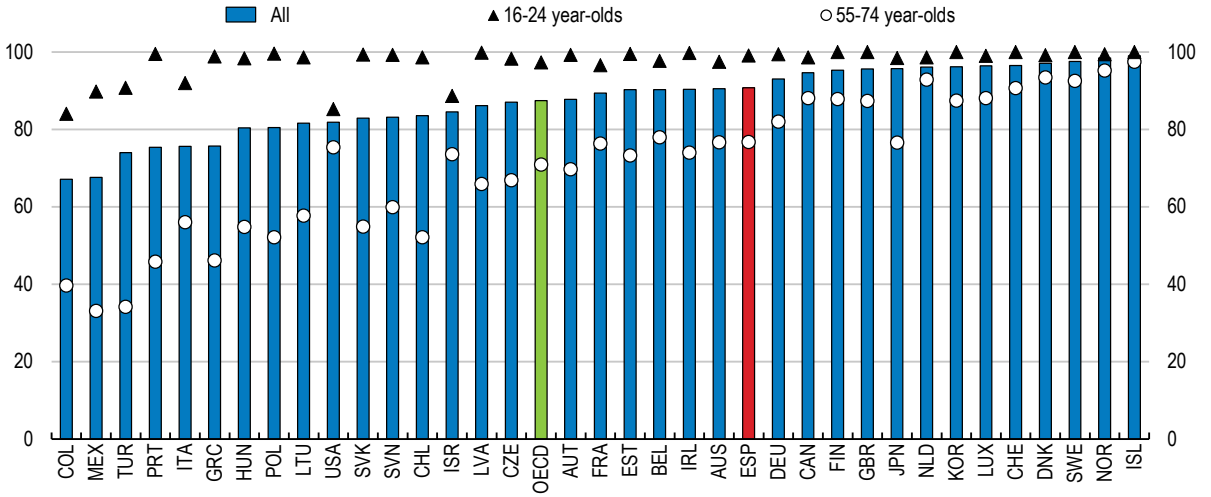
Figure 13. Internet usage is relatively widespread in Spain

Internet users by age as a percentage of the population in each age group, 2019



Note: Internet users are those having used the Internet in the last 3 months, except for Colombia and Japan (last 12 months) and the United States (any time). Data refer to 2019 except for Australia (the fiscal year ending 30 June 2017), Brazil, Canada, Colombia, Japan and Mexico (2018) and Chile, Israel, Switzerland and the United States (2017). Data refer to age groups 16-74, 16-24 and 55-74 except for Israel (20-74 and 20-24), Japan (15-74 and 55-74). OECD data figures are based on a simple average of the available countries.
Source: OECD (2020), ICT Access and Usage by Households and Individuals (database).

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The Spanish telecommunication sector performs well

Competition in the communication sector can positively influence investment and pricing decisions and can drive up the overall quality and speed of broadband offers. Laws or regulations in place have lowered barriers to entry to the communication market and have contributed to an expansion of fibre networks. In the case in which an operator has substantial market power in each segment of the market, appropriate regulations are adopted. For instance, the operator with substantial market power is required to provide access to infrastructure to others and the prices of the related products are regulated. Finally, retail tariffs for all services are not regulated or approved by the public authorities. Fixed broadband prices for Spain are high, but this largely reflects the overall quality of services, such as the speed of connections and packages with multiple services (European Commission, 2020[18]). The take-up rate of broadband connections of at least 100 Mbps has grown significantly.

The Spanish telecommunication operators have been actively engaged in expanding their activity, including through infrastructure sharing. Infrastructure sharing (for instance, fibre, ducts and masts) is one way to promote competition in telecommunication markets, particularly where markets are characterised by a dominant player (OECD, 2019[1]). In Spain, such infrastructure sharing has helped to increase the deployment of fibre networks closer to the end user (OECD, 2019[1]).

Co-investment arrangements, whereby two or more operators co-invest in network deployment, can increase competition and coverage (OECD, 2019[1]). Some arrangements have emerged in Spain as a way to lower deployment costs and thus financing constraints. However, there is a risk that such arrangements could distort competition. The impacts of such arrangements and the ideal conditions for network access for third parties depend on local market conditions and factors, such as the number of operators and the areas of co-investment, and the overall effect is unclear at this stage (Godlovitch and Neumann, 2017[20]). The Spanish authorities welcome such arrangements insofar as they do not harm competition and should continue to monitor them closely.

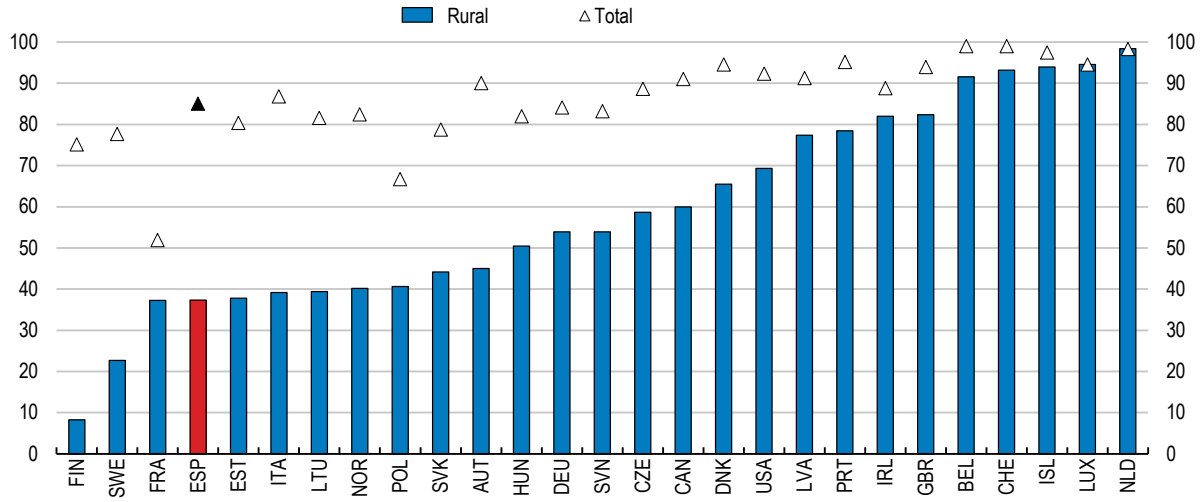
The digital divide between urban and rural areas should be reduced

There is a digital divide between urban and rural areas, with a large difference in the coverage of high-quality broadband access between them (Figure 14). The digital divide declined in the last two years, as the coverage of fibre networks in rural areas is 46%, which is well above that in other European countries (21%), but the gap between urban and rural areas in Spain remains. As in the majority of OECD countries, private investment is the largest source of investment in communication infrastructure in Spain. Rural and remote areas are less attractive for commercial operators given deployment costs, as core networks are typically located closer to densely populated areas, thus requiring further investment. As a result, there are some rural and remote areas, where there is no current or planned coverage by any private operator in the coming years. Against this situation, the latest calls for public financial support to develop broadband networks have targeted rural areas, in particular, towns with less than 1 000 inhabitants.

One effective way to ease infrastructure deployment is through a reduction of approval and construction times. Therefore, many OECD countries are aiming to streamline “rights of way” – digging up streets, laying cables, and installing masts, antennae and other infrastructure – (OECD, 2021[21]). The main areas of excessive regulation in Spain are local licencing requirements prior to the deployment of telecommunication antennas, power supply licence requirements prior to deployment works of radio stations, and planning permission requirements prior to the deployment and operation of antennas and radio stations. The current legal framework establishes a set of measures to reduce deployment costs, including permit exemptions for the installation of certain radio and cable infrastructure. To progress in this area, the authorities should reduce excessive regulatory burdens to “rights of way” to lower deployment costs and encourage investment.

Figure 14. High-speed broadband access is low in rural areas

Households in areas where fixed broadband with a speed of 30 Mbps or more is available, as a percentage of households in the total and rural categories, June 2017



Source: OECD (2019), Measuring the Digital Transformation.

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The access to "rights of way" differs across regions and municipalities, which creates barriers to infrastructure deployment. To avoid fragmentation of permits for infrastructure deployment, which do not conform to legislation, a coordination mechanism was adopted in the Spanish electronic communications legal framework. Within this framework, regions and municipalities are subject to the approval of the central government for their project of urban planning or other sorts of regulations, which relate to electronic communication networks deployment. The central government examines the content of such regulations and assesses whether they comply with the regulatory framework. Over the past years, regions and municipalities have modified their rules to conform to legislation. Such efforts to streamline the access to "rights of way" across different regions and municipalities need to be extended, with a view to establishing as uniform a practice as possible (OECD, 2018[22]).

The authorities can finance investments undertaken by private operators to solve critical bottlenecks in rural areas, as they are better placed to take a longer-term and broader view of returns. Indeed, as part of the National Broadband Plan, the authorities have provided financial support for the roll-out of broadband networks in underserved areas. The 2019 call awarded EUR 140 million in grants to fibre network deployment projects to provide coverage to half a million households. A new scheme, worth EUR 400 million to roll out infrastructure capable of providing speeds of 300 Mbps to more underserved areas in 2020-22, was declared as compatible with EU State aid rules in December 2019. While these will help lower the digital divide, there is a limit to these types of financial support as they can conflict with state aid rules.

The authorities can also undertake public investment directly in key communication networks could also help solve critical bottlenecks in rural areas, by complementing private investment. Across OECD countries, such public investment has been associated with open access policies so as not to encourage monopoly power in underserved areas (OECD, 2018[22]). Implementing open access arrangements is an increasingly common approach to avoid duplication of resources and focus on the timely expansion of services to reach the widest level of network coverage through optimised roll-out and investment plans (OECD, 2019[1]). In rural areas, where non-broadband infrastructures remain underdeveloped, adopting a "dig once" policy to leverage broadband infrastructure projects is advisable, as it reduces considerably the costs of broadband expansion (OECD, 2018[22]).

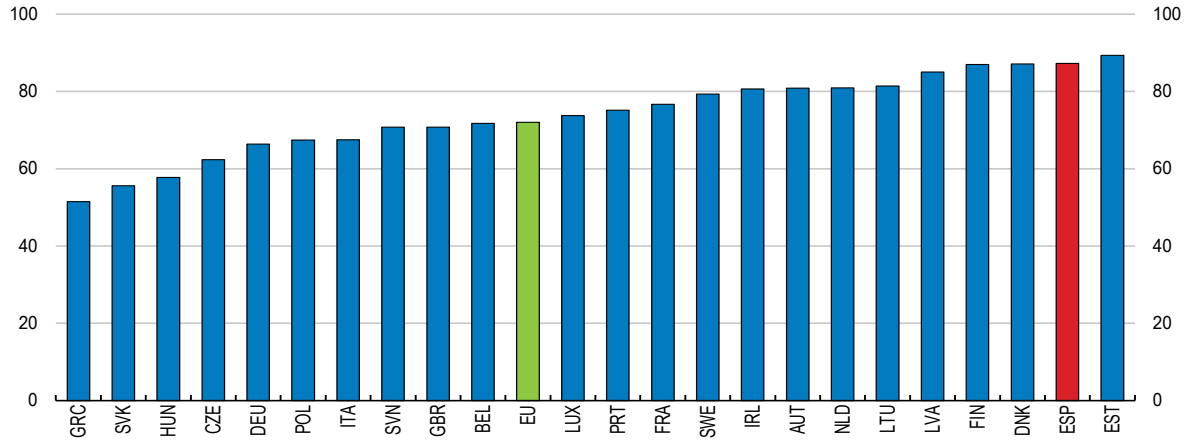
Providing information on the location of existing infrastructure and on planned construction work can also help investment, as it reduces search costs by operators. In 2019, the government approved a regulation on the "Single Information Point". In this platform, information on existing and planned physical infrastructures is provided by network operators, and access requests can be made by electronic communications operators. In addition, municipalities and other public bodies provide all the information concerning the required authorisation and processes in order to deploy electronic communication networks. The platform is currently operational, but few operators have signed up yet. The signing-up by operators can be made mandatory to ensure the full coverage of information.

Digital public services are an integral part of the digital transformation

To enable digital transformation across the economy and society, governments need to go digital themselves. Governments can digitise existing processes and offer public services online, while consumers and businesses increasingly become familiar with new digital forms of communication. Spain performs well in terms of digital public services, as it ranks second across EU countries (Figure 15), which measures the online interaction between public authorities, citizens and businesses. This reflects, in particular, the government's commitment to open data: over 98% of all services are digital-ready, due to the timely implementation of the 2015-20 ICT strategic plan and the well-developed ICT architecture. This also reflects the advancement in pre-filled forms, thanks to inter-connected registers, allowing users not to resubmit the same data to the public administration. Finally, the provision of on-line health services has advanced in Spain compared with other EU countries (Box 5).

Figure 15. Online services in public administration are advanced

Digital Economy and Society Index: Digital Public Services, score from 0 to 100, 2020



Note: "Digital Public Services" is one of the 5 dimensions in the Digital Economy and Society Index by the European Commission. This dimension measures both the demand and supply sides of digital public services as well as open data. Specifically, it measures: e-Government users, Pre-filled forms, Online service completion, Digital public services for businesses and open data. More details can be found in the Digital Economy and Society Index Report 2020.
Source: European Commission, Digital Economy and Society Index Report 2020.

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The authorities should complement these measures with policies to promote the utilisation of digital services among citizens effectively. The latter is high, when measured by the frequency of the submission of documents on-line according to the EU Digital Economy and Society Index. However, it is less frequent when a broader range of digital services are considered, such as consultation with the public administration on-line (OECD, 2020[19]). This may reflect the quality of digital services offered and digital security. Moreover, there is a marked difference in the share of those who use these services between high- and low-educated people (OECD, 2020[19]), which most likely reflects the lack of digital skills.

Box 5. E-health to make the health system efficient and resilient

The provision of on-line health services (e-health) can improve safety and cost-effectiveness, and can in some cases lead to better health outcomes than conventional face-to-face care (Oliveira Hashiguchi, 2020[23]). E-health turned out particularly beneficial in the context of the COVID-19 pandemic by allowing continuity of certain health care in times of social distancing while reducing infectious exposure (CDC, 2020[24]).

Spain ranks relatively well in the provision of e-health. According to the Digital Economy and Society Index (European Commission, 2019[25]), 29% of people in Spain have used online health care services without having to go to a hospital or a doctors surgery (for example, by getting a prescription or a consultation online), compared with 18% of people in the EU in 2017. 68% of general practitioners used electronic networks to exchange medical data with other healthcare providers and professionals, which compares with 43% in the EU in 2018. 74% of general practitioners have used electronic networks to transfer prescriptions to pharmacists (electronic prescriptions), while only about half of general practitioners have used such prescriptions in the EU in 2018.

The regional authorities have taken measures, such as the creation of comprehensive health web portals. Several of them have already implemented e-health mobile applications that allow patients access to information concerning them through their smartphones.

Source: Oliveira Hashiguchi, 2020; CDC, 2020; European Commission, 2019.

The new digital strategy, “Digital Spain 2025”, promotes the digitisation of public administration, particularly in key areas, such as employment, justice, or social policies. The strategy is complemented by the National Plan for Digitalisation of Public Administration (Box 4). It aims to streamline the delivery of public services and promote investments and reforms foreseen in the strategy, which is welcome and should be fully rolled out. Currently, digital public services are not fully utilised in public administration in certain aspects. For instance, this is the case for public procurement, which is attributed to the lack of resources among contracting authorities. More human and material resources should be provided to these contracting authorities to expand digital services, which can make public procurement proceedings more competitive and transparent.

The National Strategy on Artificial Intelligence (AI) can also help, as it aims to boost the use of AI in public institutions and in national strategic missions. Its other pillars are to boost scientific research, technological development and innovation in AI, foster digital skills, attract international talent, develop data platforms and technological infrastructures that provide a support network for AI, integrate AI in the value chains to transform the economic structure and establish an ethical and regulatory framework that guarantees the protection of individual and collective rights.

Cybersecurity underpins the digital transformation of the society

Digital security ensures the smooth operation of digitalised activities and promotes digitalisation by earning people’s trust. Digital security incidents harm businesses, governments and individuals by undermining the availability, integrity and/or confidentiality of their data, information systems and networks. For businesses, they can notably result in loss of reputation, theft of innovation assets, or disruption of operations. In 2019, 12% of firms in Spain experienced digital security incidents with implications for the availability of digital services, the destruction or corruption of data, or the disclosure of confidential data, close to the EU average of 13%, according to Eurostat.

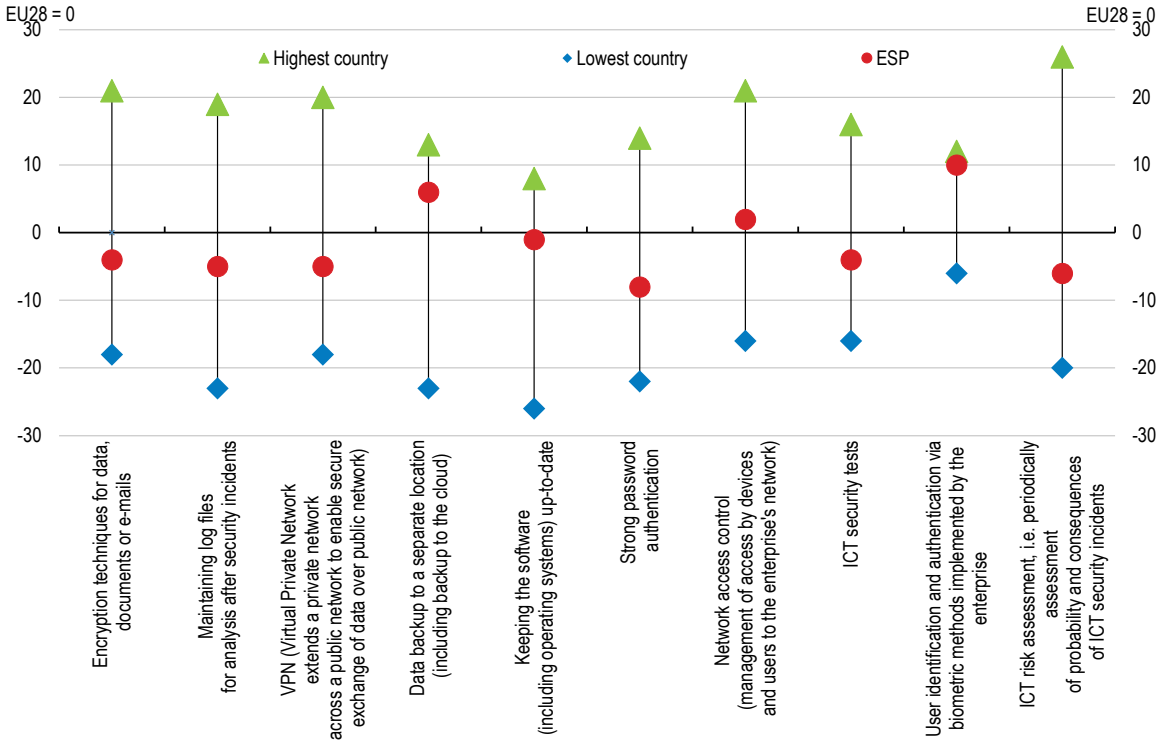
Overall, Spain is well committed to cybersecurity, as it ranks 7th out of 175 according to the Global Cybersecurity Index (which evaluates legal, technical, and organisational measures as well as cooperation and capacity building). Moreover, the new National Cybersecurity Strategy 2019 has guided Spain's actions in cybersecurity, in particular, regarding the evolution of digitalisation, new risks and threats, which was also adapted to new legal and strategic frameworks at the national and international level. The strategy created the National Cybersecurity Forum, and has promoted R&D in cybersecurity. Spain continues to make progress in improving cybersecurity capacities and promoting research through specific R&D programmes (see below).

One of the key challenges for policy makers is promoting digital security risk management as a priority for a digital security strategy (OECD, 2020[19]). There is some scope for Spanish firms to improve digital security risk management (Figure 16), in particular, digital security risk assessment. The regular assessment of the likelihood and potential severity of consequences of digital security incidents is at the core of digital security risk management (OECD, 2015[26]). It conditions which security measures are needed and in which context. In Spain, the National Institute of Cybersecurity (INCIBE) promotes awareness and training in digital security by offering a wide variety of services to cover the essential aspects of cybersecurity. Among them, the Awareness Kit is designed to understand the state of cybersecurity and what is needed to improve it, providing a self-diagnosis tool and specific plan for implementation. The National Cybersecurity Forum will also promote the improvement of digital security risk management.

Capacity building is usually one of the main pillars of the national digital strategies, ensuring a sufficient pool of practitioners for digital security risk management (OECD, 2020[19]). One of the objectives of the National Cybersecurity Strategy is to enhance the culture and commitment to cybersecurity and strengthen human and technological skills. The new digital strategy, "Digital Spain 2025", includes an objective to strengthen cybersecurity by increasing the number of cybersecurity, Artificial Intelligence and data specialists to 20 000 in 2025. This will require coordination with other ministries not often involved in digital security policy, but also complementing initiatives. This initiative should encompass, among others, the new vocational education and training (VET) plan, which aims to increase the pool of digital security talent. If implemented as planned, this would improve digital security risk management among Spanish firms.

Figure 16. Digital security measures can be strengthened further

Percentage of the enterprises (10+ employees) implementing digital security measures, 2019



Source: Eurostat, Security policy: measures, risks and staff awareness database.

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Enhancing capabilities to make full use of digital technologies

The capabilities of firms and people are crucial for the effective adoption and use of digital technologies and innovation that can result from it. Policies can promote investment in intangible assets through R&D support and partnerships between firms and research institutes for business-oriented research. Policies are particularly relevant in terms of developing people's skills through formal education and lifelong learning. These policies are found to raise the adoption of digital technologies (Andrews, Nicoletti and Timiliotis, 2018[17]) and boost productivity gains from digital adoption ((Gal et al., 2019[8]); Box 3). Taking account of these complementarities, training/skills policies and innovation/investment policies should be decided in greater connection to boost firms' investment and innovation activities.

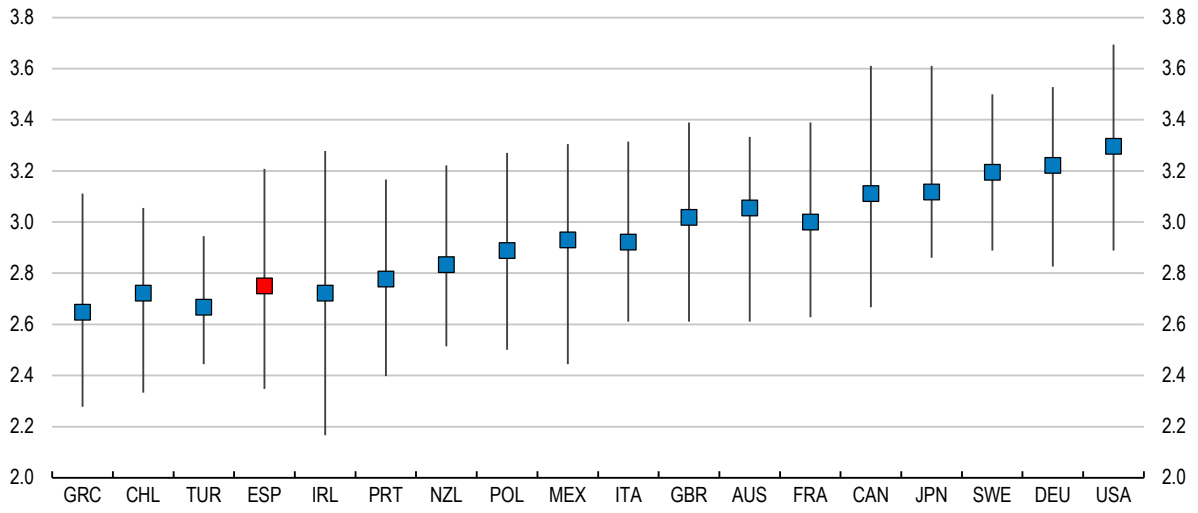
Some policies can directly promote the adoption of digital technologies. The national recovery plan allocates EUR 4 billion to the digitalisation of SMEs, mainly through the implementation of the National Plan for Digitalisation of SMEs. The Plan covers basic digitalisation for SMEs, business training for executives in digital skills, disruptive innovation and entrepreneurship, support for digitalisation in some specific sectors, such as tourism, and promotes coordination. The Plan aims to reach 1.5 million SMEs (equivalent to a half of all SMEs in Spain). While it is difficult to assess this plan yet, the authorities should ensure the measures reach those who need them most. Moreover, in order to boost productivity together with further developments in digitalisation, the Plan should be implemented, while addressing structural barriers to boost productivity simultaneously.

Intangible capital and innovation to foster digitalisation

Organisational capital, defined as knowledge, know-how and business practices, and embodied in a firm's management, is a fundamental condition to make the most use of new technologies within each firm. Digital adoption is found to be more widespread in environments characterised by high quality management (Andrews, Nicoletti and Timiliotis, 2018[17]). Organisational capital is low in Spain (Figure 17). This metric of organisational capital, which investigates management practices related to processes, monitoring, targets and incentives, is significantly associated with the degree of competition in product markets and the prevalence of family-owned firms (Bloom and Van Reenen, 2007[27]). Such managerial practices are chiefly a matter of businesses, but policies can influence them by strengthening business dynamism and market discipline (see below).

Figure 17. The quality of management practices is low

Scores from World Management Survey



Note: The figure shows the distribution of management scores across countries for randomly sampled medium-sized firms with 50 to 5000 employees in manufacturing from 2004 to 2014. The countries in the figure are ranked by country-level average management scores. The square indicates the country's median and the line indicates the country's 25th and 75th percentile and its median. Management scores are taken from (Bloom et al., 2014), and comprise average scores of all firms sampled from 2004 to 2014. Management scores reflect the simple average of 18 items of management practices, which have been scored from 1 (worst) to 5 (best) based on detailed surveys with the respective firm's managers. Items surveyed comprise managerial practices on target setting, monitoring and incentivizing.
Source: OECD calculations based on World Management Survey (Bloom et al., 2014).

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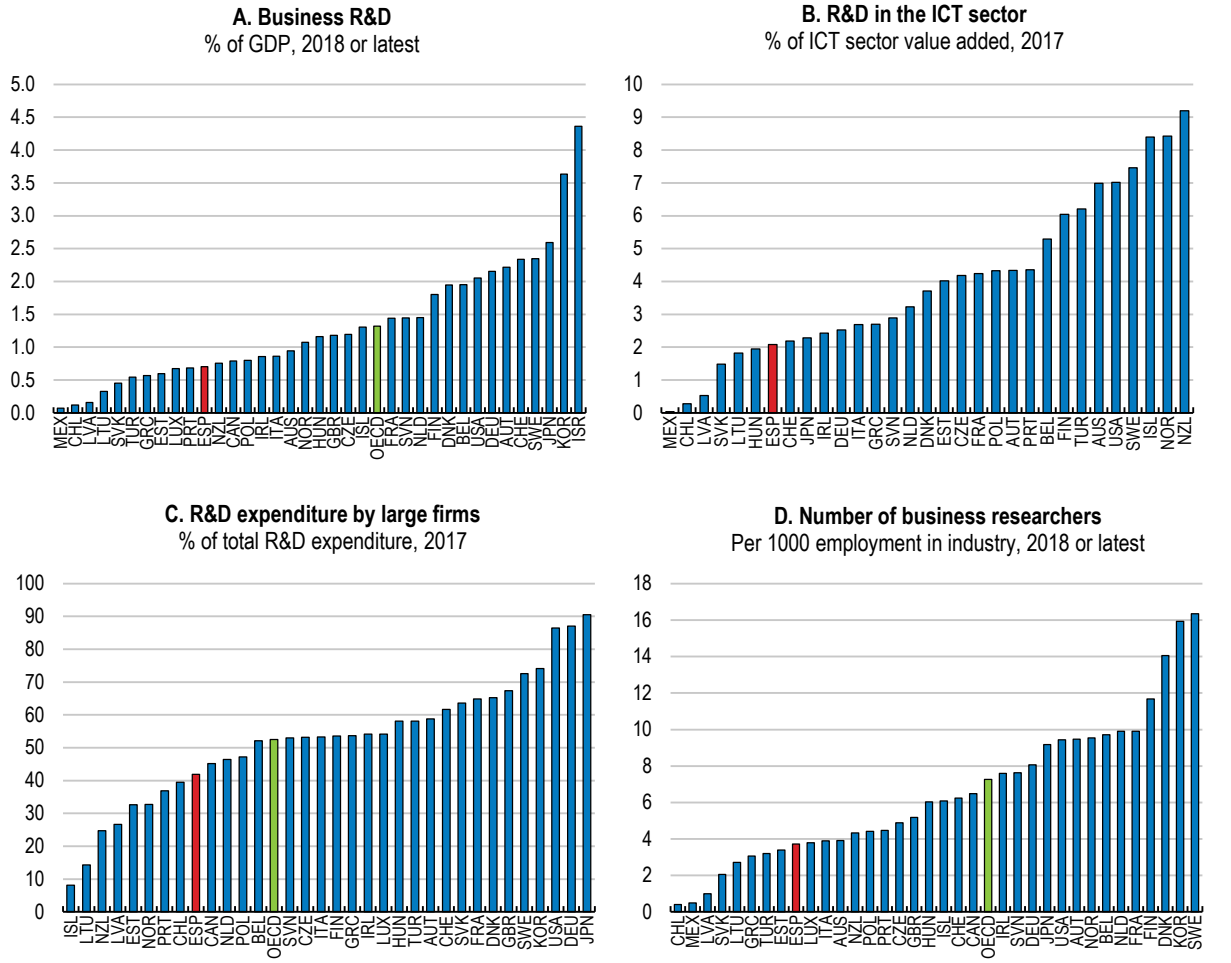
R&D activity raises the ability to experiment with business processes, new products, and thus business models made possible by digital technologies. However, business R&D investment remains low in Spain (Figure 18; Panel A). Business R&D in knowledge-intensive sectors, such as ICT, is low (Figure 18; Panel B), although digitalisation-related R&D also takes place in other sectors. Overall, large firms tend to invest more frequently in R&D and spend larger amounts in R&D investment in comparison with smaller firms in Spain (García-Posada, Menéndez and Mulino, 2020[28]). Nonetheless, the share of large firms in total business R&D is very low by international standards (Figure 18; Panel C). Finally, the number of R&D researchers in the business sector is significantly lower (Figure 18; Panel D), implying capacity constraints to conduct business R&D.

The new *Science, Technology and Innovation Strategy 2021-27* was introduced in 2020 to consolidate and reinforce the science, technology and innovation system in all fields, including digital technologies (Government of Spain, 2020[29]). The Research and Development State Plans 2021-23 will be introduced soon to support its implementation. The Strategy envisages to double the amount of public and private R&D spending by 2027, and the budget of the Ministry of Science, Technology and Innovation has increased by around 60% to EUR 3.2 billion in the Budget 2021. This reflects the *Shock Plan* (EUR 1.06 billion), introduced in July 2020, which aims to respond to the need to promote and strengthen the public and private R&D as well as the innovation system. This also reflects the *Recovery, Transformation and Resilience Plan* (EUR 3.3 billion for the Science and Innovation part over the period 2021-23). The Strategy also aims to develop researchers who can be adapted to partnerships with business (see below).

Figure 18. Business R&D in Spain lags behind in a number of areas



Source: OECD Research and Development Statistics (database).

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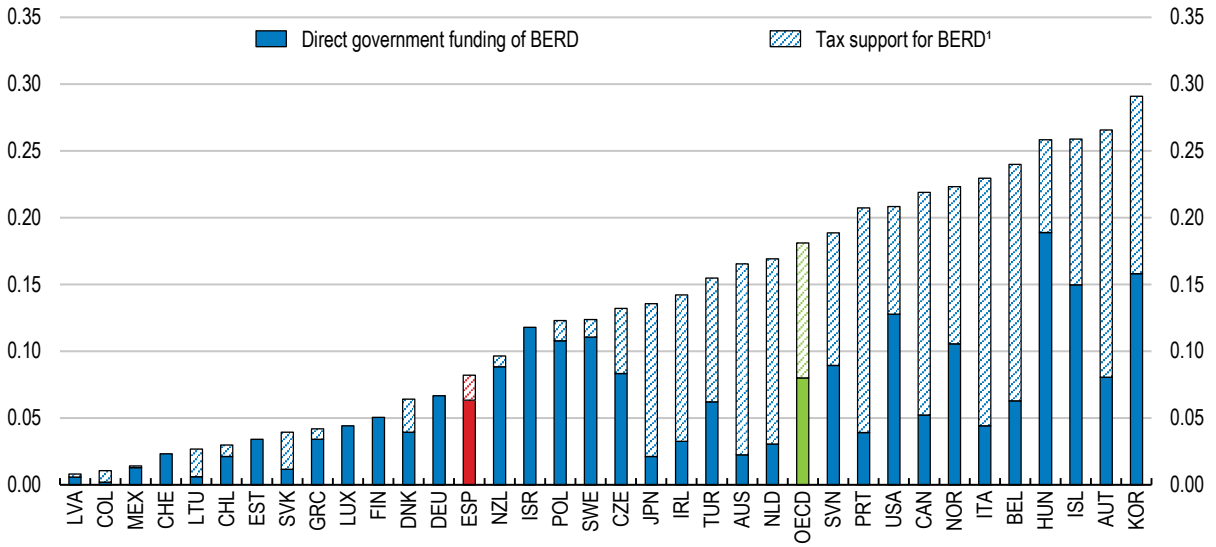
R&D tax incentives

Public support for business innovation can alleviate financial constraints and encourage R&D activities in firms. Overall, public R&D financial support is low in Spain, compared with other OECD countries (Figure 19). Some firms, in particular small businesses, face funding difficulties to undertake R&D effectively. Although equity finance is a significant determinant of R&D investment (García-Posada, Menéndez and Mulino, 2020[28]), as share investors value intangible assets more than bank creditors do, bank lending remains by far the most important source of external financing among most Spanish firms (see below). Excessive debt leverage can reduce R&D investment, while firms use cash holdings to smooth R&D investment (García-Posada, Menéndez and Mulino, 2020[28]), suggesting the importance of stable and sound financing to undertake R&D.

The use of R&D tax incentives is comparatively low in Spain (Figure 19), although it has one of the most generous tax credit systems in terms of the implied effective subsidy across the OECD (OECD, 2020[30]). The R&D tax credit is found to be effective in terms of promoting private R&D expenditure ((OECD, 2020[31]); (AIReF, 2020[32])). Nonetheless, the take-up rate of R&D tax credits remains low, partly because of the requirements to benefit from the R&D tax credit in the corporate tax system, which limits its appeal particularly for small businesses (AIReF, 2020[32]). These requirements, along with other administrative procedures for the application of R&D tax credit, should be reviewed, and the system should be streamlined to lower associated costs, as recommended in the *2018 Economic Survey of Spain*. The authorities intend to investigate the possible improvements pointed out by Fiscal Council (AIReF) in the design of the tax benefits, taking account of other policies, such as direct transfers and subsidies within the overall R&D support policy.

Figure 19. Public financial support to business R&D is low

Government support for business R&D, as % of GDP, 2018



1. Subnational tax support for BERD is included in tax support for BERD.
Source: OECD R&D Tax Incentives database (Last updated December 2020).

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R&D grants and loans

Government direct funding of business R&D, which is managed by various public bodies at both the central and regional government levels in Spain, can be more targeted to specific policy purposes. Among public bodies, the Centre for Technological and Industrial Development (CDTI) is the largest in terms of the amount of non-tax based support for business. The CDTI has decreased the share of grants in its business support over the past decade. CDTI loans are awarded with interest rates that are very close to private market financial rates, while requesting bank guarantees for the award, which makes those loans unattractive for the majority of SMEs and less adapted for newly started innovative firms (ERAC, 2014[33]).

Compared with loans, R&D grants are in principle better suited for young and innovative firms, as they lack the financial capacity against which decisions to award R&D loans are often made. R&D grants should be subject to evaluation in order to target them to those with high growth potential. When awarding R&D grants and loans, the public bodies, such as the CDTI, evaluate projects, taking account of, among others, the quality of projects, the capacity to undertake them, including human resources, and past performance, which seemingly conform to international standards. However, it is not clear how their evaluation is related to their decision making in granting direct funding, as there are cases in which such a decision is made in a discretionary way (AIReF, 2018[34]), which should be addressed. In addition, the performance evaluation of projects needs to be implemented with rigorous approaches, which should condition the continuity of grants (AIReF, 2018[34]).

The CDTI launched two new programmes, the "*Cervera*" and "*Misiones*' programmes, aiming at the promotion of technology transfer to the business sector. The "*Cervera*" programme, launched in 2018, targets 11 priority areas, including those related to digitalisation, namely, artificial intelligence, advanced mobile networks and information protection. This programme also promotes partnerships between public research and businesses (see below). The programme granted EUR 72 million in 2019 (this compares with total R&D funding of EUR 853.2 million provided by the CDTI, accounting for 45.7% of total public funding for R&D projects, in 2017). The "*Misiones*" programme, launched in 2020, aims to support sectoral strategic R&D initiatives. The budget for the first call has been EUR 70 million. As part of the National Strategy on AI, which foresees four R&D grant programmes (amounting to EUR 214 million in total), EUR 109 million was allocated to the "Misiones I+D+I en AI programme". As the "*Cervera*" and "*Misiones*" programmes will be boosted by the Recovery, Transformation and Resilience Plan, these programmes should be subject to rigorous ex-post evaluation of projects, one of the weak areas in the R&D financing system in Spain.

Partnerships between public research and business

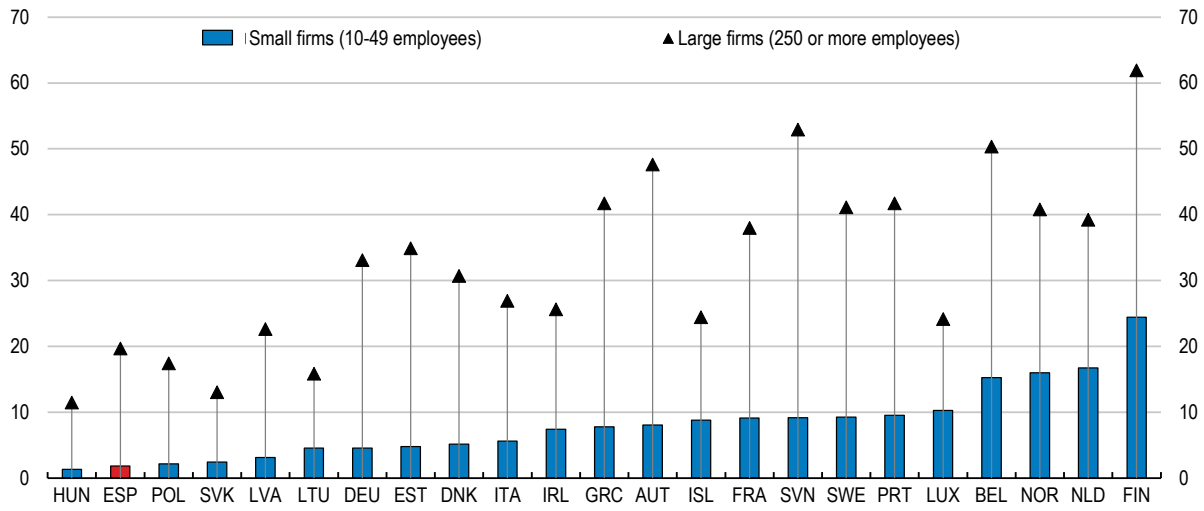
Partnerships between public research and business spur innovation by sharing both the risks and rewards of digital innovation (OECD, 2019). In the digital age, such partnerships are important because a great deal of knowledge on digital technologies cannot be transmitted easily and require significant adaptation to each specific application (Guellec and Paunov, 2018[35]). The Spanish government is currently reforming the Law 14/2011 of Science, Technology and Innovation to facilitate the transfer of the results of the research activity. The OECD, in collaboration with the European Commission, is currently working with the Spanish government to develop a roadmap for enhancing collaboration between universities, public research organisations and businesses in Spain, to be published by the end of 2021 (https://community.oecd.org/community/cstp/roadmap-innova-es/).

In Spain, partnerships between public research and business remain limited, in particular among small businesses (Figure 20). It would be particularly helpful for Spanish firms to develop such partnerships further, as many of them are not engaged in innovative activities, leading to the development of new business processes and products, although the adoption of digital technologies is overall around the OECD average (Figure 4). Such partnerships are particularly important for small business which lack necessary equipment and skilled personnel readily engaging with technologies, and cooperation with partners are

effectively found to be significant to result in producing new business models and products (López-Bazo and Motellón, 2018[36]). However, researchers find the lack of the absorption capacity of many SMEs as problematic in their partnership in Spain (University-Business Cooperation in Europe, 2020[37]). On the business side, firms tend to find the lack of adequate partners and the functioning of research institutes as structural impediments in Spain (University-Business Cooperation in Europe, 2020[38]).

Figure 20. Partnerships between public research and firms can be developed further

Share of firms which contracted out R&D, 2014-16



Source: Eurostat, the Community Innovation Survey (database).

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There is a wide range of platforms, which facilitate partnerships between firms and research centres, addressing the absorption capacity of SMEs. These include the Technology Centres, which have been mainly established by regional authorities. As a significant share of SMEs carry out R&D or innovation activities only occasionally, or tend to use only external R&D resources, Technology Centres can be key providers of R&D and innovation services for these SMEs (Martínez, Cruz-Castro and Sanz-Menéndez, 2016[39]). There are exemplary cases, such as *Tecnalia* (Box 6), in which firms successfully adopt new business processes and products based on digital technologies, while researchers have obtained patents out of partnerships with firms. However, little is known about the contribution of Technology Centres to knowledge-based development and the match between the services they deliver and the needs of SMEs (ERAC, 2014[33]).The authorities should evaluate the performance of Technology Centres systematically. Their capacity should continue to be strengthened to effectively conduct R&D through partnerships between firms, especially SMEs, and research institutes, by extending existing initiatives, such as the *"Cervera"* programme

Box 6. An example of technology transfer and ICT use: *Tecnalia*

Tecnalia is a Technology Centre based in the Basque Country, which was set up in 2011. Its mission is to "transform technology into GDP", promoting research and technological developments. It is funded by the private and public sectors, which amounts to EUR 110 million in 2018, and employs around 1 400 staff. It is deeply rooted in the business community as over 100 companies take part in its governing bodies. It had 7 400 client firms over the period 2011-19, of which 75% were small and medium enterprises (SMEs). It offers different models to work with firms, depending on their technological innovation degree, and adapts to the needs of firms.

Tecnalia develops, certifies and validates processes, systems and products that client firms need and develops customised R&D and innovation projects to generate impact on clients' business, along with various related supports. As a result of such partnerships, *Tecnalia* obtained 658 patents over the period up to 2018. Its activities vary in a wide range of sectors, such as energy and environment, ICT, industry and transport, health, etc.

Connected Industry 4.0: Digital Transformation of Industrial Companies is an example of how *Tecnalia* supported firms in terms of technology transfer in the area of ICT. *Tecnalia* has promoted the digital transformation of 15 companies based in the Basque Country, Navarre, Madrid and La Rioja. It carried out a diagnosis of the current situation and the transformation plan for each company. The main opportunities prioritised by the companies were as follows: transforming their product into a Smart product; developing a portfolio or digital services on a connected product; launching a cyber-security plan; implementing an integrated production planning tool; the digitalisation of processes which are still conducted in paper, for further interconnection with the other systems; and implementation of sensor systems in machines to collect process data which may be used to improve them and control production in real time.

Source: The Secretariat's adaptation from *Tecnalia*'s website: https://www.tecnalia.com/es/

Public research organisations are increasingly aware of the importance of partnerships with firms and a number of new initiatives have been launched. One example is the Interdisciplinary Thematic Platforms (PTIs) by the Spanish National Research Council (CSIC), launched in 2018. They cover a number of key areas, including digitalisation with a focus on quantum sciences and technology as well as 3D additive manufacturing. PTIs aim to tackle multidisciplinary challenges of high scientific, economic and social impact, associating different CSIC centres and firms, administrations, and other institutions. PTIs have mobilised more than 600 research groups in the CSIC centres, involving more than 80 firms and other institutions. As the programme has been in place for some time, it is important to evaluate them.

Knowledge transfer depends, in particular, on the availability of researchers in public research organisations, which is currently limited due to excessive regulations. It is important for researchers to have appropriate incentives (e.g. through performance evaluation) to collaborate with businesses. In most cases, researchers in Spain are civil servants in universities and public research organisations, and their performance evaluation depends heavily on the production of scientific papers. A career incentive premium (*sexenio*) for knowledge transfer activities has been introduced recently on a pilot basis. However, even with this career incentive premium, knowledge transfer activities with the private sector have not been well recognised in researchers' performance evaluation, which is one of the key obstacles for partnerships with firms (COTEC, 2019[40]). This highlights the scope to develop more flexible institutional arrangements within research centres, such as those adopted in Catalonia, which have enabled these organisations to engage more flexibly in collaborative projects. In addition, within public research centres, basically only 30% of proceeds from commercialisation is allocated to researchers from a contract with private companies.

The new *Science, Technology and Innovation Strategy 2021-27* envisages developing scientific careers and strengthening knowledge transfer activities. The reform of the Law of Science and Technology will introduce a new scientific and technological career pathway for young researchers to ensure career stability, while ensuring its quality standards. Some related programmes to support young researchers will be financed by the Recovery, Transformation and Resilience Plan (EUR 0.4 billion over the period 2021-23). The reform will also facilitate researchers to move between public research organisations and the business sector by securing their career within public research organisations. These reforms can make the management of research personnel more flexible in order to develop partnerships with firms further. The new system should ensure that knowledge transfer activities of researchers are an integral part of their performance evaluation.

The forthcoming reform also aims to improve the effectiveness of public research organisations. It plans to reorganise public research organisations within the remit of the central government to adapt them to the objectives of the Law. As the Law foresees developments of knowledge transfer activities, public research organisations themselves can also be more incentivised to undertake partnerships with firms, for instance, by developing a more rigorous framework for allocating funding, based on results and outcomes. This should be complemented with an increased managerial autonomy of public research organisations. They should be able to make choices and establish priorities related to functionality or performance, as they need to mobilise individual researchers in search of common strategies (Cruz-Castro and Sanz-Menéndez, 2016[41]).

Adapting skills of workers to digitalisation and changing nature of work

Digital diffusion hinges on the skills of people to use digital technologies. ICT competences are found to affect the digital adoption rate (Andrews, Nicoletti and Timiliotis, 2018[17]). In addition, evidence suggests that worker skills boost productivity gains from ICT investment in Spain (Cuadrado, Moral-Benito and Solera, 2020[15]). The necessary pool of skills includes not only ICT specialists, whose expertise is fundamental to deploying and managing digital technologies, but also more broadly diffused generic ICT-related skills among workers to keep up with the changing technological environment. In this respect, there is scope to raise ICT related skills among Spanish people, in particular, among the low educated and older people (Figure 9). EUR 7.3 billion of the national recovery plan funds are allocated to the modernisation and digitalisation of the education system, which is welcome. One of the key components, the National Plan for Digital Skills (Box 4), is a broad plan to improve cross-cutting digital skills, the digital transformation of education, digital skills for employment and for professionals. This plan should also be fully reflected in labour market policies in order to provide the opportunity to develop digital skills for job seekers (see the *2021 Economic Survey of Spain*).

In Spain, some critical shortages of ICT-related skills exist (Figure 21). In terms of fields of skills (Panel A), shortages in engineering, technology and telecommunications are greater than in other OECD countries. At a more detailed level, shortages of computer and electronics stand out in Spain (Panel B). In terms of specific skill requirements (Panel C), shortages in ICT-related skills, such as complex problem solving skills and systems skills (e.g. judgment and decision making) are relatively high. Although there are no significant shortages in technical skills overall, there are important shortages in some areas, such as operation analysis (Panel D).

Figure 21. Skill shortages in some segments are significant

OECD Skills for jobs indicators

Note: Positive values indicate skill shortage while negative values point to skill surplus. The larger the absolute value, the larger the imbalance. The OECD Skill for Jobs indicators are constructed by an index of the labour market pressure on occupations, which is multiplied by an index of skill intensities. First, the labour market pressure (shortage/surplus) is identified at the occupation level from labour market data such as wage growth (measured in terms of deviation from the long-run trend of the whole economy). Then, this is used to map occupations that are in shortage or surplus into the underlying knowledge types/skills requirements (for e.g. computer and electronics) for these occupations. The underlying knowledge types/skills requirements for each occupation are defined in O*NET and measured in terms of a min-max scaling varying between 0 and 1. For more detail, see OECD (2017).

Source: OECD Skills for Jobs (database).

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ICT in formal education

Primary and secondary education

The mix of skills required in the digital society is wide-ranging, including among others, foundational numeracy and literacy skills, problem-solving skills and ICT skills. Solid foundational skills coupled with problem-solving skills are indispensable to use digital technologies effectively and to benefit from the opportunities of the digital transformation. Strong foundational skills are also the basis for continuous learning, such as job training and adult education more generally. Therefore, formal education should ensure the development of foundational skills, underpinned by well-designed curricula and teacher training programmes, alongside early and targeted interventions to those facing barriers (see *2017 and 2018 Economic Surveys of Spain*; Chapter 1).

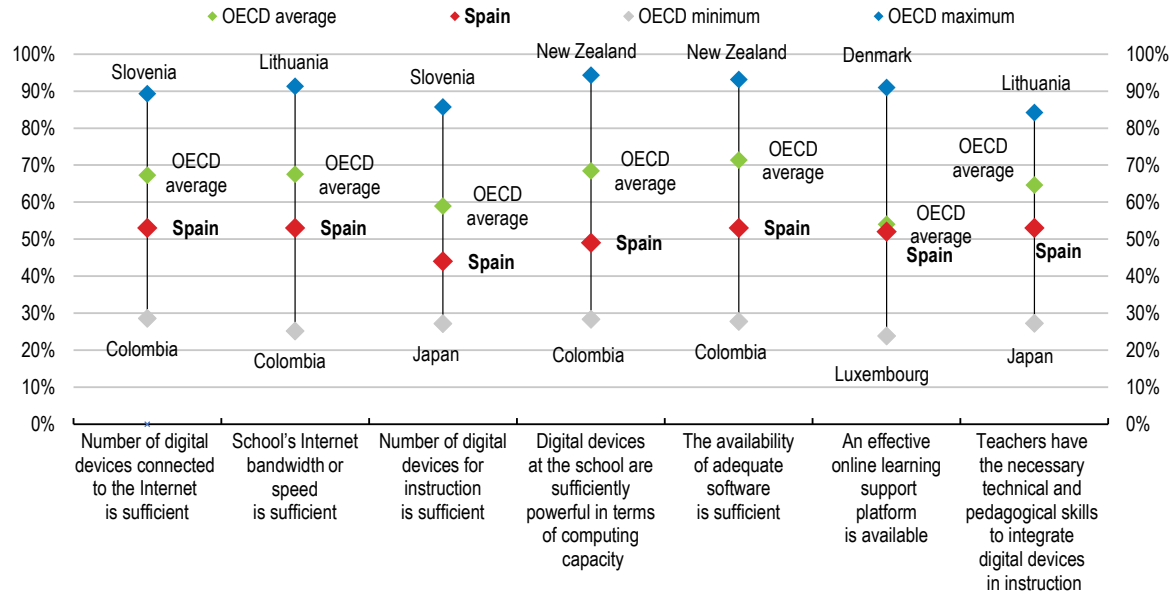
In terms of the digitalisation of the education system, Spain has adopted a number of initiatives over the past years. For example, the Ministry of Education has developed a distance education structure (the Centre for Innovation and Development in Distance Education) and *Aula Mentor*, an open free, Internet-based training system. However, Spain is lagging behind other OECD countries when it comes to the adequacy of ICT tools available in schools, and the skills of teachers in using them effectively (Figure 22). The COVID-19 crisis highlighted the problems of accessibility to digital resources, especially for the most vulnerable groups, such as low-income families, as around 1 million students were not connected. Regional authorities and schools adopted contingent measures to guarantee students' access to material and digital resources to pursue education at distance, to alleviate the adverse consequences and reduce the existing disparities.

Moreover, the authorities have approved the *Educa en Digital Program,* as part of the National Plan for Digital Skills to which the national recovery plan allocates EUR 3.5 billion. The *Educa en Digital Program* aims at several actions, including the provision of digital education resources both at school and at home as well as digital equipment to schools, and training of students and teachers. This programme should be fully rolled out so that adequate education at distance is ensured for all to prevent an increase in inequalities in human capital accumulation in digital skills.

Going forward, digital skills can be fostered in a more comprehensive approach rather than stand-alone ICT classes. In Spain, the new education law (LOMLOE) aims to develop students' digital competences. Digital skills are acquired through multiple learning areas, along with a broader range of skills, such as creativity, the ability to think critically and openly, and the ability to act ethically. The framework developed by the Australian Curriculum Assessment and Reporting Authority is an example to develop digital skills in this way. It consists of managing and operating ICT (e.g. managing data, selecting and using software); communicating with ICT; creating with ICT (e.g. using ICT to generate ideas or manage digital solutions for issues arising in learning activities; investigating with ICT (e.g. finding and analysing information, verifying sources and reliability of digital data); and applying social and ethical protocols and practices when using ICT (e.g. recognising intellectual property, applying personal security protocols). Such an approach would facilitate students to prepare for navigating a complex world competently through critical thinking, resilience and the ability to learn throughout life.

Figure 22. Spain lags on the use of ICT tools in schools and teachers' preparedness

Percentage of students in schools whose principal agreed or strongly agreed with statements about the school's capacity to enhance learning and teaching using digital devices



Source: OECD calculations based on PISA (2018).

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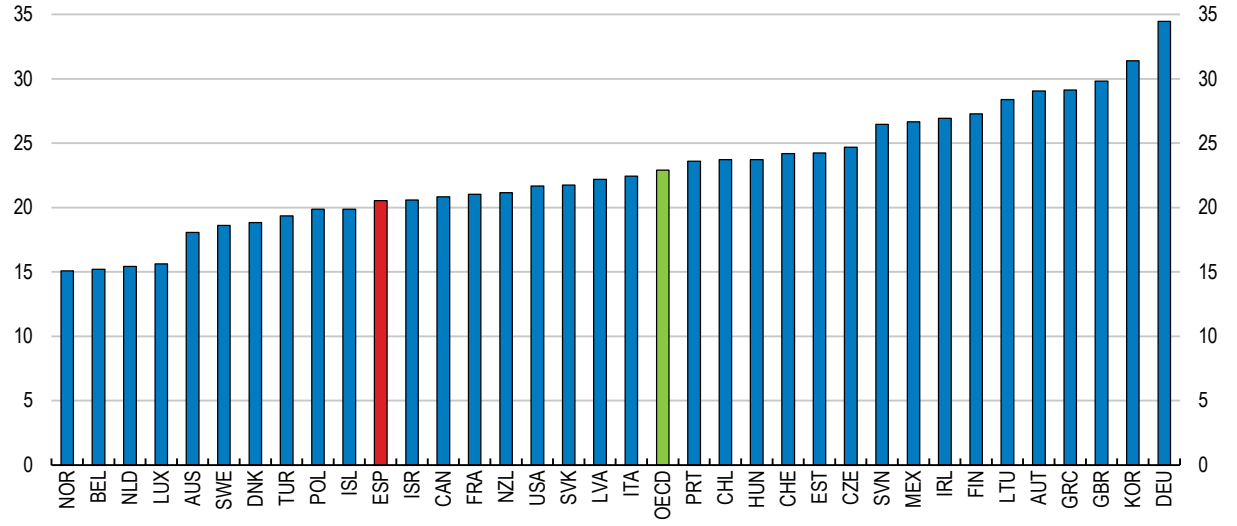
Universities

As required ICT skills become increasingly advanced, the role of tertiary education plays a prominent role. University students also need to be familiarised with constantly evolving ICT technologies. On-line teaching in traditional universities has been developed for some time, which accelerated with the COVID-19 crisis. There is no formal assessment on on-line teaching, but the authorities perceive needs for materials, such as computers to be provided to students, in order to develop this form of teaching further.

In terms of aligning university education to labour market needs, the field of study is a key determinant, which affects the subsequent working life for tertiary graduates. In Spain, the proportion of tertiary graduates in STEM courses, which are closely related to ICT skills, remains lower than the OECD average (Figure 23). Indeed, the ICT related skill shortages (Figure 21) point to the necessity to increase related degree courses further and improve quality of ICT related education in tertiary education, which does not meet labour market needs effectively, which is one of the aims of the Recovery, Transformation and Resilience Plan.

Figure 23. University graduates in STEM courses are relatively low

Share of university graduates in STEM courses, 2018



Note: "STEM" programmes include "Natural sciences, mathematics and statistics", "Information and Communication Technologies", and "Engineering, manufacturing and construction". The numbers refer to all educational programmes at the Bachelor's or equivalent level.
Source: OECD, Education at a Glance (database).

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The offering of degree courses remains rigid. Under current regulations, universities can determine freely the degree courses they offer, with some specific exceptions. In practice, however, they continue to offer a broad range of degree courses, although there are very few students enrolled in some degree courses. This could be related to the management of universities.

The improvement in the management of universities can raise the labour market relevance of programmes, facilitating them to eliminate programmes with limited demand and redirect funds to programmes with higher demand. Such a reform should be based on an incentive mechanism, as the 'imposed' autonomy within each university failed in the past (for example, an autonomous hiring and promotion system led to increased practices of internal recruitment and promotion (Cruz-Castro and Sanz-Menéndez, 2015[42])). Such an incentive mechanism can be introduced, for example, by modifying the funding formulas to increase competitive funding depending on the performance and outcomes of each university. This would require, in turn, a change in the way universities are evaluated. Currently they are evaluated at the level of each faculty, which needs to be at the level of each university, taking account of their overall strategies.

The improved management of universities would also raise their overall performance. For the incentive mechanism to function properly, it is important for the university board to have a solid strategic orientation. Currently, the selection of the board members, which is regulated by the central government, favours internal staff and reflects their professional backgrounds (OECD, 2015[43]). Board membership could be opened to those external to universities, in order to raise their relevance of research in the society. This would help facilitate better linkages between tertiary institutions and employers, and greater specialisation of universities. Greater specialisation could in turn raise the quality and relevance of skills. Such better linkages could also enable universities to better use the new career pathway for scientific and technology researchers and to conduct partnerships with firms more effectively (see above).

Vocational education and training

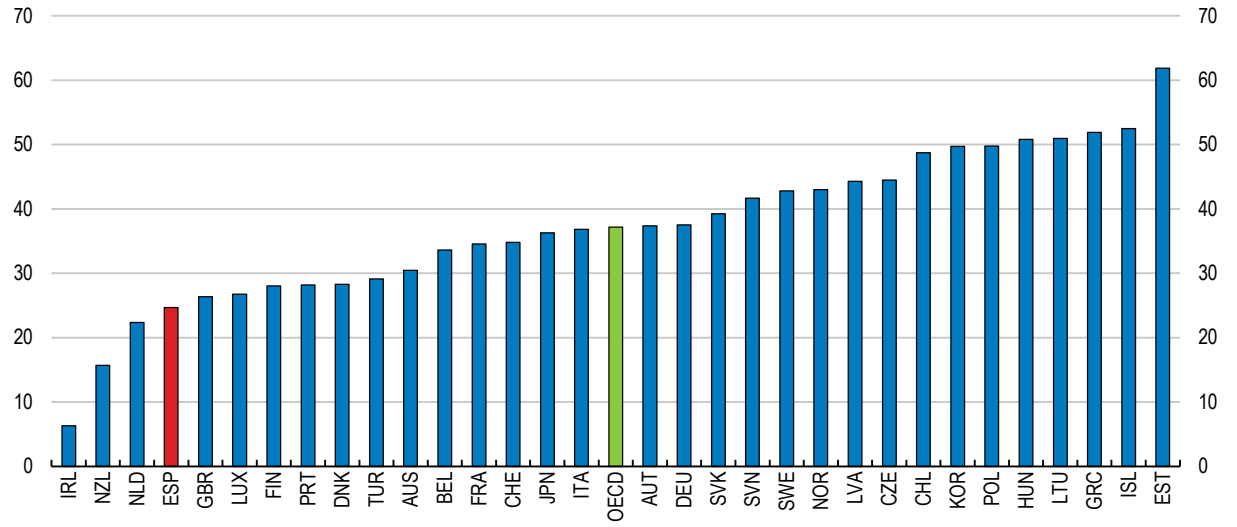
High quality vocational education and training (VET) can promote necessary work skills, including ICT-related skills. VET is particularly adapted to jobs that require a limited set of specific skills (e.g using automated machine tools), some of which are in shortage in Spain (Figure 21). Although increasing, the share of students enrolled in upper-secondary VET remains low in Spain (35.8% of total students at the upper secondary level versus the OECD average of 43.3%). This is particularly the case in the dual VET system, which provides students with school-based training and practical training in a company simultaneously and has been in place since 2012 (1% of total students at the upper secondary level).

VET as public policy should evolve with a long-term vision. While it is important to meet immediate labour market needs, occupation specific skills can quickly become obsolete. Thus, when meeting labour market needs, VET programmes should look at categories of skills which are considered to be increasingly in need and versatile across many occupations (Figure 21; Panel C). VET should also consider foundation skills to develop workers' applied skills over the course of their career life. The Organic Law for Improvement of the Quality of Education (LOMCE) introduced optional subjects related to general skills and facilitated transition to tertiary VET. Such efforts need to be extended since the shortage of basic skills stands out in Spain (Figure 21, Panel C), which can hamper continuous learning.

In 2020, the government introduced the Modernisation Plan for Vocational Training, with a budget of EUR 1.9 billion (0.15% of 2019 GDP) for four years. The plan will add 200 000 places in the VET offering by 2023, which correspond to training needs in the labour market. Currently, ICT-related VET programmes are limited (Figure 24), but the government plans to expand the range of degrees related to digitisation and new technologies, such as telecommunications, cybersecurity, 3D printing (additive manufacturing), implementation of 5G infrastructures, artificial intelligence and Big Data and BIM ('Building Information Modelling'). This is going in the right direction, as they broadly seem to correspond to skills needs (Figure 21).

Figure 24. STEM-related VET programmes should be developed further

Share of upper-secondary VET graduates in STEM courses, 2018



Note: "STEM" programmes include "Natural sciences, mathematics and statistics", "Information and Communication Technologies", and "Engineering, manufacturing and construction" The numbers refer to all educational programmes at the Bachelor's or equivalent level.
Source: OECD, Education at a Glance (database).

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In terms of the governance structure, the Plan has the objective of introducing a single VET system that integrates vocational training in the educational system with the one in companies through training and apprenticeship contracts. Streamlining all training activities in a single VET system can help citizens of any age and of any level of qualification to plan and design lifelong learning itineraries, and increase cost efficiency in terms of training centres. Furthermore, the National Plan for Digital Skills will reinforce the Modernisation Plan for Vocational Training to foster STEM vocational training at schools, with a focus on women, and the integration of a flexible digital vocational training programme oriented to re-skilling and up-skilling.

The Plan aims to strengthen public-private collaboration by raising the in-work training components of all types of VET. For example, the objective for the dual VET system (which is specifically designed for combining school and 'in-work' components and is not part of the single VET system) has an objective to raise the 'in-work' components to 80%. The targeted increase in the number of places in the VET offering will raise the need for training and apprenticeship contracts. This would require securing commitment from more firms to provide students with practical training opportunities, but the high prevalence of SMEs in Spain is an important obstacle to develop firms' engagement in VET further. About 90% of Spanish firms have five employees or less, which makes it difficult for them to identify training needs and provide a training tutor.

The co-operation with various stakeholders can be extended to overcome these constraints. To do so, some existing initiatives, such as Centres of Vocational Excellence (CoVEs), can be extended further. CoVEs typically develop and implement better quality VET programmes and are engaged in a range of cooperative activities, including the provision of placements for students by businesses (European Commission, 2019[44]). *Tknika* in the Basque Country is one such example of CoVE. *Tknika* has a network with firms, in particular with SMEs, allowing them access to services and infrastructure. Such initiatives can help facilitate engagement of SMEs and to identify their training needs accurately, which is the key to a successful VET training programme for SMEs (OECD, 2017[45]). They can also be helpful for the training of those already in employment (see below).

Lifelong learning and ICT

Widespread digital adoption also hinges on continuous enhancement of skills of workers to keep pace with the fast changing technological landscape. Participation in lifelong learning and on the job training is positively associated with the adoption of digital technologies by firms (Andrews, Nicoletti and Timiliotis, 2018[17]). ICT skill shortages in Spain (Figure 21) likely largely reflect the lack of skills of incumbent workers. Across OECD countries, shortages of key information-processing skills are related to the skills gap between older and younger workers (OECD, 2019[1]). Hence, adult training and lifelong learning is key to develop digitalisation further in Spain, in particular, in the context of demographic ageing (see the 2021 Economic Survey of Spain). In addition, the percentage of workers in jobs at high risk of being automated in the next 15-20 years at 21% in Spain is higher than the OECD average of 14% (Nedelkoska and Quintini, 2018[46]), as discussed in the *2018 Economic Survey of Spain.* Lifelong learning can also address these risks, which can exacerbate inequalities.

The impact of lifelong learning for low-skilled workers on digital adoption is stronger than that for those who are already highly skilled (Andrews, Nicoletti and Timiliotis, 2018[17]). Focusing on low-skilled workers is also cost efficient, since their training costs tend to be lower. The opportunity costs of training low-skilled workers due to absence from work for training are low (Andrieu et al., 2019[47]). Moreover, the probability for low-skilled workers to quit their firm who had borne training costs is low (Bechichi et al., 2018[48]). These findings argue for focusing particularly on low-skilled workers when strengthening the lifelong training system, as was recommended in the *2018 Economic Survey of Spain*.

In Spain, the overall adult learning system performs well, but there is high demand, reflecting low general skills among workers ("Urgency" in Figure 25). The coverage of adult training is high, and financing is not a major barrier, essentially due to the mandatory professional training levy (see below). Nonetheless, there are some important gaps in adult learning opportunities in terms of equal access ("Inclusiveness"), which stands out in particular for SMEs and low-wage workers. In terms of the alignment of adult learning courses to firms' needs, it is close to the OECD average, as the share of firms reporting their training provision in response to future skill needs is very high. However, the share of firms who assess their future skill needs precisely is lower than the OECD average, implying the challenge of aligning precise skill needs and training provided.

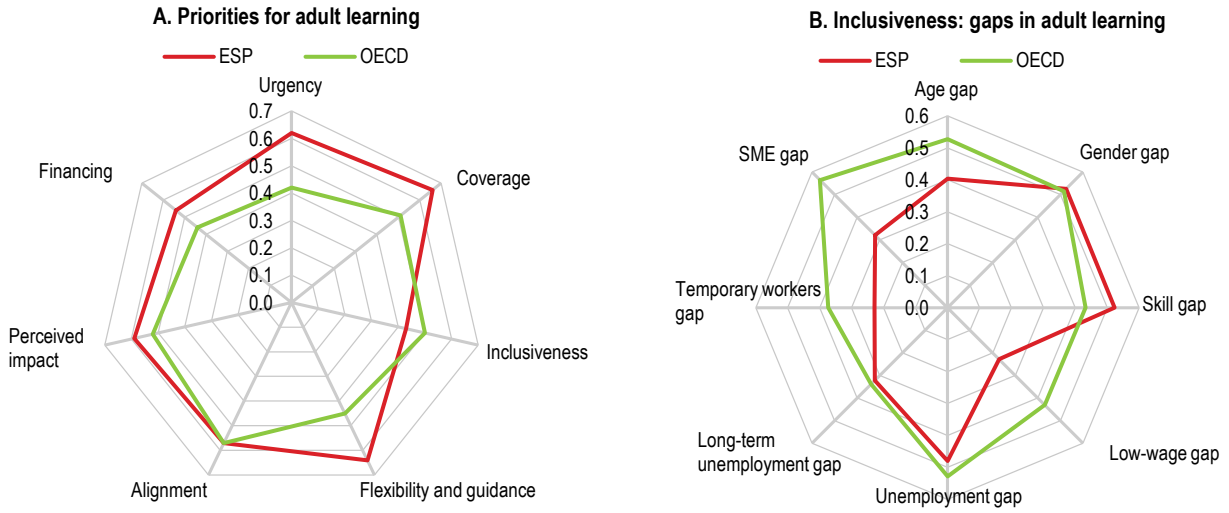
Professional training in Spain is financed mainly from the proceeds of the professional training levy. The professional training levy (*Cotización para formacion profesional)* is a contribution of 0.7% of a company's payroll. Out of these funds, firms are given training credits to finance training for their employees, which account for around a third of the professional training budget (the rest is used for other purposes, such as programmes for the unemployed). Employers are incentivised to provide training since their training credits expire after one year. In 2019, only 19.8% of firms that paid the levy provided training for their employees, which has declined from 27.4% in 2015 ((Fundación estatal, 2015[49]) (Fundación estatal, 2019[50])). The percentage varies greatly across firms: 91.6% among large firms and 15.1% among micro-enterprises.

The government introduced a legislation in 2015 to make professional training more responsive to firms' demand (*Ley 30/2015*). The previous system was exclusively managed by social partners (i.e. employer associations and trade unions) in terms of the design and delivery of training, and the quality of training provided in this system was relatively low (OECD, 2017[45]). The aim of the 2015 reform was to introduce more competition among training providers and change the management of training funds, by making it mandatory to base training on needs that are immediate and specific to the firm and its employees. The decline in the number of firms, which provide training, especially micro-enterprises, suggests that the lack of the capacity of SMEs to organise training themselves could have hampered their ability to take advantage of the reform.

Many employers, especially SMEs, also have difficulty in identifying their skill needs precisely, which can lead to a sub-optimal investment in training. While 85.4% of large firms (more than 500 employees) identified their training needs, only around 27.5% among small firms (5-9 employees) could identify such needs in 2018 (MITES, 2019[51]). This suggests that job training organised by employers often does not correspond to addressing skill needs. For example, even after the 2015 reform, the most common type of training activity is risk prevention in the workplace (Fundación estatal, 2015[49]) (Fundación estatal, 2019[50]), which is mandatory workplace training. Hence, firms continue to recoup levy funds by undertaking training which they would have been required to provide anyway (OECD, 2017[45]). As the professional training scheme has been in place for five years, the authorities should conduct an evaluation of this scheme to determine if it has succeeded in meeting specific and real training needs that the law mandates.

Given the circumstance of the job training by firms, subsidies for individuals could work better when targeting specific groups, such as low-skilled or older people. The 2015 legislation on the professional training system (*Ley 30/2015*) introduced two measures to promote lifelong learning for workers: training leave and individual training accounts (*Cuenta Formación*). As part of the training leave, workers are entitled to a 20-hour period of training leave per year. The individual training accounts (*Cuenta Formación*) are intended to keep track of training participation and qualifications of workers over the course of their careers, strengthening the signalling power of skills attained, which can leverage the new VET system made more flexible for lifelong learning (see above). However, no funding is tied to job training on an individual basis. Financial incentives for lifelong learning can be targeted to individuals, rather than to firms, as recommended in the *2018 Economic Survey of Spain*. It would help low-skilled workers in particular, as they need to keep up with skills, which is often not ensured by employer-based programmes. In doing so, it is important to have quality career guidance for individuals, in particular, for low-skilled workers (OECD, 2019[52]).

Figure 25. There are some important gaps in adult learning opportunities



Note: Indicators normalised to 0-1, 1 = top OECD country and 0 = bottom OECD country. "Urgency" assesses how pressing the need for up- and reskilling is in different countries; "Coverage" assesses the extent to which individuals and employers are engaged in adult learning; "Inclusiveness" looks at how equitable participation in adult learning is across countries; "Flexibility and guidance" looks at how well countries do in providing information and guidance to adults on training opportunities and reducing barriers to their participation through flexible provision; "Alignment" dimension looks at how well adult learning systems take into account the changing skill needs of the labour market; "Perceived impact" measures such aspects of certification, monitoring and evaluation; and "Financing" assesses the extent to which adult learning systems are adequately financed by different actors.
Source: OECD Priorities for Adult Learning Dashboard; OECD calculations.

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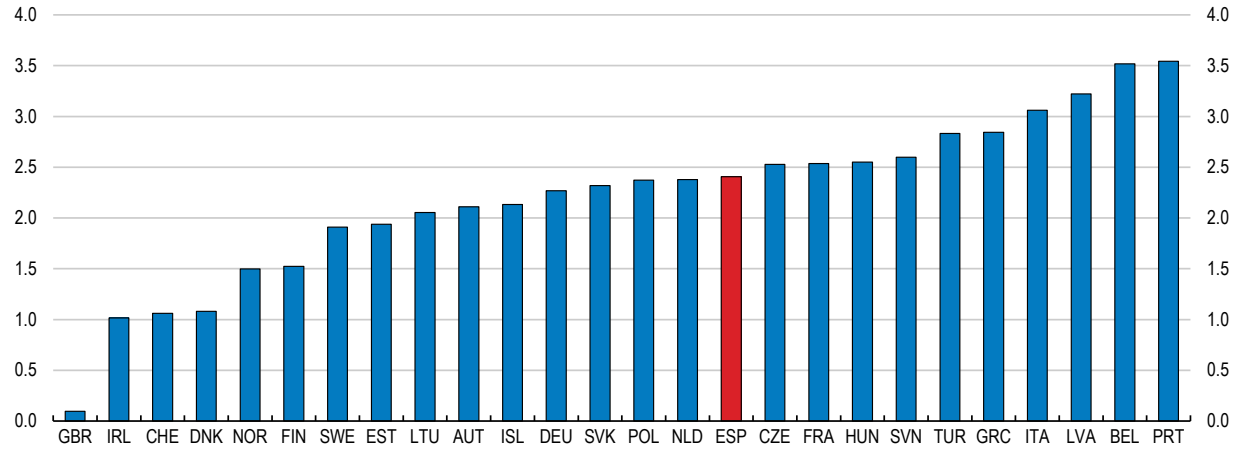
The authorities can also promote job training for low-skilled or older people more actively. According to *Ley 30/2015*, training needs that are not met by firms' training programmes are supposed to be covered by relevant public authorities, partly through the funds financed by the professional training levy. Given the difficulties faced by many firms, in particular SMEs, to identify training needs and organise training themselves, and the existence of a significant gap between high- and low-skilled workers in terms of training opportunities (Figure 25), there is scope to develop specific training programmes for low-skilled workers by public authorities. Such training programmes can target ICT-related skills, which is a key objective of the new VET Plan. These programmes then can benefit from the flexibility created by the introduction of the single VET system to accommodate people of any age and of any level of qualification to promote lifelong learning (see above).

Sharpening incentives to take advantage of digital technologies

Firms' incentives to take advantage of digital technologies are rooted in the business environment, which ensures the efficient entry, scaling up and exit of firms. Regulatory frameworks and insolvency regimes shape market discipline and affect incentives to adopt new forms of organisation, and new sources and processes of value creation. Such business dynamism is found to affect digital adoption (Andrews, Nicoletti and Timiliotis, 2018[17]) and boost productivity significantly ((Gal et al., 2019[8]); Figure 26). It also necessitates efficient allocation of capital and workers for innovative firms to grow unimpeded and strengthen firms' capabilities through raising managerial quality and intangible assets, such as R&D. Finally, labour markets should remain flexible to facilitate the reallocation of the necessary workforce, and thus boost ICT-related activities and radical innovation more generally (see the *2021 Economic Survey of Spain*).

Figure 26. Regulatory reforms matter for digital adoption and productivity gains

Effect after 3 years on productivity through digital adoption of closing half the gap relative to countries with the least strict regulation, %



Note: Estimated effect on multi-factor productivity of the average firm from reducing administrative burdens on start-ups (a subcomponent of the OECD PMR indicator), improving the insolvency regime as measured by the indicator in Adalet McGowan and Andrews (2018), and reducing employment protection legislation on regular contracts. For each of these indicators, it is assumed that half of the gap to the country with the least strict regulation in the sample is closed.
Source: Sorbe et al. (2019), "Digital dividend: Policies to harness the productivity potential of digital technologies", *OECD Economic Policy Papers*, No. 26, OECD Publishing, Paris.

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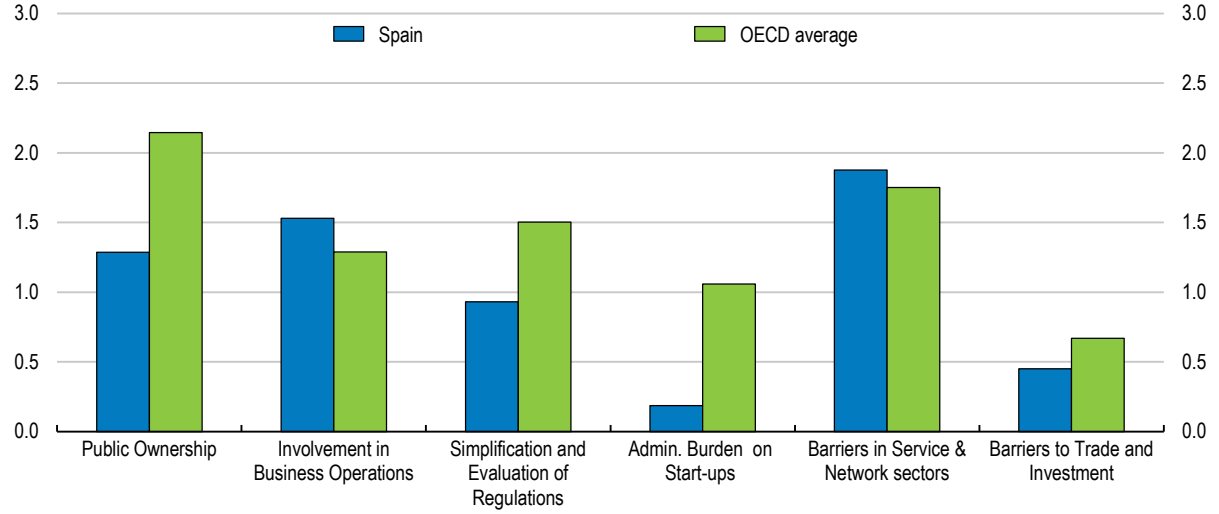
Market regulation should be revamped further to generate competitive pressures

Reducing anti-competitive regulations facilitates more entry of young firms, which tend to have a comparative advantage in commercialising and adopting new technologies (OECD, 2015[53]). It strengthens market discipline, as new entrants create competitive pressures for incumbents to adopt innovations and reduce business costs (OECD, 2015[53]). The stringency of product market regulation is lower than the OECD average, except for a few aspects, such as barriers in service sector and involvement in business operations (Figure 27). These restrictions, by raising costs and/or reducing the quantity of available services, indirectly affect other sectors through trade linkages ((Conway and Nicoletti, 2006[54]); (Bourlès et al., 2010[55])). This reflects somewhat stringent regulations in the retail and professional services sectors.

Perhaps more importantly, the volume of regulations matters, in particular, when these differ across regions, for business operations. In Spain, as local authorities have increasingly assumed competences, the total number of new regulations in a given year has increased by four folds since 1980, with the share of those introduced by local authorities reaching over 70% in 2018 (Mora-Sanguinetti and Pérez-Valls, 2020[56]). Moreover, firms perceive an increase in regulations to operate in different regions as of 2019 (INE, 2020[57]). The disparities in regulation across regions hamper the expansion of firms to take advantage of economies of scale. The size of limited liability companies is found to be significantly affected by the volume of local regulations, which is a source of market fragmentation (Mora-Sanguinetti and Pérez-Valls, 2020[56]).

Figure 27. Product market regulations are stringent in some respects

Index ranges from zero (least stringent) to six (most stringent), 2018



Note: The OECD Indicators of Product Market Regulation are a comprehensive and internationally-comparable set of indicators that measure the degree to which policies promote or inhibit competition. The indicator ranges from zero (least stringent) to six (most stringent).
Source: OECD Product Market Regulations Statistics (database).

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The Market Unity Law was adopted in 2013 as a framework for good regulation across regions to tackle market fragmentation. There is room to further improve its implementation, as a single market has not been achieved as the Law initially intended. The principle of "national effectiveness" foreseen by the Law ensures that firms would not be subject to any additional requirements in other regions than their own. In 2017, the Constitutional Court declared that this principle cannot be incorporated in national legislation due to the distribution of competences. This principle can still be achieved, if incorporated in regional legislation, as recommended in the *2018 Economic Survey of Spain*. For example, the region of Madrid announced it would apply this principle to any entities established in other regions. In this case, firms would not be subject to further requirements in Madrid, if they are licensed or authorised in their region of origin. This is a welcome step, but it may be difficult to be adopt by all other regions.

An alternative to achieve a single market is through the effective implementation of the other principles, which remain valid. According to the "necessity" and "proportionality" principles, activity licenses should be grounded on general interests and be proportional to guarantee general interests. If all the regions adopt relevant regulations on activity licenses complying with these principles, common standards across regions can be achieved spontaneously. If such common standards are recognised mutually by all regions, it would create a single market *de facto*, ensuring a level playing field across regions. To achieve this, the existing coordination instruments should be fully exploited, such as sectoral conferences, which bring together regional and central government representatives to discuss and define approaches to improve regulation and overcome fragmentation (European Commission, 2020[58]).

The new digital strategy, "Digital Spain 2025", introduces a number of initiatives to improve the business environment in the context of digital transformation. Among others, the Start-up Support Law will be adopted to create a regulatory framework facilitating the creation of new start-ups and boosting their growth, and thereby promoting a strong digital entrepreneurship ecosystem. It will be supported by measures relating to tax and social security aimed at both the start-ups and investors. It is part of the National Recovery, Transformation and Resilience Plan.

Insolvency regimes could be reformed further to encourage risk taking activities

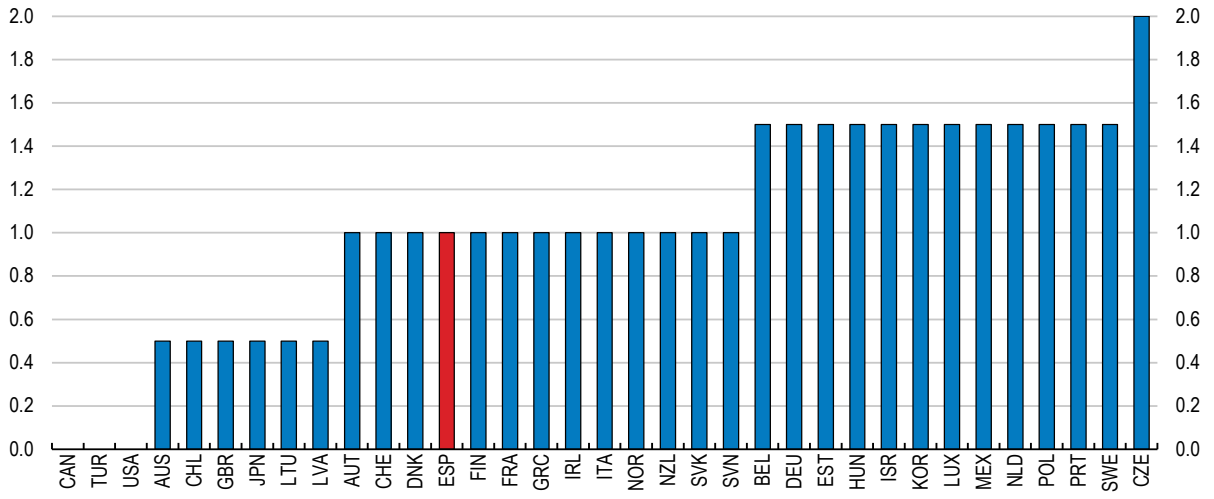
High exit costs disproportionately affect firms with riskier business strategies, which entail a high risk of failure (Bartelsman, Perotti and Scarpetta, 2008[59]). This holds true for digital adoption and innovation as the payoffs from investments in new technologies are often highly uncertain. An effective insolvency regime, which reduces barriers and costs to firm restructuring or exit, encourages risk taking activities and facilitates technological experimentation (Adalet McGowan, Andrews and Millot, 2017[60]). According to the OECD insolvency indicator, the Spanish corporate insolvency regime is considered to be effective, in terms of low overall barriers to restructuring of viable firms, but some gaps in insolvency regimes remain.

The penalties for failed entrepreneurs remain somewhat strong in the Spanish bankruptcy law (Figure 28), although having been reduced by the series of reforms over the past decade. In particular, the time to discharge (the period over which the bankrupt person is legally required to repay debt) is basically 5 years (see *2017 Economic Survey* for further details), which remains high in international perspective (Carpus Carcea et al., 2015[61]). The 2013 reform made the time to discharge immediate for some types of debt (unsecured and subordinated debt), if certain conditions are fulfilled, including repayment of a certain percentage of debt (e.g. 25% for unsecured debt, see *2017 Economic Survey* for further details). Although there are no official data, the number of those who benefited from this provision is reported to be limited. The authorities are currently working to transpose the *2019 EU Directive Insolvency and Second Chance*, which would reduce the time to discharge to 3 years, which should be implemented without delay.

The treatment of the liabilities to public authorities (tax and social security contributions, among others) is often an important obstacle during bankruptcy proceedings in Spain ((IMF, 2017[62]); (García-Posada Gómez, 2020[63])). These liabilities are generally not dischargeable and therefore make the debtors often unwilling to start proceedings. The repayment of such liabilities is one of the conditions to benefit from the immediate discharge of other debt and they cannot be exempted even after the bankruptcy sentence. Indeed, individual entrepreneurs facing insolvency often owe a large amount of liabilities to public authorities.

Figure 28. Penalties for failed entrepreneurs remain strong

Treatment of failed entrepreneurs, 2016



Note: The indicator is constructed based on the OECD questionnaire on insolvency regimes. It ranges from zero (least stringent) to one (most stringent) for each aspect. "Treatment of failed entrepreneurs" takes into account the following 2 aspects: time to discharge; and bankruptcy exemptions.

Source: Adalet McGowan and Andrews (2018), "Design of insolvency regimes across countries", *OECD Economics Department Working Papers,* No. 1504, OECD Publishing, Paris.

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SMEs need different treatments in a debt restructuring process, as they often cannot deal with complex, lengthy and rigid procedures. The adoption of special insolvency procedures for SMEs, such as simplified or pre-packaged proceedings targeting them, could help (Adalet McGowan, Andrews and Millot, 2017[60]). Spain has an out-of-court restructuring process specific for the self-employed and SMEs ("*Acuerdo Extrajudicial de Pagos*, *OCAP*"). This mechanism is designed for small claim cases (e.g. with a threshold of debt up to EUR 5 million). This process has been used to some extent, mainly by individual entrepreneurs: 1 364 cases between 2015 and 2019 which compares with 1 553 in-court bankruptcy proceedings by the self-employed during the same period. In the case of SMEs, the OCAPs have been very rarely used. One of the main reasons is that the OCAPs cannot deal with liabilities to public authorities, which account for a significant part of their debt. The OCAP can be extended so that it covers liabilities to public authorities (IMF, 2017[62]). The authorities are planning to facilitate the restructuring of liabilities as part of the transposition of the above-mentioned EU Directive.

While the OCAP essentially envisages firm restructuring, out-of-court mechanisms for the resolution of non-viable firms should also be strengthened, either within the OCAP or by introducing a separate process. Such a pre-packaged process for firm resolution can be done on a voluntary basis, with adequate incentives. The aim of such a process should be the smooth exit of unviable firms, while avoiding the stigma of business failure. The case of the Guideline for Personal Guarantee Provided by Business Owners, an out-of-court process in Japan, can illustrate how such an out-of-court process works (OECD, 2017[64]); Box 7). In some other countries, such as France and the United Kingdom, there are low-cost fast bankruptcy procedures for individuals, including failed entrepreneurs.

Box 7. Out-of-court proceedings: the case of Japan

The Guidelines for Personal Guarantees Provided by Business Owners in Japan

The orderly exit of non-viable firms can be facilitated by greater co-operation among the parties concerned. The Guidelines for Personal Guarantees Provided by Business Owners introduced in 2014 provides a common set of voluntary standards for self-regulation by SME groups and financial institution associations regarding guarantees by SME owners. The Guidelines expedite out-of-court settlements for debt resolution within a framework of institutionalised procedures, such as intervention by SME Revitalisation Support Councils.

According to the Guidelines:

The financial state of the firm should be made transparent, allowing the parties concerned to correctly evaluate the true value of the firm, which often reveals hidden assets of the debtor.

Launching debt resolution at early stages prevents the deterioration of the firm's financial status and the obsolescence of its assets, and raises the amount of assets collected by the creditor.

As the amount of collectable assets is increased, it can be shared with the debtor, allowing him or her to retain more assets, including private dwellings, than in the case of personal bankruptcy.

As the debtor avoids personal bankruptcy, no information is transmitted to the credit registers, allowing him or her to retain access to lending.

It is important to note that the proceedings following the Guidelines are characterised by incentive mechanisms: both the debtor and creditors can be better off than in the situation in which the debtor goes bankrupt. The creditors are further incentivised as they are allowed to deduct losses incurred as part of this debt resolution process from their corporate taxes.

Source: OECD (2017), *OECD Economic Surveys: Japan*.

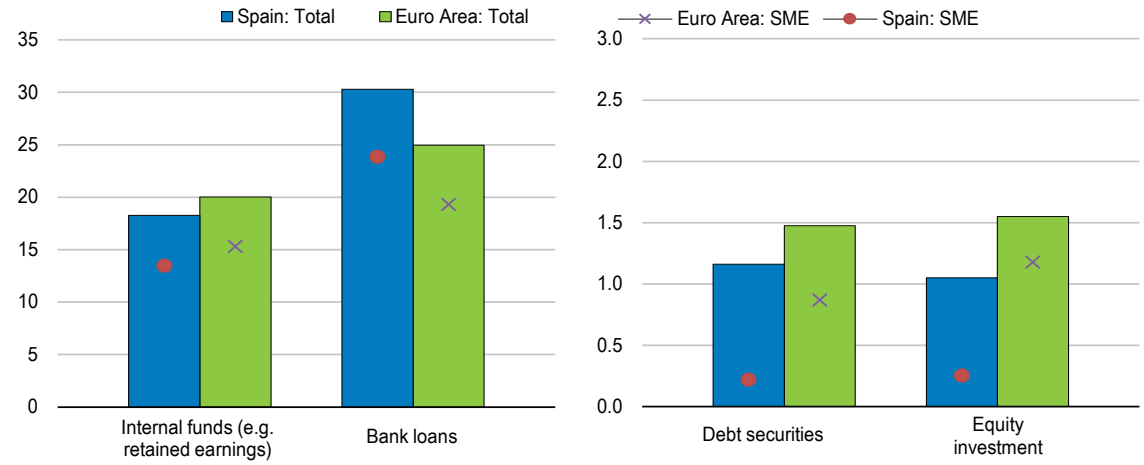
Access to capital is key to diffusion of technologies

Well-functioning capital markets ensure the efficient allocation of capital. They facilitate the entry and expansion of high-potential businesses, by supporting their capital investments, for example in digital technologies. Financing transactions are in general affected by market failures, such as information asymmetry, which is particularly the case for those involved in innovation processes with uncertain outcomes (Calvino, Criscuolo and Menon, 2016[65]). The problem becomes acute when it comes to assets, whose nature is intangible and difficult to evaluate, such as patents. In Spain, the entry and expansion of new, high-potential businesses is likely to be limited, in particular if financing conditions become tighter after the COVID-19 crisis (Albert, Caggese and González, 2020[66]).

Bank loans remain by far the most important source of financing for Spanish firms (Figure 29), although their reliance on bank loans has decreased since the global financial crisis. The Spanish banking sector went through structural changes over the past decade (see past Economic Surveys of Spain). These efforts need to be extended, since banks are not fully adapted to financing high-risk businesses, which can be a barrier to developing digitalisation further.

Figure 29. Spanish firms rely more frequently on bank loans than on capital markets

Percentage of firms which used each financial instrument, 2019H2



Source: ECB, Survey on Access to Finance of Enterprises (database)

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In order to support high growth potential firms with high risks, public loan guarantee schemes are particularly useful as public authorities assume the potential losses (OECD, 2019[67]). In Spain, the latter schemes have been ensured by Mutual Guarantee Companies (SGRs) owned by SMEs, as well as local authorities, banks and chambers of commerce that guarantee bank loans. The guarantee scheme has been significantly strengthened following the COVID-19 crisis in 2020, by increasing the coverage of SGR guarantees of bank loans up to 100% under certain conditions. When the economy will be on the recovery path, the scheme needs to increasingly target its beneficiaries. The OECD countries that have strengthened public guarantees and direct lending schemes increasingly have targeted young, innovative firms that lack credit history and tangible assets, over the past decade (OECD, 2019[67]). While at the moment initial SGR guarantees cover 100% of the loan, any renewal of the guarantee and its coverage should be subject to assessment on financing constraints still faced by firms when reaching the end of their initial contract.

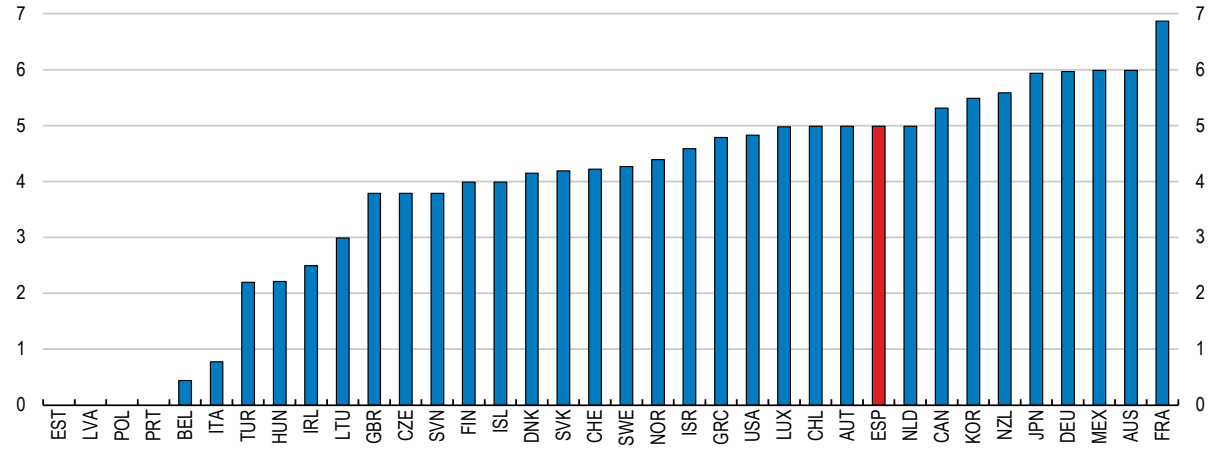
Equity Financing

Equity finance is particularly important for firms with a high risk-return profile, such as new, innovative and high-growth firms. Spanish firms rely less on equity finance (Figure 29), while the value of listed shares at 31% of GDP in the first quarter of 2020 is lower than the euro area average of 42%. The asymmetric tax treatment of debt and equity hampers the developments of equity finance. While interest expenses are deductible, equity finance is not considered as a deductible cost, making equity financing comparatively costly (Figure 30). This in turn favours certain business types that are more suited to debt than equity financing, which can bias capital allocation away from innovative new investments (OECD, 2017[68]).

Currently there are some specific measures in the corporate income tax system to support equity finance. The so-called 'capitalisation reserve' allows firms to reduce their tax base up to 10% of the equity increase between one year and the previous one if their profits are used to buttress their capital. The so-called 'equalisation reserve' allows SMEs to reduce their tax base by up to 10% if they raise funds by equity finance. With a view to generalising support for equity finance, as recommended in the *2017 Economic Survey of Spain*, Spain can consider introducing an allowance for new equity (to avoid windfall gains for the investment undertaken before its introduction) while carefully designing it (to avoid strategic tax planning by multinational enterprises) (OECD, 2017[68]). Such a change could also be useful in addressing the rising solvency needs as a result of the COVID-19 crisis (Demmou et al., 2021[69]).

Figure 30. Debt bias in the Spanish corporate tax system is strong

Estimate of the debt-equity bias at the corporate level, percentage points, 2019



Source: OECD Corporate Tax Statistics.

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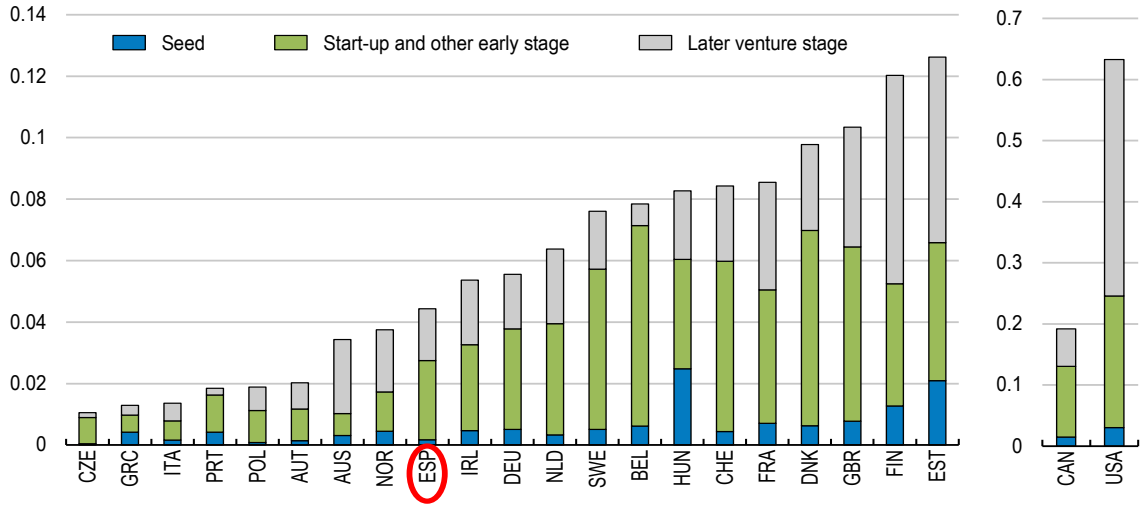
Venture Capital

Venture capital is particularly suited for high-potential firms, which can spur diffusion of digital technologies. Venture capitalists are formally organised funds meeting retail investors' requirements. They target companies with the capacity to yield high returns in a short time frame, and intervene at a later stage, after a business idea or product has been successfully test-marketed, to finance full-scale marketing and production (OECD, 2015[70]). Venture capital financing in Spain remains relatively limited (Figure 31), in particular, for early stages. However, venture capital financing in a broader sense (i.e. when other private equity institutions are taken into account) is more developed in Spain (0.69% of GDP) than in other European countries (0.53% of GDP on average). The information and technology sector is the largest beneficiary of venture capital (40.2% of total), followed by consumer products, industrial services, and medicine and health (ASCRI, 2020[71]).

In order to develop venture capital financing, the government has introduced a series of policy initiatives. These include a reduction in the corporate tax rate for venture capital companies and exemptions from capital gains for those investing in smaller, younger and unlisted firms. In addition, a public venture capital fund*, Fond-ICO Global*, was set up to boost private venture capital by investing in private venture capital funds. In this "fund-of-funds" scheme, private venture capital funds finance firms based on their own commercial investment decisions. Although this is considered a good practice, public support in this scheme is concentrated in a limited segment of the economy, such as the digital economy, where most venture capital funds invest and those at later stages of development.

Figure 31. Venture capital can be developed further

Total venture capital investment as a percentage of GDP, 2019



Source: OECD Enterprise Statistics (database).

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In the latest call launched recently, *Fond-ICO-Global* focuses on promoting digitalisation and sustainability. This call is the largest since the creation of the fund, both in terms of the amount (EUR 430 million, which compares with EUR 2 billion funded by *Fond-ICO-Global* to date) and the number of funds which it invests in. While it focuses on such topics as AI and cybersecurity in terms of digitalisation, specific criteria are not clear, in contrast with the domain of sustainability where a series of criteria are specified. As there are many potential beneficiary firms financed by private venture capital funds, specifying such criteria would help increasing accountability and conducting *ex-post* evaluation. *Fond-ICO-Global* aims at targeting firms at early development stages, through private venture capital funds' commitments during the tendering process. The fulfilment of such commitments should be monitored, and strengthened if necessary, as venture capital financing is currently concentrated in those at middle or later stages (Figure 31).

Venture capital financing can be developed further to reach a wider segment of the economy. Another public venture capital fund, *Fond-ICO PYME*, aims to invest in those with expansion plans and a long-term business vision. It adopts the "fund-of-funds" model (investing in business angels, for example) or the co-investment model in which private-sector fund managers make their own commercial investment decisions in the context of an agreed investment strategy with a public entity to finance firms jointly. As a public fund, *Fond-ICO PYME* should better target those at earlier stages, where market failures are most pronounced. This would fill crucial financing gaps as most private venture capital funds concentrate on firms at later stages. This would also help avoid the risk of crowding out private funds from the comparatively limited venture capital market. Finally, *Fond-ICO PYME* should target a wider range of sectors, as long as young firms have a high potential to grow.

MAIN FINDINGS	RECOMMENDATIONS (key recommendations in bold)
Ensuring communication infrastructure for all	
Although communication infrastructure is fairly well developed, there are many rural and dispersed areas where there is no current or planned coverage by any private operator in the coming years.	Consider complementing through public investment the extension of communication networks in rural areas when private operators are absent.
Barriers to "rights of way" (permission to install necessary equipment) are excessive in some regions and municipalities, hampering further development of communication infrastructure.	**Continue to reduce excessive regulatory burdens to develop communication infrastructure while reducing regulatory differences across regions, through the consultation mechanism in place**.
Information on the location of existing infrastructure and on planned construction work is not sufficiently disseminated, making cost estimates difficult.	Fully develop the Single Information Point and make its use mandatory for all private operators.
Digital services by public administration are fairly developed. However, there is scope to develop them further, such as the provision of e-procurement by regional contracting authorities.	**Fully roll out the National Plan for Digitalisation of Public Administration.**
Digital security risk assessment and security measures are not sufficiently undertaken among firms.	Increase cybersecurity experts, by ensuring the increased offering of related education and training courses.
Enhancing capabilities to make full use of digitalisation	
The ex-post evaluation of projects benefitting from R&D grants and loans is not widespread and rarely taken into account for renewal of projects. The importance of ex-post evaluation is higher for more radical technologies and innovation.	Promote the ex-post evaluation of R&D grants and loans and take them into account for the renewal of grants, including for the Cervera programme, which promotes digitalisation.
Many small businesses lack the capacity to conduct R&D and do not know how to access the newest technologies.	**Strengthen Technology Centres' capacity to effectively conduct R&D through partnerships between firms, especially SMEs, and research institutes.**
Researchers lack incentives to collaborate with businesses, which are not considered in their performance evaluation.	Ensure that collaboration with businesses is duly taken into account in performance evaluation. Apply such performance evaluation in existing programmes, such as Interdisciplinary Thematic Platforms, which promotes digitalisation.
The COVID-19 crisis highlighted the problems of access to digital resources, especially for the most vulnerable groups in formal education.	Fully roll out the *Educa en Digital* Program so that adequate education at distance can be ensured for all.
The management of universities, including the offering of degree courses and the funding formula, remains rigid. University boards consist mostly of internal members and are not very diverse.	Enhance incentive mechanisms by increasing universities' competitive funding based on performance, which can help align their strategies to labour market needs, in particular, ICT skills. Include external members from the private sector and civil societies in university boards.
Engagement of firms in 'in-work' components of vocational education and training (VET) remains limited.	Promote co-operation with firms, by developing such initiatives as Centres of Vocational Excellence, to help identify skill needs and place VET students in firms.
Training needs are often not well identified and do not reach workers that need it the most, such as low-skilled and older workers.	**Shift job training subsidies to individuals at least partially, or develop public job training programmes targeted to low-skilled and older workers for specific purposes, such as promoting ICT skills.**
Sharpening incentives to take advantage of digitalisation	
Regulations are stringent and differ across regions in some sectors, such as professional services and trade, weighing on the expansion of prospective firms.	Foster the implementation of the Market Unity Law using available instruments to reduce regulatory differences across regions.
Some aspects of the Bankruptcy Law remains stringent, such as high penalties for business failures, discouraging risk taking. Debt restructuring in formal proceedings is complex and uncertain, and is often hampered by the treatment of liabilities to public authorities.	**Promote out-of-court insolvency proceedings, especially for small and medium-sized enterprises.** Consider including liabilities to public authorities in out-of-court insolvency proceedings.
Young and innovative firms without collateral can have difficulty accessing bank loans, which remain the more important source of financing.	Strengthen targeted support to new and high-potential firms through public guarantee schemes, while making their renewal conditional on an updated assessment of the performance of the firm.
Venture capital financing is not ample and concentrated in a limited segment of the economy, such as firms at middle or later stages of development.	Monitor and, if necessary, strengthen the requirements to support firms at earlier stages by private venture capital funds financed by Fond-ICO Global in the latest call to promote digitalisation.

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