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Irish enterprise digitalisation: A cross-country exploration

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IRISH ENTERPRISE DIGITALISATION: A CROSS-COUNTRY EXPLORATION

Karen Hogan, Janez Kren and Conor O'Toole*¹

ABSTRACT

This research provides a cross-country perspective on the rate of digitalisation of Irish enterprises. We explore differences across countries, sectors and firm size categories by deploying data on both the usage of digitalisation technologies (stock of digital activities) as well as investment in new digital activities (flow). We draw on two main datasets: a) the Eurostat ICT usage in enterprises survey; and b) the European Investment Bank Investment Survey. We find that Ireland performs relatively well in terms of e-commerce and some more advanced technologies. However particular sectors and firm size groups (such as construction and smaller firms) display low levels of digitalisation. This supports the continued deployment of a sector-specific targeted policy approach that can cater for heterogeneous challenges faced by different firms. We find some evidence of correlations between enabling factors like employment skill levels and the cost of finance and the level of investment in digitalisation.

1. INTRODUCTION

The digital transformation for enterprises is high on the agenda of policymakers and industry and is seen as a critical component to the future success of the Irish enterprise sector. The COVID-19 pandemic brought many challenges but, in particular, it highlighted the benefits of having a well-developed digital capacity that can help build operational flexibility and resilience.

Recent research by the OECD and other organisations has stressed the many channels through which the benefits of digitalisation² can potentially materialise. First, it can directly benefit productivity by increasing operational efficiencies in business activities. It can indirectly provide a further stimulus to productivity through boosting innovation and enabling the ownership of digital assets, the former which have been shown in research to boost growth and productivity (Acemoglu et al., 2020). It can help reduce information asymmetries about business performance and allow better information and data to be generated

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² Digitalisation in this paper is used as a broad concept which relates to the application of any digital technologies to business activities. This can be e-commerce activities or the deployment of computer services in the production process. Throughout the paper, we will define different indicators or specific aspects of digitalisation.

about the success of the business. This can improve decision-making and investment planning. It can also facilitate access to finance and boost recruitment and training activities (OECD, 2021). Finally, it can allow an integration into global markets by reducing transaction costs as well as opening new sales opportunities for firms abroad.

However, it is also clear that the degree, and type, of digitalisation matters for the impact on growth and whether the engagement is with more entry-level digitalisation activities such as sales and marketing on websites and social media, or the adoption of more advanced digitalisation such as robotics, artificial intelligence, machine learning and automation. While the former is often a pathway for firms on their digital journey, the latter is more likely to be efficiency enhancing and give rise to productivity gains. There is also notable evidence of differences across firms with small and micro firms facing greater barriers than larger firms to adopting technologies (OECD, 2021; EIB, 2020). This warrants exploration to understand how this has evolved in Ireland and is likely to be important to ensure that any policy response is targeted and tailored to the heterogeneous needs across firms.

Recent reports on the Irish SME population have stressed two key findings: a) that productivity growth is stagnant and business dynamism is low (OECD, 2019); and b) investment in research and development is lower than in other countries (Gargan et al., mimeo). Furthermore, general investment has been slow to recover following the Global Financial Crisis (Gargan et al., 2018) which is likely to impact firms' capital stocks and productivity. Coupled together, these two findings indicate there is considerable scope to invest in new technologies to improve productivity. Given the aforementioned benefits of digitalisation and the productivity challenge that is faced by domestic small Irish businesses, it is critical to understand and profile the adoption and integration of digital processes across enterprises and sectors in Ireland, and explore whether there are constraints and barriers limiting digitalisation.

Given this context, this Research Note aims to look at two aspects of digitalisation: 1) the stock of adopted digital technologies and digitalisation in Ireland relative to other European countries; and 2) the flow of investment into digitalisation by Irish enterprises. This dual view will provide a lens into the level of capital stock in digital activity as well as its evolution. To undertake this assessment, we draw on two sources. First, we draw on information from the European Investment Bank's Investment Survey (EIBIS) to give a cross-country assessment of the digitalisation of firms in Ireland, with a particular emphasis on exploring heterogeneity across firms. The research draws on published data from recently added questions on the

use of advanced digital technologies (such as the internet of things, big data/AI, 3D printing, augmented or virtual reality, digital platform technologies, automation using robotics, drones) but crucially it contains information on the level of investment expenditure on digital activities by enterprises. Second, we draw on the pan-European survey on ICT usage in enterprises that is collected by national statistical authorities and reported by Eurostat to provide context.

A number of findings emerge from this research. First, in terms of digital commerce, Ireland performs relatively well, with approximately 30 per cent of sales from e-commerce activities as compared to less than 20 per cent in the EU and euro area (EA). Considerable differences exist by sector with manufacturing and services sectors posting notably higher shares relative to the construction sector. For the construction sector, levels of e-commerce sales are lower. Relatively little of this activity is supported through firms' own websites or apps so this is a potential pathway for firms to further their digital offering. Across all size classes Irish firms perform better than their European peers. There are however clear differences between firms across the size classes with small firms having considerably less digital sales than both medium and large sized firms.

Second, in terms of the use of digital technologies, we consider two groups of technologies. The first (Group 1) captures information on chatbot or virtual agent usage, big data analytics and machine learning, natural language processing, and service robots. For these technologies, Ireland performs well in a cross-country context. Approximately one-in-five Irish firms report using these technologies, above the EU27 average of 6 per cent of firms. Comparing across sectors, manufacturing is notably higher than construction for Ireland (19.2 per cent as compared to 12.5 per cent) but both sectors are well above their peers in a pan-European context.

For the second group of AI technologies (text mining, speech recognition, natural language processing, machine learning for data analysis, robotic automation of vehicles etc. and robotic automation software), the overall average usage for Irish enterprises is just under 8 per cent. However this is the same for the other EU countries. For manufacturing, the level of usage of these technologies is somewhat larger at 8.5 per cent and is higher than that for other countries. The usage for construction in Ireland is virtually zero and is considerably lower than the other European countries at just under 5 per cent. There is therefore a potential digital dividend which could be leveraged for the Irish construction sector if it can even catch up with the average or better performing countries.

In terms of investment in digitalisation, Ireland has a higher rate (proportionally) than for the average of other countries for all years except 2021. Irish firms were on average committing approximately 18-20 per cent of their capital expenditure on digital and IT activities over the period 2018 to 2020. This compares to a total of 13-15 per cent for other European countries. The drop in 2021 (down to approximately 12 per cent) is notable. For Ireland, the share of investment has been highest in the services and other sectors.

Focusing on small and micro firms, Ireland has a high share in these categories relative to EU small firms. These firms did not experience a decline in the share in 2021, rather it was large or medium sized firms. The proportion of overall investment in digitalisation is higher for small relative to larger firms for all countries, which is notable. For medium and large firms, the share of digitalisation expenditure has trended downward quite sharply between 2019 and 2021 and is now lower than the level for other European countries.

While the share declined in 2021, it may not have fallen in level terms (rather other activities increased). Considering the level of investment, we find the average investment per employee across the EU was €3,000 in 2021. This compares to €2,000 per employee in Ireland. The highest was in Italy at just under €27,000 per employee. Austria and Sweden also had levels above €24,000 per employee. The lowest was in Bulgaria, Slovakia, Malta and Cyprus. It is notably lower than some of the countries that could be seen as comparable in terms of size, economic structure and trade openness (like Belgium, Austria, Denmark) where the spend is double the Irish rate.

Considering differences across size classes, in general, expenditure per employee has been lower for small and medium-sized firms in Ireland than in other countries over the period 2016 to 2020. For large and medium sized firms, the level of investment expenditure per employee was notably larger than for other countries before 2019. It has dropped to a position similar to other countries in 2021.

A final element in the research was to consider selected obstacles to long-term investment that might be correlated with digital activities. We consider the broader digital infrastructure and more Irish firms report it as an obstacle to long-term investment than their EU counterparts, and this holds across the size distribution. Secondly, there is also an upward trend in terms of finding sufficiently skilled staff being reported as an obstacle both in Ireland and in the EU. However, neither of these aspects has a strong correlation with the investment per employee in digitalisation. We do find a positive correlation with digital skills as measured by the percentage of specialists in total employment and a negative correlation with

firm-level interest rates. These correlations suggest that more skilled digital staff and lower costs of finance can boost investment in digitalisation.

The rest of this Note is structured as follows. Section 2 presents the background and policy context; Section 3 introduces the cross-country patterns in digitalisation using the EIBIS data and Section 4 concludes.

2. BACKGROUND AND POLICY CONTEXT

2.1 International evidence and academic literature

Benefits of digitalisation

In recent years, a large volume of international research has focused on identifying the benefits of digitalisation for firms and on determining the channels through which digitalisation affects firm activity and growth. A large recent study by the OECD (2021) notes a range of benefits of digitalisation. First, by reducing transaction costs and improving information flows it can boost operational efficiency and communication between staff, suppliers and networks. Second, it can boost the ability of small firms to access global markets through reductions in transport costs, access to new customers, and a reduction in border frictions (Teruel Carrizosa et al., 2021). Third, it can improve access to various online or digital resources including access to financial services (credit such as peer lending, payment technology etc), government services, and also human resources and recruitment. It allows better production and analytics of firms' own data which can be used to boost operational efficiency and is thus a key driver of innovation at the firm level (Gal et al., 2019). Acemoglu et al. (2020) study the firm-level implications of robot adoption in France. Of 55,390 firms in their sample, 598 adopted robots between 2010 and 2015, but these firms accounted for 20 per cent of manufacturing employment. Adopters experienced significant declines in labour shares, the share of production workers in employment, and increases in value added and productivity.

Indeed, the benefits of digitalisation go beyond just productivity enhancing growth or expanding market size. Cui and Wang (2023) examine the impact of digital transformation on financial distress in listed companies and find that enterprises' digital transformation can significantly alleviate financial distress, and higher economic policy uncertainty will promote the role of enterprises' digital transformation to alleviate financial distress. Digitalisation can also affect economic growth through improving access to financial services and improving financial inclusion. Nurazira and Ahmad (2023) consider panel data across 84 countries since the Global Financial Crisis and find a positive and significant effect

of financial inclusion and digital technology on firm-level economic growth. Acemolgu et al. (2022a) find that AI changes the skills mix of firms away from the jobs that AI can complete towards higher skills requirements.

These benefits of digitalisation are also highlighted in the EIB's recent reporting series on digitalisation in Europe (EIB, 2023). The report notes that digitalisation helps firms to build resilience in particular in an era of repeated shocks. It also will allow them to better manage the climate transition and adapt to climate change. The data indicate that firms engaging in digitalisation had higher productivity, were more likely to engage in international trade and also to perform better. It must be noted that this study does not identify these as causal relationships and the relationship between digital activity and performance is likely to be endogenous.

Barriers to digitalisation and differences across firms and regions

Despite the clear benefits from digitalisation, there are notable challenges in the adoption of different technologies and digital inputs that differ across country, sector and firm size. The OECD notes that the divide between large and small firms is particularly sizable and this can be due to a number of factors, including access to financing for digital and intangible assets, gaps in infrastructure provision, and internal skills gaps (OECD, 2022). SMEs often use off-the-shelf technologies that are low cost. They also often begin their digitalisation journey through online marketing (such as with ecommerce websites and social media) and general administrative functions. Particular technologies which need more specific knowledge or critical mass for implementation (such as resource planning for back office and customer relationship management technology for front office) often see a greater divide between small and large firms. Acemoglu et al. (2022b) collect data on the use of over 300,000 firms on the use of five advanced technologies: AI, robotics, dedicated equipment, specialised software, and cloud computing. They find that usage in the US remains low but has considerable differences across firms. Large and young firms appear to be the greatest adopters and the firms that do adopt often use the technology to replace labour as part of automation, and therefore have higher rates of labour productivity. These raise the skill requirements for the employees who remain.

Considerable variation also exists across countries and regions, with the US being the leader relative to the EU in terms of digital adoption (EIB, 2023). While recently the EU has closed the adoption of advanced digital technologies relative to the US, the gap remains (69 per cent of firms relative to 71 per cent of firms) which is likely to impact relative productivity trends and the growth outlook in these regions.

The heterogeneity in adoption has also been noted in various country contexts. Trinugroho et al. (2022) consider the impact of digital adoption in Indonesia and find that considerable heterogeneity exists across firms and owners, with the characteristics of the enterprise and ownership explaining variation in adoption rates. EIB (2023) research indicates that digitalisation is determined by both internal and external factors. This can include infrastructural issues such as adequate digital networks like broadband and competition friendly regulation, as well as management decisions around employee training and trade with innovative firms.

These differences across firms matter, as the extent to which digitalisation occurs as well as the type of digital technologies that are adopted will determine which of the aforementioned benefits accrue to firms and to what extent. First, if small firms are undertaking more basic digitalisation (such as the use of social media or e-commerce websites or basic digital communications activity), this is likely to impact these firms in particular ways such as allowing for the potential of greater market size thus increasing output. It may also lead to some operational efficiencies that improve productivity by increasing output per worker within a given time period. However, implementing advanced technologies may provide an even greater stimulus to productivity growth and better targeting of activities (such as data analytics, robotics, AI etc). Therefore the type, and scale, of digitalisation matters for the impact on growth and productivity. Adopting the more advanced technology requires a different level and type of investment, and the EIB note that the transformation of the EU economy from a digitalisation perspective will need considerably more advanced technology such as 3D printing, advanced robotics, the internet of things, big data analytics, AI, drones and other investments (EIB, 2023, p.4). The differences across these types of activities are even more stark between firm sizes than the more basic activities. European Investment Bank (2020) notes that this will slow digitalisation in Europe.

2.2 Policy context and background

The European Commission's Digital Decade policy programme³ came into force on 9 January 2023 and it sets out the EU's path to the digital transformation of the economy and society to 2030.

To track progress the programme includes targets as measurable goals for each of the four points of the EU Digital Compass. These four points are skills, digital transformation of business, secure and sustainable digital infrastructures and digitalisation of public services.

³ 2030 Digital Compass: the European way for the Digital Decade - EU4Digital (eufordigital.eu).

The programme also outlines a number of objectives to ensure that the digital transformation in Europe benefits all people. Several objectives relate specifically to SMEs:⁴ small businesses and industry have access to data; start-ups and SMEs have access to digital tech; SMEs can compete in the digital world on fair terms; and all organisations can ensure cybersecurity. Every year, the Commission will publish a report to take stock of the progress made.

Ireland launched its digital strategy titled *Harnessing Digital – The Digital Ireland Framework* in February 2022,⁵ setting out a pathway to drive and enable the digital transition across the economy and society. The strategy seeks to position Ireland as a digital leader, driving and enabling digital transformation across the economy and society, and it includes targets, high-level workstreams and deliverables across four dimensions, in line with the EU’s Digital Decade 2030; i.e. Digital Transformation of Business, Skills, Digital Infrastructure, and Digitalisation of Public Services.

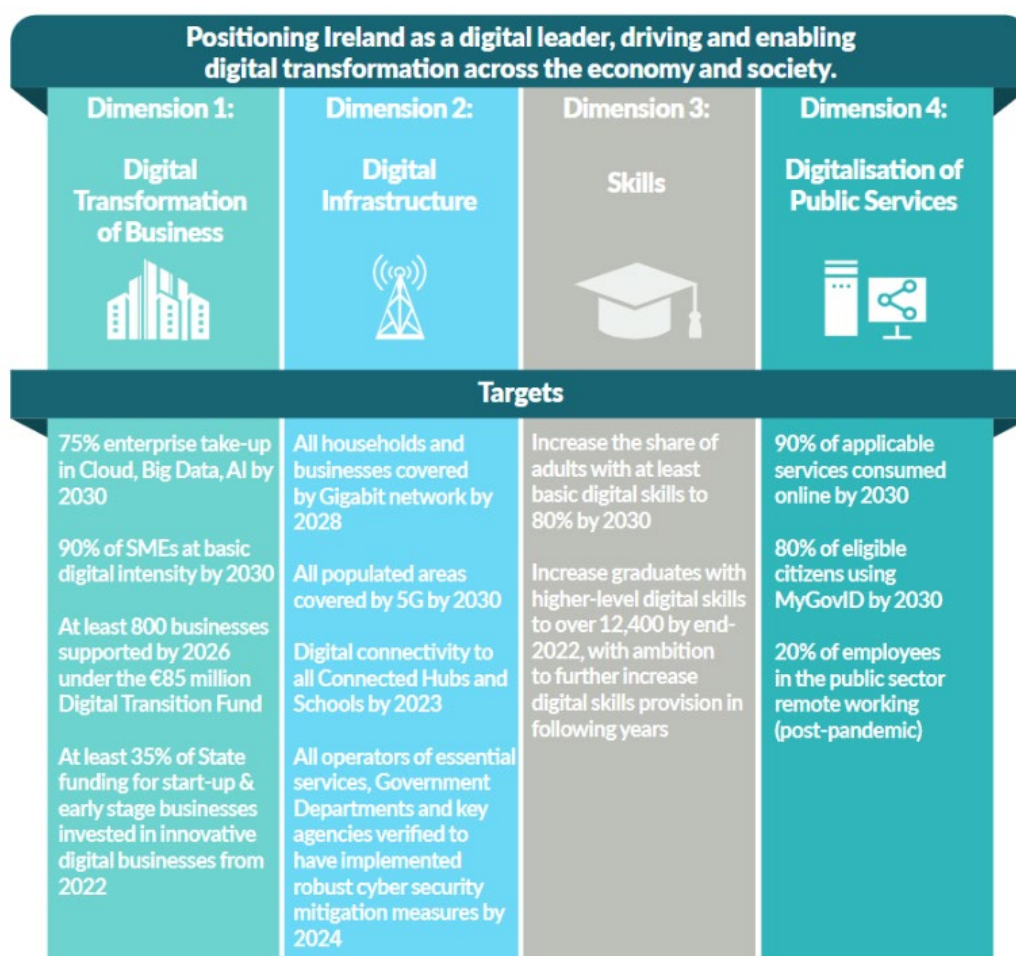
The strategy specifically notes the need to increase the adoption of digital technologies by all businesses in Ireland – but in particular SMEs – while highlighting the two-speed nature of the Irish economy, with only a small proportion of the enterprise base having fully embraced digitalisation. The strategy aims to achieve a significant productivity dividend from a further and sustained uptake in digital adoption across the Irish enterprise base.

Under *Dimension 1: Digital Transformation of Business*, the Government will drive the acceleration of digitalisation across enterprises, in particular SMEs, to achieve the following key targets: 75 per cent enterprise take-up in cloud computing, big data and AI by 2030; 90 per cent of SMEs at basic digital intensity by 2030; at least 800 businesses supported by 2026 under the €85 million Digital Transition Fund; and at least 35 per cent of State funding for start-up and early stage businesses invested in innovative digital businesses from 2022 (see Figure 1 for an overview of all targets).

⁴ Other objectives: A safe and secure digital world; Everyone can participate in digital opportunities / no one is left behind; Small businesses and industry have access to data; Start-ups and SMEs have access to digital tech; Innovative infrastructures converge to work together; SMEs can compete in the digital world on fair terms; Public services are readily available online; Research is focussed on developing and measuring the impact of sustainable energy and resource efficient innovations; All organisations can ensure cybersecurity.

⁵ gov.ie - Harnessing Digital - The Digital Ireland Framework (www.gov.ie).

FIGURE 1 OVERVIEW OF TARGETS AS SET OUT IN *HARNESSING DIGITAL*



Source: *Harnessing Digital, The Digital Ireland Framework 2022.*

Progress reports on *Harnessing Digital* will be published every year. The first was published in December 2022⁶ and it outlines progress against the targets, as measured under the EU’s 2022 Digital Economy and Society Index (DESI). Overall, Ireland retained its strong overall position of fifth out of the EU27 on digital progress. Under the 2022 DESI, Ireland performed ahead of EU averages on big data (23 per cent versus 14 per cent), cloud computing (47 per cent versus 34 per cent) and on par with the EU average for AI (8 per cent) in terms of the adoption of digital technologies by enterprise, with 64 per cent of Irish SMEs having a basic level of digital intensity (versus our target of 90 per cent by 2030). See Figure 2 for summary of all results.

A number of initiatives were noted in the progress report relating to *Dimension 1: Digital Transformation of Business*, including the establishment of the Enterprise

⁶ gov.ie - Harnessing Digital - The Digital Ireland Framework (www.gov.ie).

Digital Advisory Forum, the €85 million Digital Transition Fund, a new digital training scheme for SMEs ('You're the Business'), the published report on AI Skills by the Expert Group on Future Skills Needs, Ireland's participation in the European Commission's High-Level Group on AI, and Digitalisation of Business.

FIGURE 2 **PROGRESS AGAINST TARGETS, AS MEASURED UNDER DESI 2022**

	TARGETS		PROGRESS	
	EU Digital Decade 2030	Harnessing Digital 2030	Ireland 2022 DESI	EU Average 2022 DESI
DIGITAL TRANSFORMATION OF BUSINESS				
Cloud Computing	75%	75%	47%	34%
Big Data	75%	75%	23%	14%
AI	75%	75%	8%	8%
SME Digital Intensity (Basic)	90%	90%	64%	55%
DIGITAL INFRASTRUCTURE				
Gigabit Network	100%	100% By 2028	89%	70%
5G coverage	100%	100%	72%	66%
SKILLS				
Basic Digital Skills	80%	80%	70%	54%
DIGITALISATION OF PUBLIC SERVICES				
Govt Services Online / e-Govt users	100% (key public services)	90% (applicable services consumed online)	92% e-Govt Users*	65%

*This indicator measures the percentage of all internet users (aged 16-74) who used the Internet to interact with public authorities

Source: *Harnessing Digital, The Digital Ireland Framework 2022 Progress Report*, December 2022.

In addition, under *Dimension 2 – Digital Infrastructure*, the progress report noted the new *Digital Connectivity Strategy*,⁷ which was published in December 2022, and sets out the State's ambition for digital connectivity to 2030. Key enablers include delivering the *National Broadband Plan* and implementing Ireland's Cyber Security Strategy. Under *Dimension 3 – Skills*, initiatives include the Human Capital Initiative, the development of a national framework on micro-credentials, the Ireland/OECD Skills Strategy Review, the Adult Literacy for Life Strategy, and the Digital Strategy for Schools to 2027.

Lastly, under *Dimension 4 – Digitalisation of Public Services*, policy measures include the ongoing implementation of *Connecting Government 2030 – A Digital*

⁷ Digital Connectivity Strategy (www.gov.ie).

and ICT Strategy for Ireland's Public Service, the Digital Inclusion Roadmap, and the 2023 ICT Apprenticeship programme.

As noted earlier, this Research Note finds that Ireland's construction sector performs poorly on digital e-commerce and usage of some AI technologies. The Government's Build Digital⁸ project was launched in the fourth quarter of 2021 and aims to help firms in the Irish construction sector develop their capabilities as digitally enabled, standards-based, agile, collaborative and sustainable participants in the delivery of Project Ireland 2040, by supporting the standardisation and adoption of Building Information Modelling (BIM) and modelling in the construction industry, including with SMEs. Construct Innovate – a new Enterprise Ireland technology centre – was launched in December 2022. The centre has a strong emphasis on digital adoption through accelerating research and innovation in the construction sector using a network of government, industry and academia.

Further, Ireland's National AI Strategy, *AI – Here for Good*, was published in July 2021 and sets out a whole of government approach to putting the necessary enablers in place to underpin AI adoption in enterprise and public services, including a supportive innovation ecosystem, a secure data and connectivity infrastructure, and policies to ensure that the workforce is prepared for the impact of AI.⁹

3. CROSS-COUNTRY PATTERNS IN DIGITALISATION

3.1 Reviewing the 'stock' of adopted digitalisation and its usage

The first aspect in the cross-country assessment of digitalisation we consider is to look at a snapshot of the stock of digital technologies that have been currently adopted as well as looking at the usage of digitalisation by firms. We first explore the extent to which firms rely on digitalisation for sales purposes. Given that online sales are considered one of the pathway channels for smaller firms to begin their digitalisation journey, it is important that we understand the extent to which this activity is occurring, as well as how Ireland is performing relative to other peer economies and across sectors. Second, we look at the use of more advanced technologies which are likely to be productivity enhancing and are key elements to improve in the governments' recent *Harnessing Digital* strategy.

⁸ Build Digital Project (www.builddigitalproject.ie).

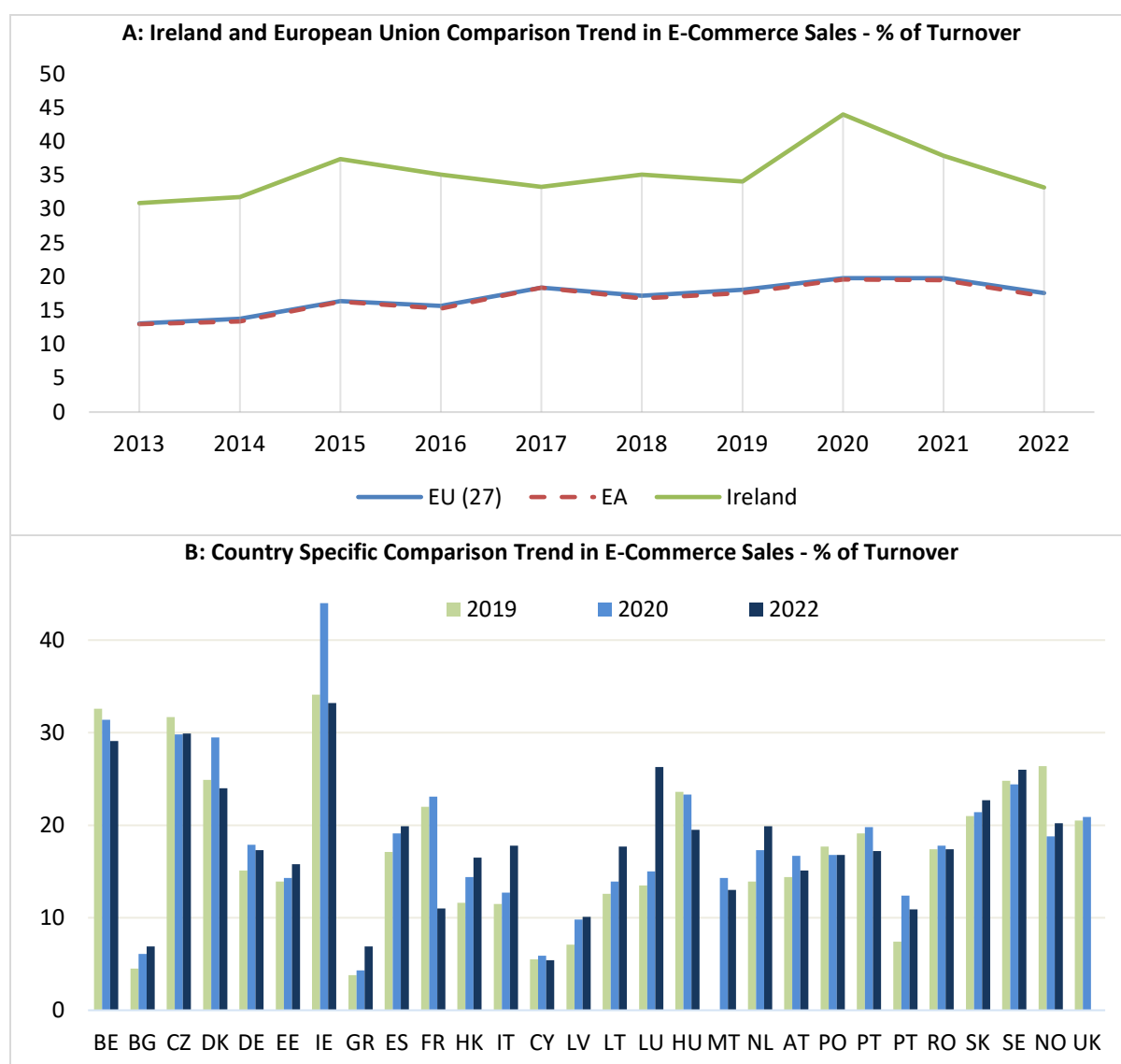
⁹ gov.ie - AI - Here for Good: National Artificial Intelligence Strategy for Ireland (www.gov.ie).

Trends in e-commerce sales

To explore trends in e-commerce, we draw on the Eurostat Survey on ICT usage in enterprises. The survey contains a range of indicators on the e-commerce, digitalisation, advanced digital technologies and other indicators for ICT deployment and adoption. Figure 3A presents the trends in e-commerce sales as a percentage of total sales for Ireland and two comparator blocks of countries, the EU27 and the euro area (EA) over the period 2013-2022. Ireland has clearly a much higher share of e-commerce activity relative to other European countries and this gap has remained in the data for the full sample period. In 2022, Irish firms reported approximately 30 per cent of their sales from e-commerce activities whereas the EU27 and EA figures were below 20 per cent. The impact of the COVID-19 pandemic is clearly evident and caused a rise in e-commerce activity across all countries as lockdowns moved activity online. It has moderated somewhat from the peak in 2020 suggesting that some of the pandemic's impact has not been permanent in nature.

Figure 3b presents the data for the share of e-commerce sales in total sales across individual countries. At 33.3 per cent in 2022, Ireland has the highest percentage of e-commerce sales across all the countries presented. The second highest was Belgium which is only marginally below the Irish figure, while Czechia was third on just under 30 per cent. There is a clear digital divide between countries, with some countries (Greece, Cyprus, Bulgaria) recording less than 10 per cent of sales from e-commerce by firms. Some countries have experienced a larger impact from COVID-19 that appears to have remained in place in 2022. Given Ireland had a high relative level of e-commerce sales to begin with, it is not unsurprising that the COVID-19 bounce has been less permanent.

FIGURE 3 CROSS-COUNTRY COMPARISONS OF E-COMMERCE SALES



Source: Eurostat, Survey of ICT Usage.

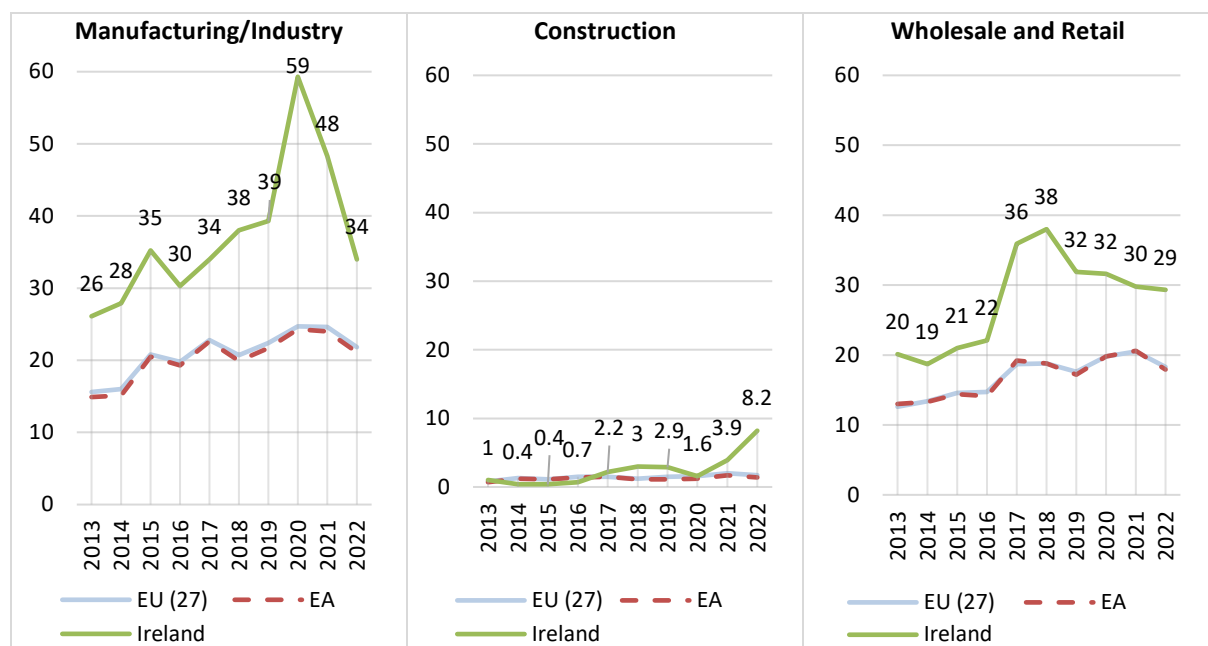
It is likely that considerable differences exist across sectors in relation to their digitalisation. This heterogeneity can be driven by firm-specific deployment of capital and labour, the orientation of the type of capital required, as well as the traditional productivity of the enterprises within the sectors. Other factors such as credit access, managerial capacities and the type of activity and market are also likely to be critical determinants of digital activities.

To explore the differences across sectors, data are presented in Figure 4 for three groups: a) industry and manufacturing; b) construction; and c) wholesale and retail. In an Irish context, these are three critically important sectors but have very different structural characteristics. Industry and manufacturing are dominated by very large multinational, globally trading firms which are likely to have high levels

of digitalisation, while construction and wholesale and retail are more domestic focused sectors. The recent OECD report (2019) also highlights low productivity amongst construction firms and a requirement to move towards more modern technologies. Digitalisation is likely to make up part of this required transition. The data indicate that e-commerce sales for Ireland are indeed highest in the manufacturing sector and are far higher than in other countries at 34 per cent in 2022. This is down notably from the pandemic peak but is also lower than the pre-pandemic level of 39 per cent in 2019.

For the construction sector, levels of e-commerce sales are considerably lower. This is not surprising given the physical nature and type of product if the output is housing, other buildings or renovations; but there is likely some smaller construction activity that could be moved online to boost orders with this technology. In recent years, there has been a notable increase for Irish firms in terms of e-commerce sales in the construction sector with the share of sales from this channel rising to just over 8 per cent. This is considerably higher than for other countries. It is also notable that there is no evidence of a COVID-19 bounce in 2020 in terms of digitalisation which likely reflects the nature of the sector’s activity and the terms of the lockdowns which prevented all but essential activity during the period of strict public health measures.

FIGURE 4 CROSS-COUNTRY COMPARISONS OF E-COMMERCE SALES – SECTORAL BREAKDOWN (% OF SALES)



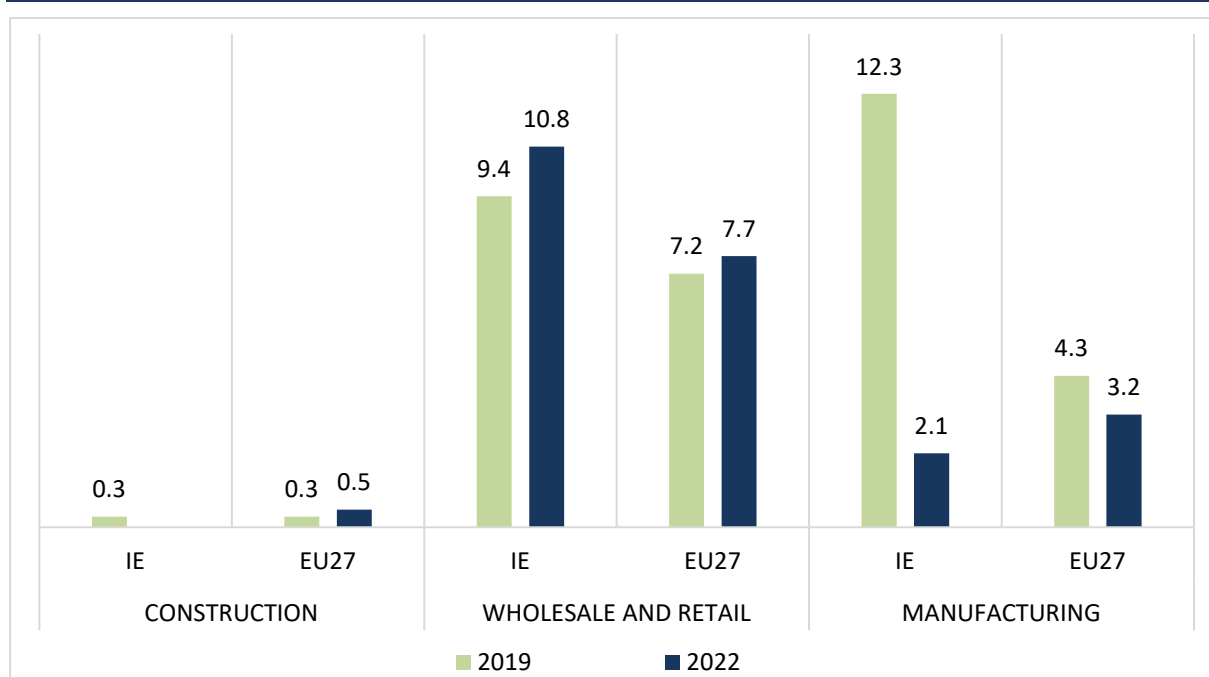
Source: Eurostat, Survey of ICT Usage.

In terms of the wholesale and retail trade, Ireland again is performing well relative to other European countries, with just under 30 per cent of sales from e-commerce. This is again notably higher than the EU27 and EA averages. Further detail on the country-by-country variation across sectors is presented in Appendix 1.

Having considered the overall level of e-commerce, we move to explore whether this activity took place on the firms’ own websites or other channels. Research indicates that digital marketplaces and social media are often a first step for firms moving into the digital space and they can do this at relatively little cost.

Using their own website or app (an indicator in the ICT survey), is therefore a good indicator of a greater degree of adoption at the very basic access point. The percentage of sales coming from e-commerce sales via a company’s own websites or apps is presented in Figure 5 by sector and with the EU27 comparison for Ireland.

FIGURE 5 CROSS-COUNTRY COMPARISONS OF E-COMMERCE SALES – SECTORAL BREAKDOWN – ENTERPRISE TURNOVER FROM WEB SALES VIA OWN WEBSITES OR APPS (% OF SALES)



Source: Eurostat, Survey of ICT Usage.

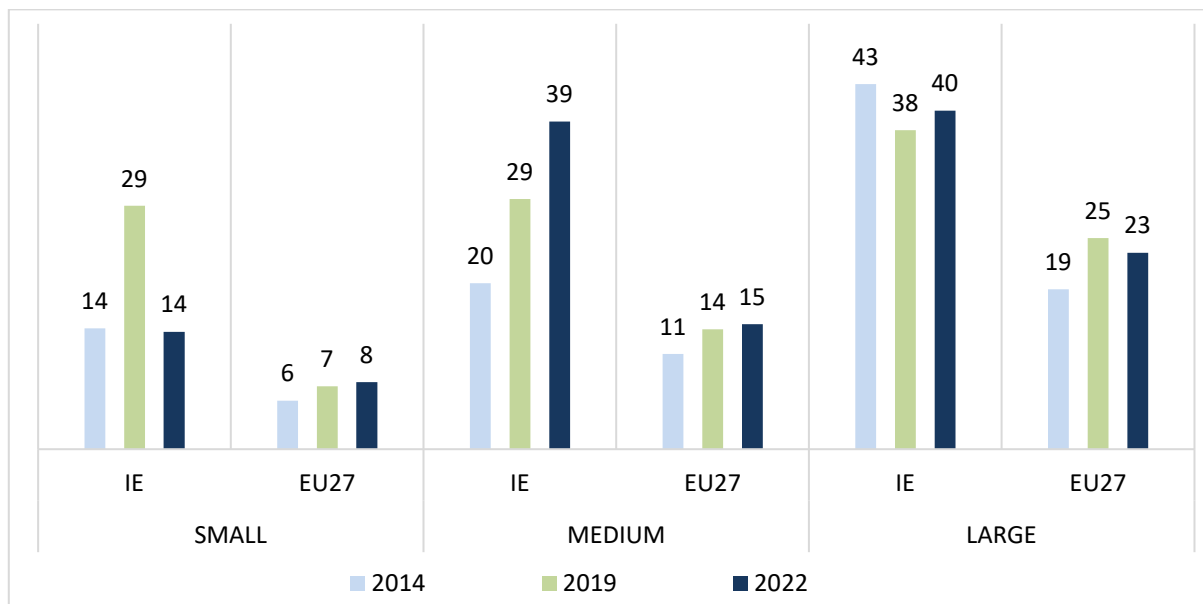
Notes: Data for Ireland redacted for 2022 due to low number of observations.

For the construction sector, there is little to no online commerce happening through their own apps or websites in either Ireland or the EU.¹⁰ For the wholesale and retail sector, Ireland is lower than the other European countries and approximately 10 per cent of sales come from own websites and apps. Given the total above was approximately 30 per cent, it does indicate that Irish enterprises' e-commerce does not necessarily materialise from their own websites. This is a possible avenue to improve the digital offering. For manufacturing, Ireland is well ahead of other European countries in 2019.

While differences exist across countries and sectors, there is also likely to be a considerable divergence across size classes. Differences in firm size have been correlated with varying degrees of business challenges such as the impact of labour costs, access to finance, managerial capacity and other factors. This is likely to impact the adoption of digital technologies. The data for Ireland vis-à-vis the EU27 are presented for 2014, 2019 and 2022 in Figure 6. It is clear that across all size classes Irish firms perform better than their European peers. There are however clear differences between firms across the size classes with small firms having considerably less digital sales than both medium and large sized firms. It is also noteworthy that Irish small firms have less e-commerce sales than in 2014, whereas EU27 small firms are continuing to increase the share, even if at a lower base. Medium-size firms increased their use of e-sales dramatically since 2014 with an increase of nearly 20 percentage points to just under 38.5 per cent. For large firms, the share also declined marginally from just under 43 per cent in 2014 compared to just under 40 per cent in 2022. While Ireland has a considerably higher share than other countries, these declines for small and large firms are potentially a point of concern in terms of increasing digitalisation.

¹⁰ The 2022 data for Ireland have been redacted.

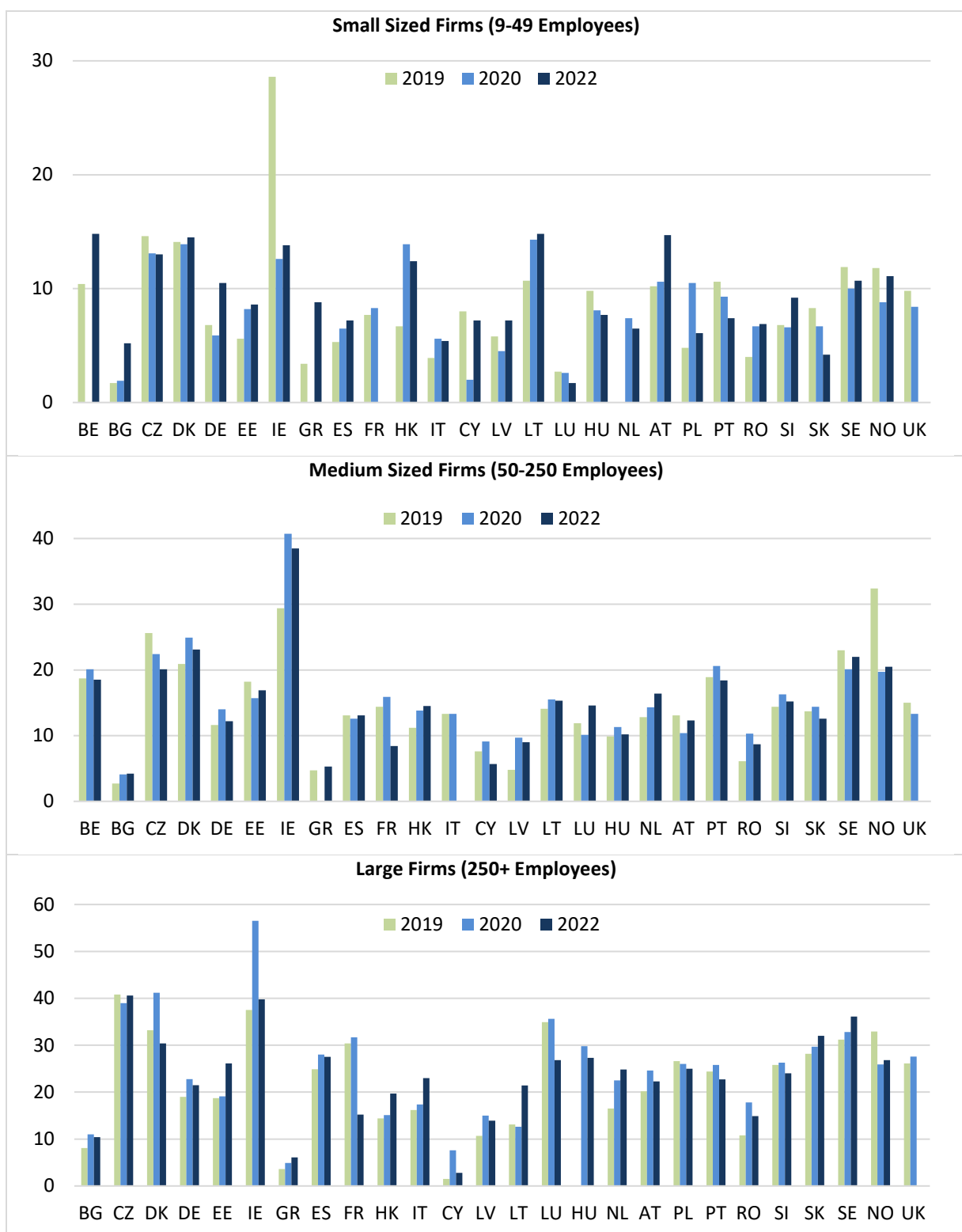
FIGURE 6 CROSS-COUNTRY COMPARISONS OF E-COMMERCE SALES – SIZE BREAKDOWN (% OF SALES)



Source: Eurostat, Survey of ICT Usage.

A further breakdown of the data by size class across countries is presented in Figure 7. For small firms in 2022, Ireland is on the high end of the distribution along with Denmark, Belgium, Lithuania, Austria and Czechia. For medium-sized firms, Ireland has the highest reported sales by e-commerce as a percentage of total of all the countries presented, with Denmark, Belgium, and Czechia slightly lower. For large firms, Ireland is also performing well ahead of its peer group. This is likely to reflect the presence of high-technology multinationals as well as a concentration of knowledge intensive ICT sector firms in Ireland.

FIGURE 7 CROSS-COUNTRY COMPARISONS OF E-COMMERCE SALES – SECTORAL BREAKDOWN (% OF SALES)



Source: Eurostat, Survey of ICT Usage.

Use of advanced digital technologies

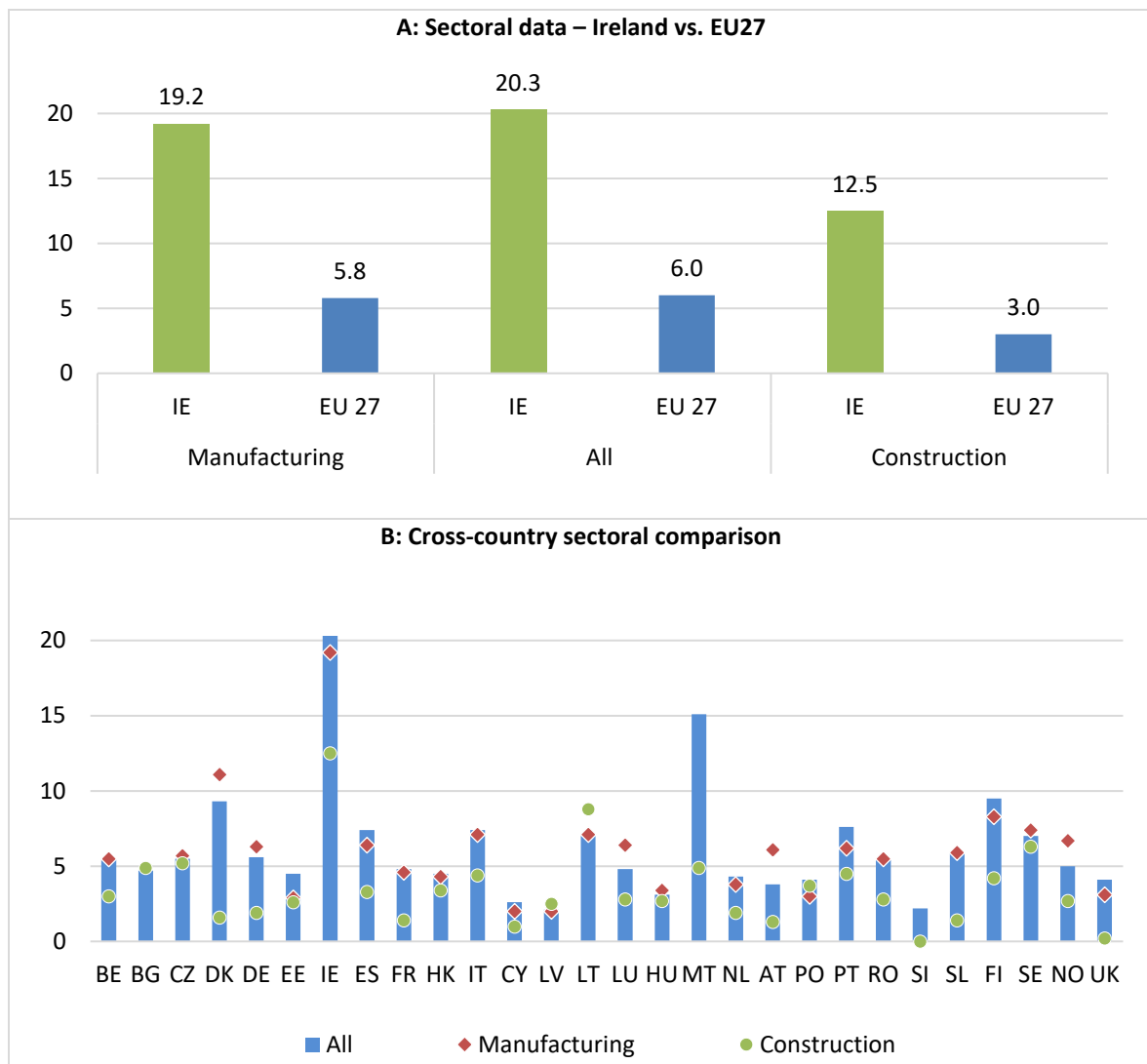
While e-commerce activity is a good indicator for the specific channel of market access through digitalisation for enterprises, it is less informative about productivity enhancing technology adoption and the scope for efficiencies in the production process to be gained from advanced technologies. To understand this channel in more detail, we draw on additional information from the Eurostat ICT survey on the use of artificial intelligence and other advanced digitalisation activities to understand better their penetration across Irish enterprises.

While a large range of indicators are available in the survey, there are some limitations to their usage given considerations such as small sample sizes in the reporting population, in particular where sector specific and country specific data are required. We have therefore used a combination of indicators for how many firms use groups of different technologies.

The first group of advanced digital technologies capture information on the following activities; chatbot or virtual agent usage, big data analytics and machine learning, natural language processing, and service robots. We define this set of activities as Group 1 in the charts below. These activities are likely to be useful to firms in increasing the efficiency of the production process, improving information flows as well as for targeting new markets and emerging trends in business activities. The second group of AI technologies (Group 2) considered includes, amongst others, the following; text mining, speech recognition, natural language processing, machine learning for data analysis, robotic automation of vehicles etc. and robotic automation software. These activities are more digitally advanced than the first group (with some cross-over) therefore their adoption indicates a high degree of digitalisation.

We first present the data for the Group 1 set of indicators. The data for all firms, for manufacturing firms and for construction firms are presented in a comparative context in Figure 8. The data cover the year 2021 which was the latest data-point available with sufficient information. Overall Ireland performs well in a cross-country context. Approximately one-in-five Irish firms report using AI activities of the Group 1 type in their operations, and this is well above the EU27 average of 6 per cent of firms. Comparing across sectors, manufacturing is notably higher than construction for Ireland (19.2 per cent as compared to 12.5 per cent) but both sectors are well above their peers in a pan-European context. This can also be clearly seen when exploring the more detailed data on a cross-country basis in Figure 8b. Ireland is well ahead in both a cross-country and cross-sectoral perspective.

FIGURE 8 USE OF ANY ARTIFICIAL INTELLIGENCE TYPES FROM GROUP 1 – CROSS-COUNTRY – 2021 DATA



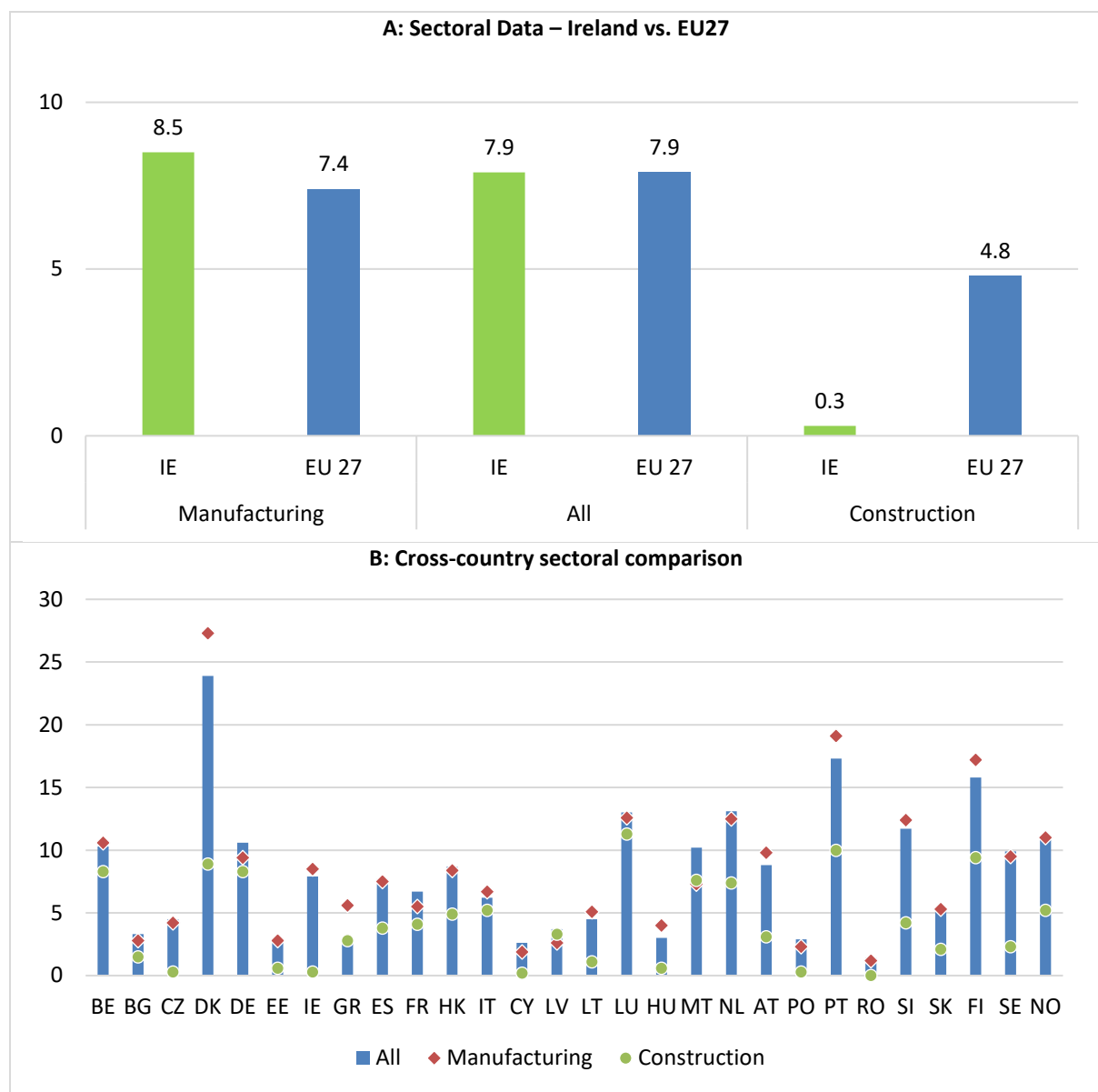
Source: Eurostat, Survey of ICT Usage
Notes: Enterprises use one AI system: ‘Chatbots for replies with customers’, ‘Machine learning analytics’, ‘Natural language processing’, or ‘Service robots’.

Figure 9 presents the data for the Group 2 set of indicators. For this group the overall average usage for Irish enterprises is just under 8 per cent of enterprises. However this is the same for the other EU countries. For manufacturing, the level of usage of these technologies is somewhat larger at 8.5 per cent and is higher than that for other countries. The usage for construction in Ireland is virtually zero and is considerably lower than the other European countries at just under 5 per cent.

The cross-country patterns (Figure 9b) also highlight the sectoral differences for Ireland which performs above average for manufacturing but much more poorly for construction. There is therefore a considerable digital dividend which is likely to be able to be leveraged for the Irish construction sector if it can even catch up

with the average or better performing countries. This difference is also likely to be explained by the presence of high productivity ICT multinationals in the Irish economy which will be operating at the international frontier for these technologies. The leaders in general in the usage of these technologies are Denmark, Finland, Portugal and Belgium.

FIGURE 9 USE OF ANY ARTIFICIAL INTELLIGENCE TYPES FROM GROUP 2 – CROSS-COUNTRY – 2021 DATA

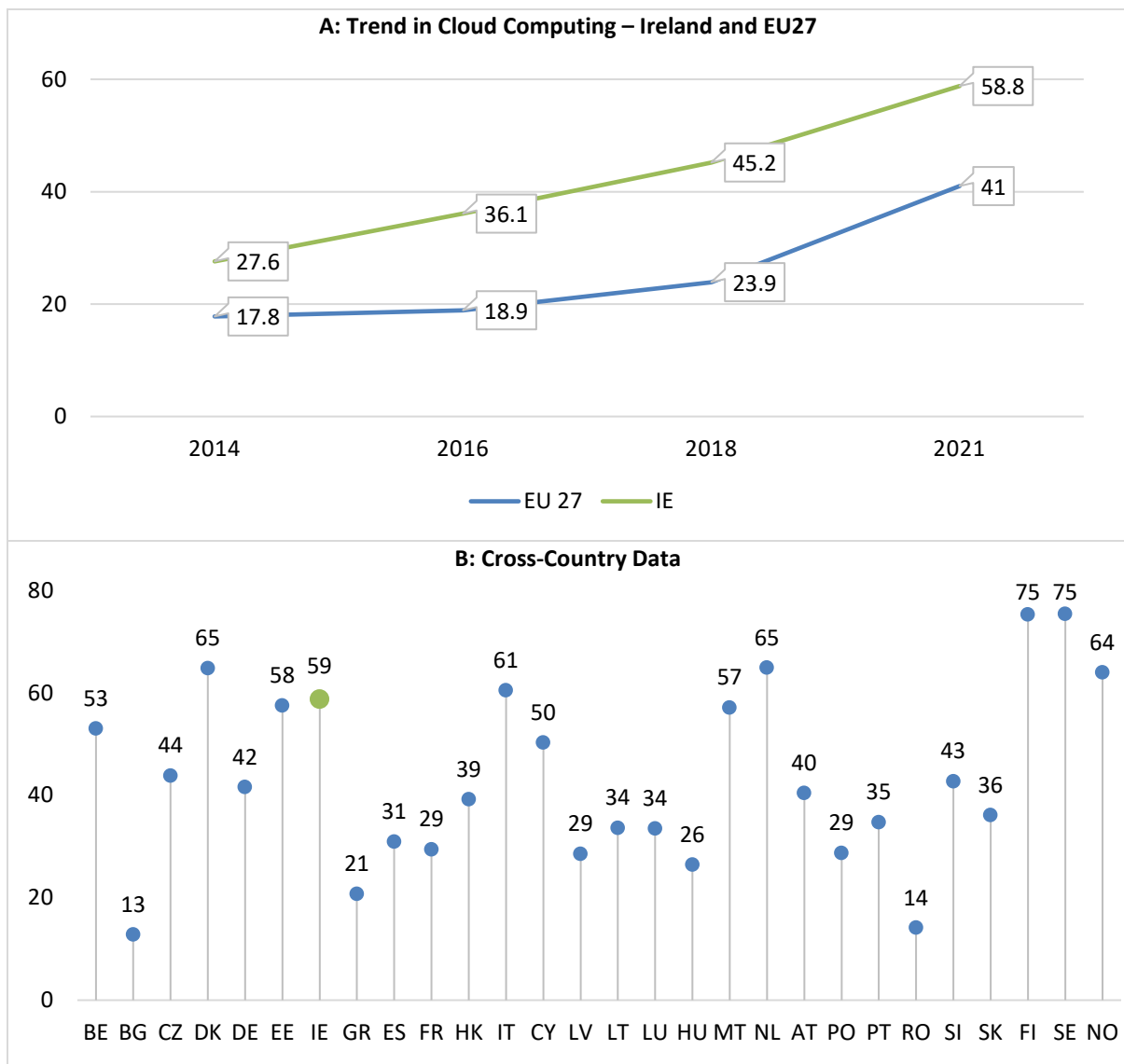


Source: Eurostat, Survey of ICT Usage

Notes: Enterprises use at least one of the AI technologies: ‘Text mining’, ‘Speech recognition’, ‘Natural language processing’, ‘Image recognition and processing’, ‘Machine learning’, ‘AI based process automation’ or ‘AI for movement, such as autonomous robots, self-driving vehicles’.

The final type of technology that we consider is cloud computing, which is an efficiency enhancing digital activity for enterprises. The data for the usage of cloud computing are presented in Figure 10. Again, Ireland performs well in terms of the usage of cloud computing with 59 per cent of enterprises using this technology, which is well above the level for the other European countries at 41 per cent. The rising trend over time also provides reassurance of the inflow of investment into this type of technology and its broad-based adoption by enterprises.

FIGURE 10 USE OF CLOUD COMPUTING ACTIVITIES – CROSS-COUNTRY – 2021 DATA



Source: Eurostat, Survey of ICT Usage.

3.2 Investment in digitalisation and Its adoption from the EIBIS survey

While the above discussion on digital usage provides an overview of the stock of technologies and their deployment, it does not provide detailed insight into the investment flow into new technologies. Arguably considering the trends in the flow

is more important, as that provides the insight into the direction of travel and allows firms and policymakers to understand better the barriers to increasing the usage of these technologies.

To gain more insight into the investment flows, we draw on data from the European Investment Bank Investment Survey. This is a cross-country survey that takes place in EU Member States and selected other economies to explore the investment behaviour, financing activity and growth constraints for large and small firms. The annual survey covers over 12,000 enterprises across the European Union and also collects a smaller 800 firm sample for the US. Information is collected across both quantitative and qualitative indicators on investment and firm performance and is used to inform the EIB annual investment report and country reports on each Member State.

The data are collected for all firms above five employees and uses stratified sampling to achieve representativeness at three levels: EU level, country level, and industry (across broad categories such as manufacturing, services, construction and infrastructure) and also firm size (micro, small, medium, and large).¹¹ For Ireland, the sample is approximately 400 enterprises for each survey wave. For 2022, the total number of manufacturing firms in Ireland surveyed was 106, with 152 service firms, and 131 construction and infrastructure firms. Across the size distribution, in 2022, a total of 337 small or micro firms were sampled as compared to just 66 large or medium sized firms.¹²

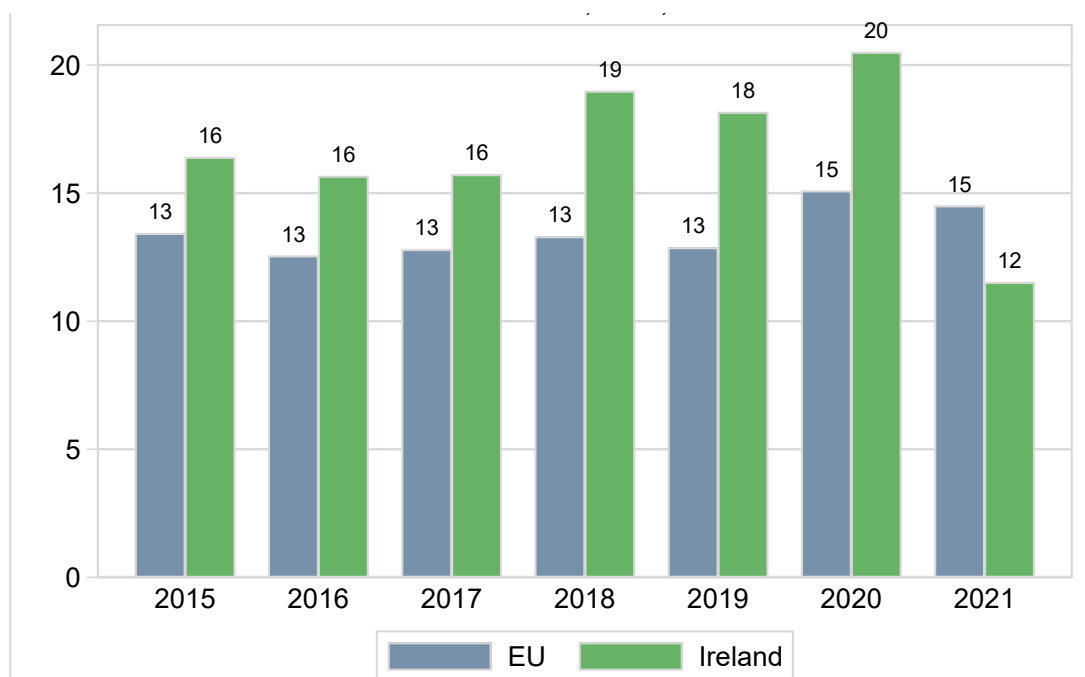
3.3 Overall investments

The EIBIS survey contains a large volume of information on the investment activity of enterprises. Data are collected on the following categories of investment activity: IT and digitalisation, Buildings, Machinery and equipment, Research and Development, Staff, and Process improvements. Figure 11 presents the trend in the average share of digitalisation expenditure in total investment for Ireland and the basket of other EU countries from 2015 to 2021.

¹¹ For more information on the EIBIS survey, please see:
<https://www.eib.org/en/publications-research/economics/surveys-data/eibis/about/index.htm>.

¹² More detail on the Irish-specific EIBIS sample can be found here:
https://www.eib.org/attachments/publications/20220266_econ_eibis_2022_ireland_en.pdf.

FIGURE 11 AVERAGE SHARE OF INVESTMENTS IN DIGITALISATION – OVER TIME



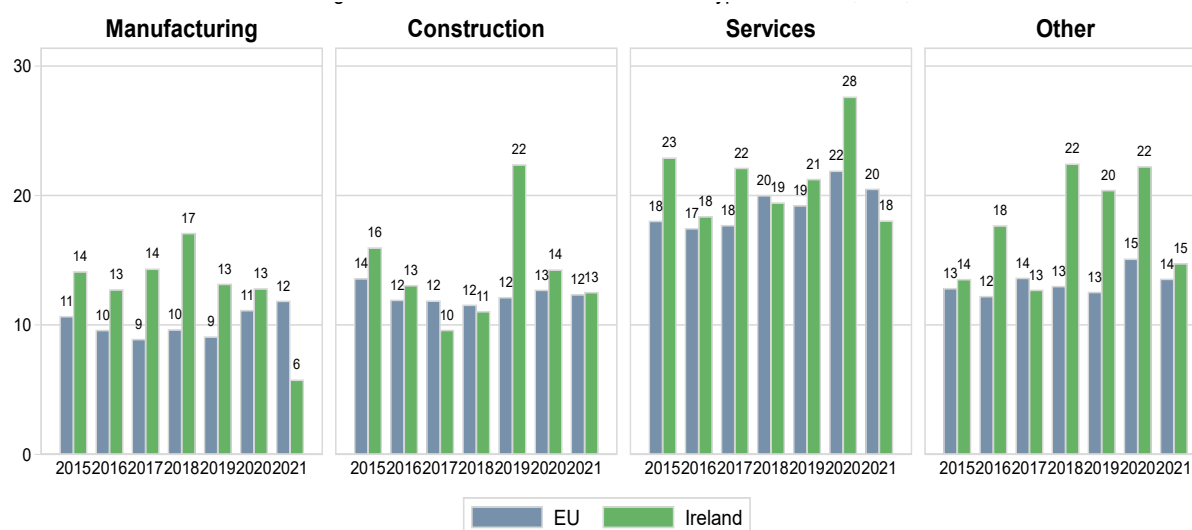
Source: EIBIS Data.

Notes: Investments in software, data, IT networks and website activities. All sectors and all size categories total.

Investment in digitalisation for Ireland is higher (proportionally) than for other countries for all years except 2021. Irish firms were on average committing approximately 18-20 per cent of their capital expenditure on digital and IT activities over the period 2018 to 2020. This compares to a total of 13-15 per cent for other European countries. The drop in 2021 (down to approximately 12 per cent) is notable but more information is required to know if this is a level shift downwards or just an increase in the share of other activities.

To explore differences across firms and sectors for Ireland in a comparative context, we present the average share of investment in digitalisation for four sectoral groups (what is available in the survey): manufacturing, construction, services, other. For Ireland, the share of investment has been highest in the services and other sectors. ‘Services’ in Ireland is likely to include the very highly productive ICT sector which is dominated by global firms. It is therefore unsurprising that the services sector has such a high share of investments in digital activity. Both the construction and manufacturing sectors had investment levels below those of their service counterparts. This is somewhat surprising given the productivity in the manufacturing sector and the operations of the pharmaceutical firms but could be explained by a digital divide within manufacturing.

FIGURE 12 AVERAGE SHARE OF INVESTMENTS IN DIGITALISATION – BY SECTOR



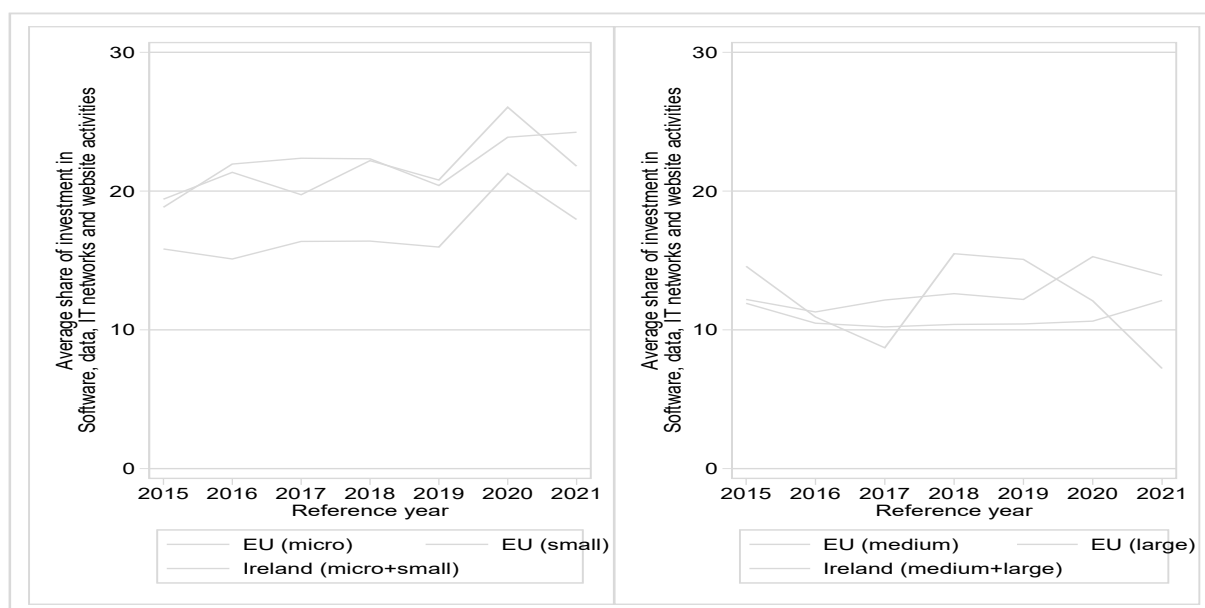
Source: EIBIS Data.

Notes: Investments in software, data, IT networks and website activities. All size categories total.

In a comparative context, up until 2020 Ireland’s investment share in digital activities was greater than the average for the EU and it was particularly strong in the other sectoral categories. However the share of digital expenditure in total investment fell between 2020 and 2021 in all sectors in Ireland, but the drop was most pronounced in manufacturing and services areas. For these sectors, the expenditure as a proportion was actually lower in Ireland than for the basket of other countries in 2021 which is a concerning reversal.

Figure 13 presents the share of investment in digitalisation by size category. Two charts are presented: 1) for small and micro firms; and 2) for medium and large firms. The Irish data are combined into one group across these two categories for statistical disclosure reasons by the EIB. Focusing on small and micro firms, Ireland has a high share of overall investment in digital activities relative to EU small firms but relatively similar to that of micro firms. Interestingly, there is no decline in the share in 2021 for small and micro firms whereas it is clearly evident for larger (medium and large) firms. The proportion of overall investment in digitalisation is higher for small relative to larger firms for all countries, which is notable. For medium and large firms, the share of digitalisation expenditure has trended downward quite sharply between 2019 and 2021 and is now lower than the level for other European countries.

FIGURE 13 SHARE OF INVESTMENTS IN DIGITALISATION – BY SIZE CATEGORY



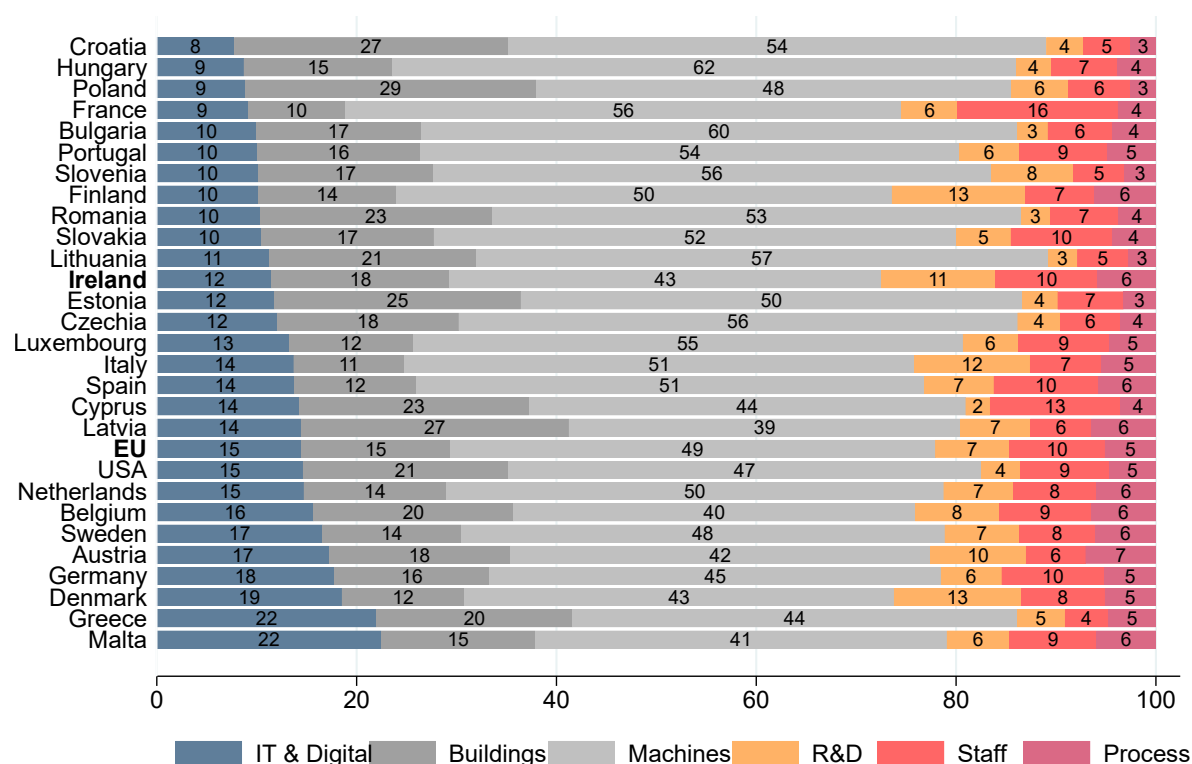
Source: EIBIS Data.

Notes: Investments in software, data, IT networks and website activities. All sectors total.

To contextualise the share of investment expenditure by enterprises on digital activities, it is important to understand what else firms are investing in. For example, Irish firms were investing between 15 and 20 per cent on digital activities prior to 2021. What else are they spending the other 80-85 per cent on and is it different from other countries? Figure 14 presents the shares of investment in 2021 across all of the available asset classes in the survey (digital, buildings, machinery and equipment, R&D, staff, and process improvements). All the available countries are presented. The chart is ordered by the lowest to the highest share of digital expenditure. The countries with the highest expenditure in 2021 on digital were Malta, Greece, Denmark, Germany and Austria. The lowest was in Croatia, Hungary, Poland, France and Bulgaria. The largest investment item across all countries is general machinery and equipment. For Ireland, the level of expenditure on this category is 43 per cent which is 3.6 times the expenditure share on IT and digital. For Denmark for example, this ratio is closer to 2 times. The second largest is investment in buildings. For a majority of countries, the expenditure on digital is in third place. Notably for Ireland, the lower digital spending share appears to correspond to a higher share of expenditure on R&D and staff investments. Indeed, Ireland has one of the highest shares of investment in both of these categories. Investments in assets such as R&D and human capital are likely to be high yielding in terms of productivity gains in the long term, therefore the lower share of digital should not be equated to lower potential productivity growth going forward. However, Brunello et al. (2023) find that investment in advanced digital technologies is a substitute to investment in staff

training, therefore there could be competitive selection across the investment types underway.

FIGURE 14 AVERAGE INVESTMENT STRUCTURE IN 2021



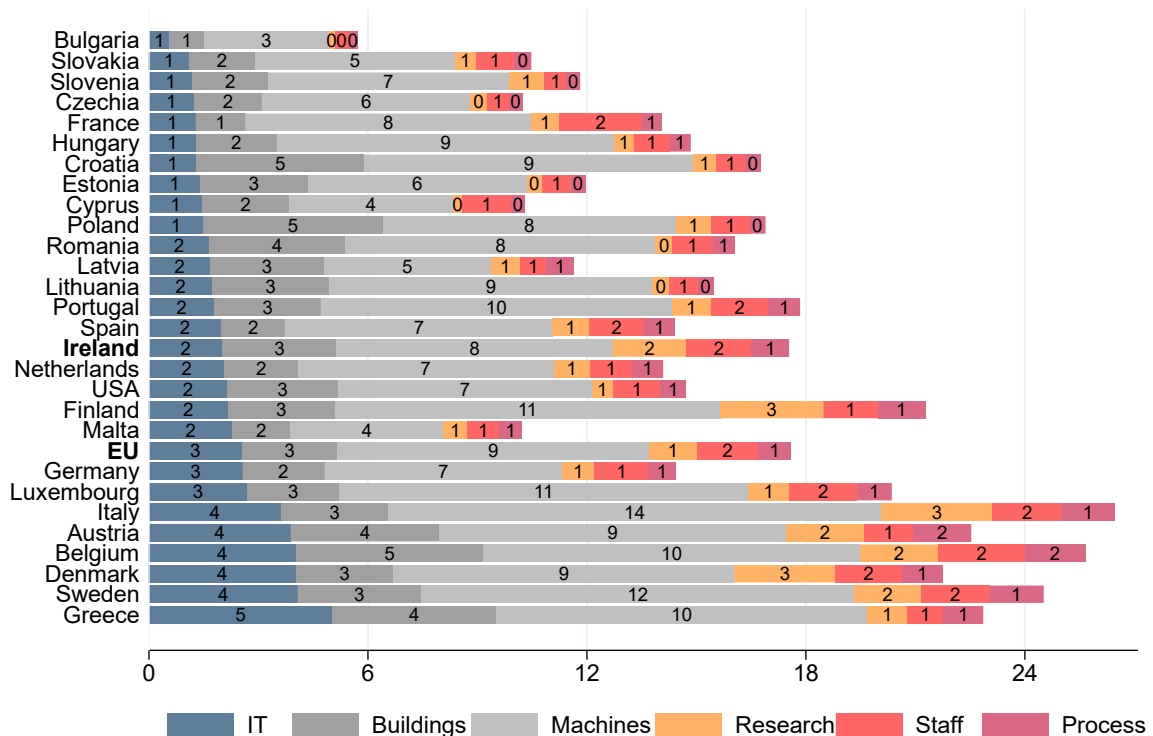
Source: EIBIS Data.

Notes: Share of investments by type in 2021. All sectors and all size categories total.

To this point, we have considered the share of total expenditure by firms on digital activities as our investment metric. However, this is likely to mask considerable differences in the levels of expenditure across countries and over time. The published EIBIS data do not contain a clean measure of the expenditure on investment in euro level terms. Rather they provide a figure on a per employee basis. While this is somewhat problematic for understanding investment differences, as it scales the increase in capital inputs into production by the variable labour input, it does give some insight into the level of capital commitments by enterprises. In an attempt to shed some light on the differences in levels terms, we present data on the expenditure as €1,000 per employee. Figure 15 presents the expenditure across countries in 2021. The highest was in Italy at just under €27,000 per employee. Austria and Sweden also had levels above €24,000 per employee. The lowest was in Bulgaria, Slovakia, Malta and Cyprus.

In terms of the level of expenditure on digitalisation, the average across the EU was €3,000 per employee in 2021, this compares to €2,000 per employee in Ireland. This is notably lower than some of the countries that could be seen as comparable in terms of size, economic structure and trade openness (like Belgium, Austria, Denmark) where the spend is double the Irish rate.

FIGURE 15 AVERAGE INVESTMENTS BY TYPE IN 2021 (IN €1,000 PER EMPLOYEE)



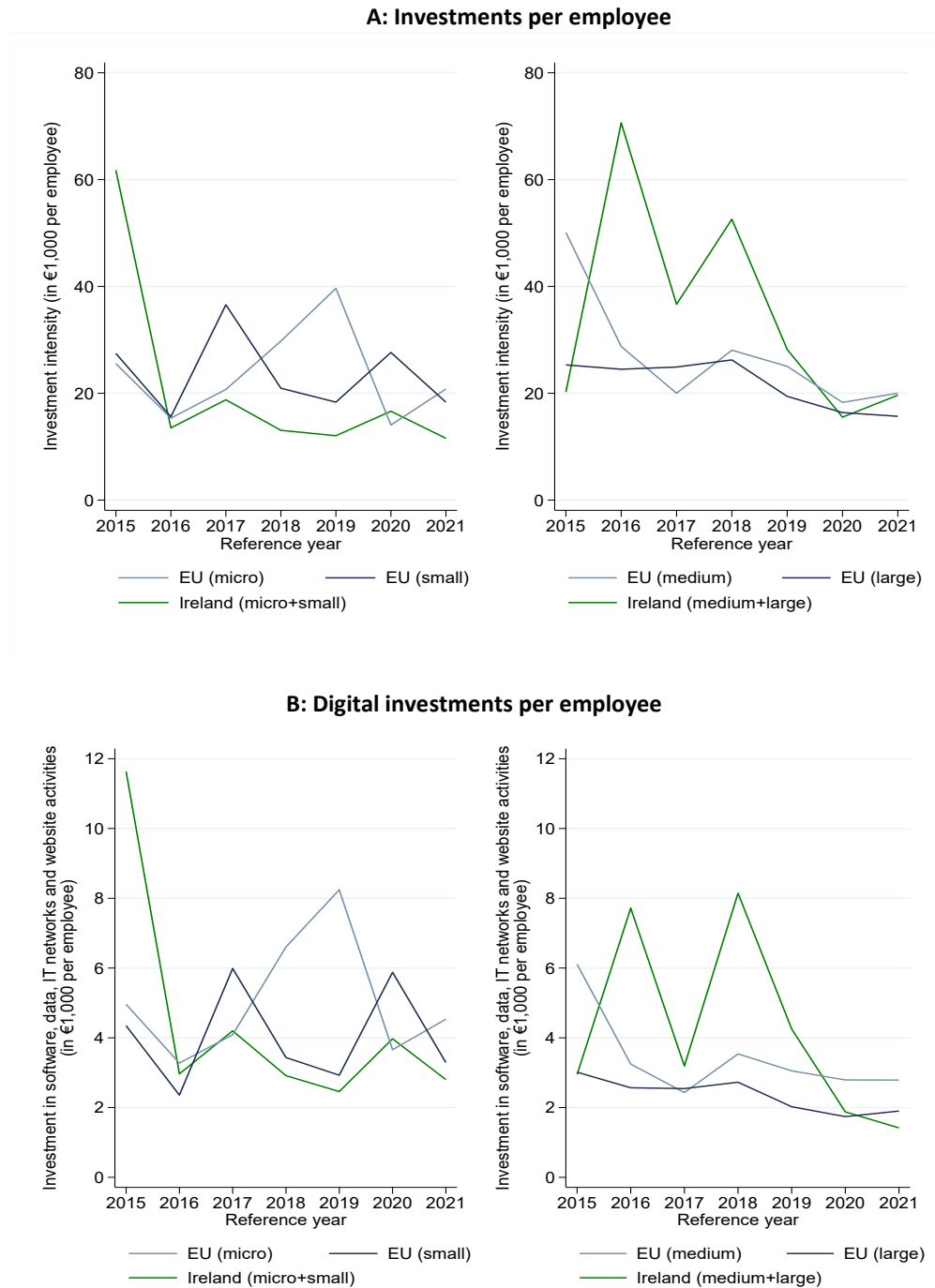
Source: EIBIS Data

Notes: Calculation from the investments by types shares and average investment per employee. All sectors and all size categories total.

There are often differences in investment levels across firm size as investment obstacles can differ dramatically. For example, credit access challenges, regulatory burdens, labour shortages, input cost exposures etc. are all areas where firm size could have a notable effect on the degree to which these constraints are binding on firms. To explore this in more detail, we consider the expenditure by firm size in Figure 16. The first two charts (panels on row A) present expenditure in total. The same firm size groups are presented for these data as used in the explanation for the share of digital expenditure. In general, expenditure per employee has been lower for small and medium-sized firms in Ireland than in other countries over the period 2016 to 2020. The level also displayed relative stability over this period at just under €20,000 per employee. For large and medium sized firms, the level of investment expenditure per employee was notably larger than for other countries before 2019. It has dropped to a position similar to other countries in 2021. The picture is similar for digital expenditure, albeit at a much lower level in euro terms.

It is noteworthy that the level of expenditure does not appear to have experienced the very notable drop between 2020 and 2021 which was observed in the share of investment, which suggests that firms continued to commit to digital capital but increased expenditure on other items as well, lowering the share.

FIGURE 16 INVESTMENTS IN DIGITALISATION – BY SIZE CATEGORY



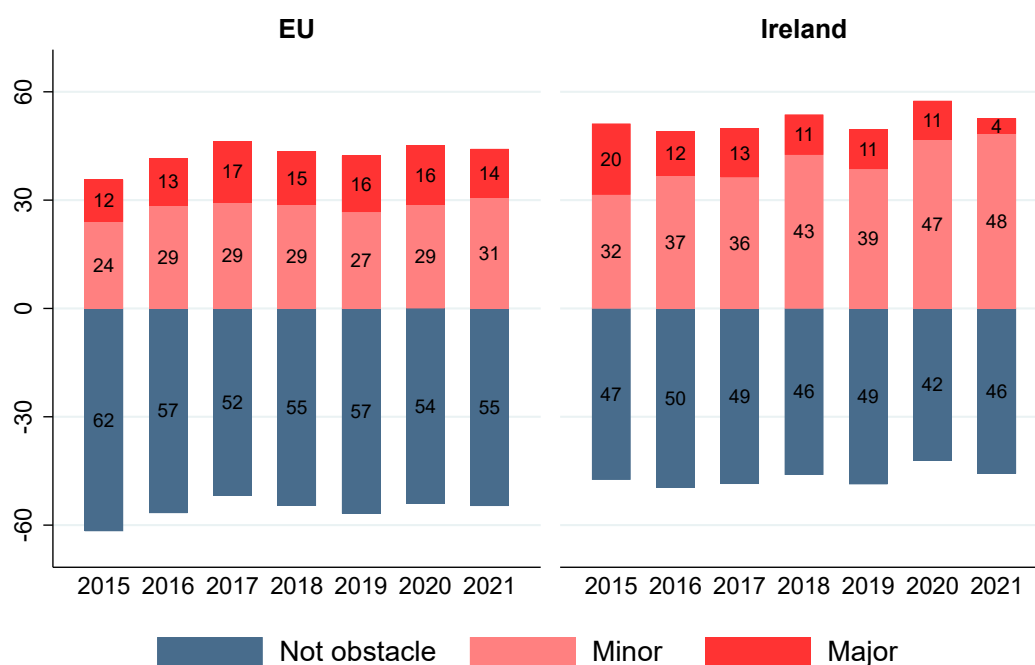
Source: EIBIS Data.
Notes: Investments in software, data, IT networks and website activities. All sectors total.

3.4 Obstacles impacting long-term investments decisions

To this point we have considered investment trends in assets specifically related to digital activities. However, it is highly likely that digital expenditure or the digital infrastructure can be complementary activities to other investments. Furthermore, the trends across time and countries in digital investment are also likely to be impacted by complementary infrastructure enablers such as the digital and telecommunications network, which make digital investment possible and can act as a catalyst to crowd in firm-level capital.

In this section, rather than consider the expenditure levels in isolation, we focus on some of the reported barriers to long-term investment by enterprises in the EIBIS survey. While these barriers are asked in relation to overall investment, it is likely they have some relationship with the expenditure on digital activities as well. We first present data on digital infrastructure as an obstacle to investment for the EU and Ireland. Three categories are presented: not an obstacle, minor obstacle and major obstacle. More Irish firms are reporting the digital infrastructure as an obstacle to long-term investment than their EU counterparts, however the share of firms reporting it as a major obstacle is lower than in the EU.

FIGURE 17 DIGITAL INFRASTRUCTURE AS AN OBSTACLE – EU AND IRELAND OVER TIME

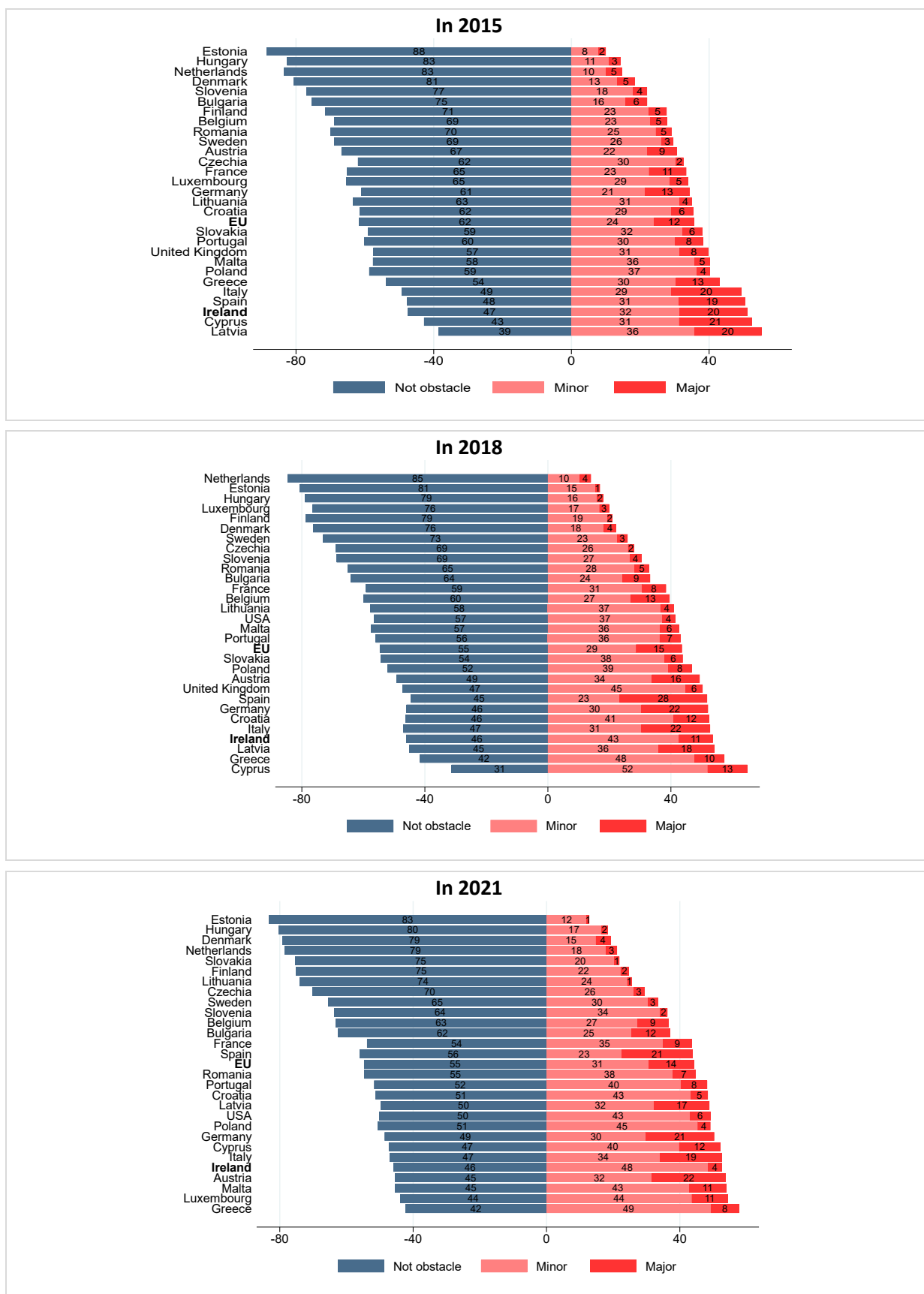


Source: EIBIS Data.
Notes: Access to digital infrastructure as a factor impacting long-term investments decisions. All sectors and all size categories total.

The data on a country-by-country basis are presented in Figure 18 for 2015, 2018, and 2021. A clear trend emerges for Ireland which has some of the highest

reported data for whether the current digital infrastructure in the country presents an obstacle to long-term investment. Ireland is the fifth highest in 2021, down from the fourth and third highest in 2018 and 2015 respectively. The countries with the lowest reported level of digital infrastructure challenges are Estonia, Denmark, Netherlands and Hungary. We also consider the differences across sectors (presented in Figure A.2 in the Appendix) and the general pattern documented above persists across sectors, albeit with a lower-level digital infrastructure reported as an obstacle in the service sector.

FIGURE 18 DIGITAL INFRASTRUCTURE AS AN OBSTACLE – CROSS-COUNTRY

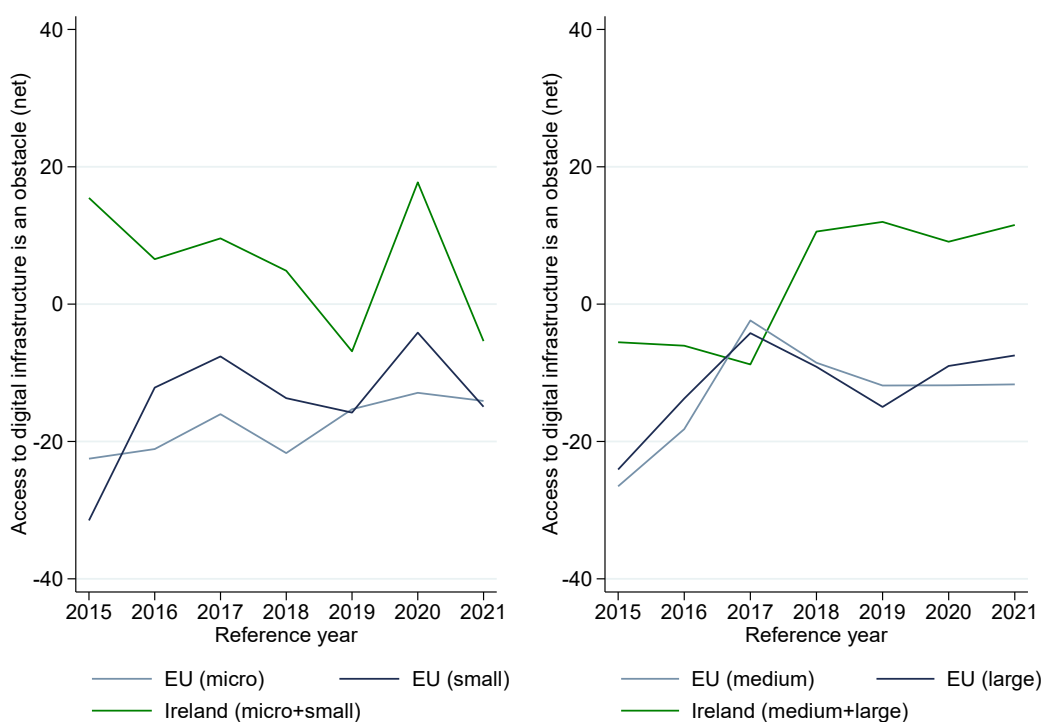


Source: EIBIS Data.

Notes: Access to digital infrastructure as a factor impacting long-term investments decisions. All sectors and all size categories total.

Figure 19 presents the firm's responses to the issue of digital infrastructure as an obstacle by size category. Again given data confidentiality reasons, small and micro and large and medium are grouped together for the Irish data. For small and micro firms, there is a higher reporting of this challenge relative to firms in the EU as a whole. For medium and large firms, since 2017 they have been systematically reporting the digital infrastructure as an obstacle to long-term investment in greater proportions, as compared to the rest of the EU. Indeed, there is a very large differential between Irish and non-Irish responses at the aggregated level.

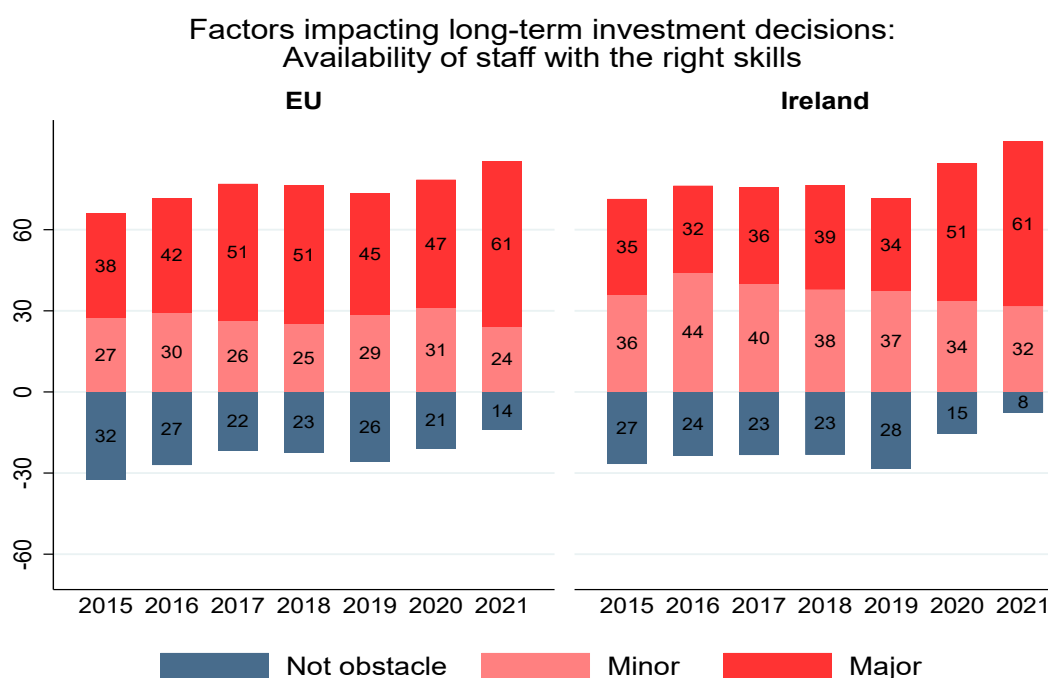
FIGURE 19 DIGITAL INFRASTRUCTURE AS AN OBSTACLE – BY SIZE CATEGORY



Source: EIBIS Data.

Firms naturally make investment choices in combination with their decisions around other factors of production such as labour inputs. Indeed, deploying capital within a firm requires a sufficiently trained workforce to have the skills to use that capital productivity. Figure 20 presents the share of firms reporting that skilled staff is an obstacle to their investment.

FIGURE 20 AVAILABILITY OF SKILLED STAFF AS AN OBSTACLE – EU AND IRELAND OVER TIME

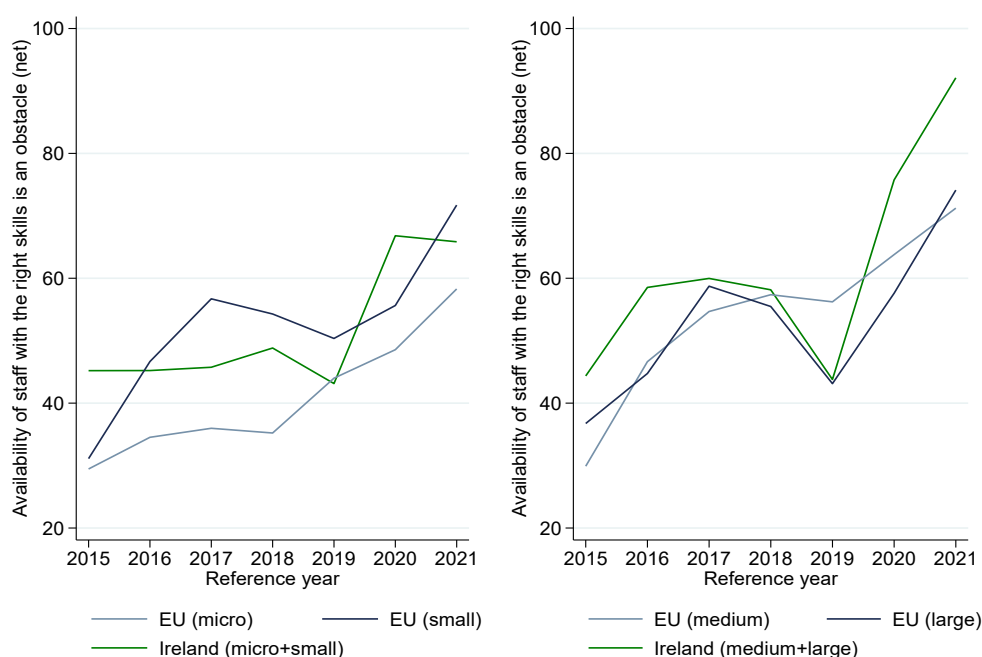


Source: EIBIS Data.

Notes: Availability of staff with the right skills as a factor impacting long-term investments decisions. All sectors and all size categories total.

We see skilled staff as a key enabler for digital investments and therefore it is likely to be a related factor in firms' investment decisions. It is clear that many firms are reporting skilled labour as an obstacle to investment in both Ireland and the other European countries. Over 61 per cent of firms report it as a major obstacle in both areas. This has increased since the onset of the pandemic and in particular has become more acute in 2021. In Ireland, firms in the construction sector and the manufacturing sector have reported the highest levels of obstacles, and these are above the other countries. Figure 21 presents the data by firm size. While there is an upward trend in staffing as an obstacle, this has become much more acute for large and medium sized Irish firms who report levels well above the EU average. For small and micro firms the trend is similar, but the level is somewhat lower. However, it must be noted that Ireland's labour market in general is considerably tighter in terms of staff availability than other European countries. This is likely to increase the reported levels of staffing as an obstacle relative to other countries across the board in Ireland.

FIGURE 21 STAFFING AS AN OBSTACLE – BY SIZE CATEGORY



Source: EIBIS Data.

3.5 What drives digitalisation investment? Association or causation

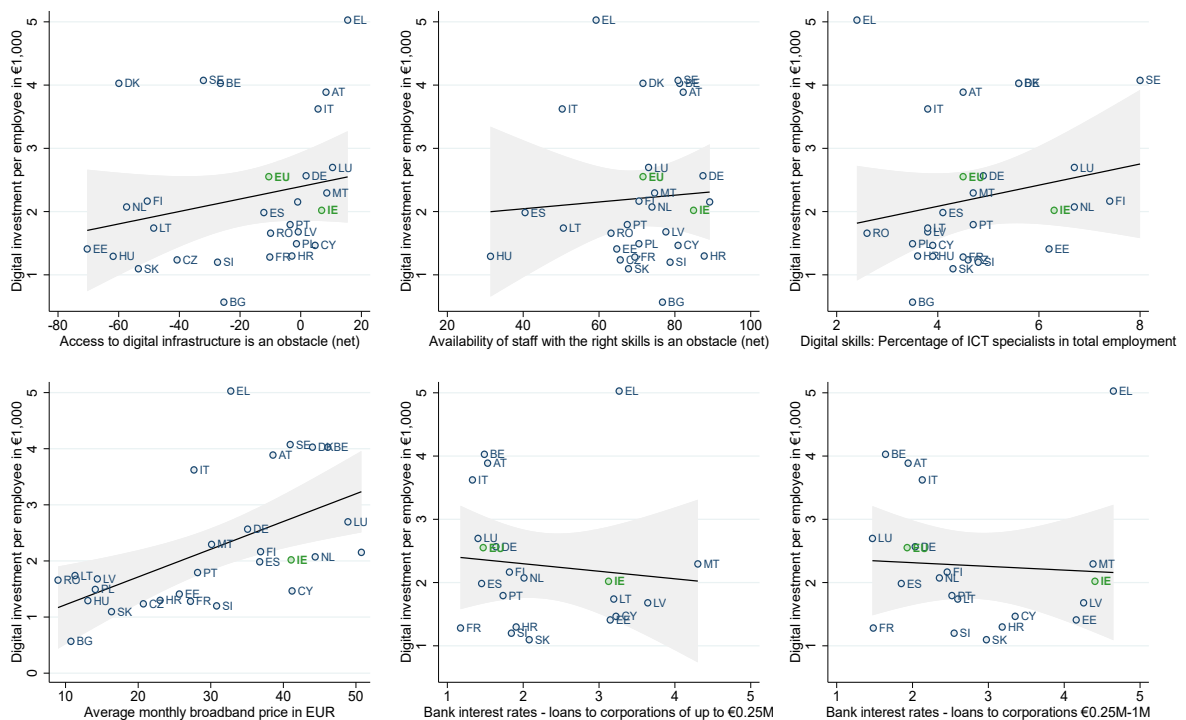
To this point, we have mainly focused on the trends in digital activity and provided some potential factors such as the digital infrastructure and staffing that may impact the level of investment. We have not provided any detailed correlation or review of the association between these variables. Indeed, the existing literature presents a range of factors that are likely to determine investment in any asset class. These include the cost of finance and the investment hurdle rate, access to sufficient volumes of external and internal financing, the degree of uncertainty in the economic and sector-specific outlook, the costs of trade activities, labour cost and availability, regulatory challenges, taxation and many others. For digitalisation investment, the quality and cost of telecommunications and the labour skills issue are likely to be important.

While it is outside the scope of this Note to consider the causal determinants of investment in digitalisation, we present some tentative correlations between some of the aforementioned variables. In addition to staffing activities and infrastructure obstacles as reported by the EIBIS survey, we complement the analysis with information from interest rates on corporate loans from the ECB, and information on broadband prices from Eurostat. We also draw on the Eurostat data on the percentage of ICT specialists in total employment to attempt to gain more information on the absorptive capacity of the labour market in different economies to adapt to digital changes.

Scatterplots of these variables against the level of investment in digitalisation per employee are presented in Figure 22. We would expect that the obstacle variables would have a negative relationship with investment, i.e. the higher the obstacle, the lower the investment. However we do not find this relationship, instead finding a weakly positive, or no, correlation. We do find a positive correlation with digital skills as measured by the percentage of specialists in total employment and a negative correlation with firm-level interest rates. These correlations suggest that more skilled digital staff and lower costs of finance can boost investment in digitalisation.

It must be noted that these correlations are purely exploratory and the low level of variation across countries and over time (only surveyed since 2015 for EU countries only) would likely prove problematic in any econometric analysis due to small sample sizes.

FIGURE 22 SCATTER PLOTS – DIGITAL INVESTMENTS PER EMPLOYEE IN 2021



Source: EIBIS Data, Eurostat, ECB.

The aim of this section is to introduce into the discussion some of the strategic enablers that are often cited as key constraints on the degree of digitalisation. These include the quality and scope of the broadband infrastructure, the quality of

the labour force in terms of digital skills and other such economy-wide factors. While we have only provided simple correlations of these factors with digital investments, understanding the extent to which they act to influence firm investment in digital assets is critical to better designing and calibrating the policy response. In this regard, future research should be conducted to econometrically determine the factors that influence digital investments using matched firm and cross-country data. This would greatly enhance our understanding of the link between digital investment and the policy response.

4. SUMMARY OF KEY FINDINGS AND CONCLUDING REMARKS

A number of findings emerge from this research. First, in terms of digital commerce, Ireland performs relatively well, with approximately 30 per cent of sales from e-commerce activities as compared to below 20 per cent in the EU and EA. Considerable differences exist by sector with manufacturing and services sectors posting notably higher shares relative to the construction sector. For the construction sector, levels of e-commerce sales are considerably lower. Relatively little of this activity is supported through firms' own websites or apps, so this is a potential pathway for firms to further their digital offering. Across all size classes Irish firms perform better than their European peers. There are however clear differences between firms across the size classes, with small firms having considerably less digital sales than both medium and large sized firms.

Second, in terms of the use of digital technologies, we consider two groups of technologies. The first (Group 1) captures information on chatbot or virtual agent usage, big data analytics and machine learning, natural language processing, and service robots. For these technologies, Ireland performs well in a cross-country context. Approximately one-in-five Irish firms report using these technologies, above the EU27 average of 6 per cent of firms. Comparing across sectors, manufacturing is notably higher than construction for Ireland (19.2 per cent as compared to 12.5 per cent) but both sectors are well above their peers in a pan-European context.

For the second group of AI technologies (text mining, speech recognition, natural language processing, machine learning for data analysis, robotic automation of vehicles etc. and robotic automation software), the overall average usage for Irish enterprises is just under 8 per cent of enterprises. However, this is the same for the other EU countries. For manufacturing, the level of usage of these technologies is somewhat larger at 8.5 per cent and is higher than that for other countries. The usage for construction in Ireland is virtually zero and is considerably lower than the other European countries at just under 5 per cent. There is therefore a considerable digital dividend which is likely to be able to be leveraged for the Irish

construction sector if it can even catch up with the average or better performing countries.

In terms of investment in digitalisation, Ireland has a higher rate (proportionally) than for other countries for all years except 2021. Irish firms were on average committing approximately 18-20 per cent of their capital expenditure on digital and IT activities over the period 2018 to 2020. This compares to a total of 13-15 per cent for other European countries. The drop in 2021 (down to approximately 12 per cent) is notable. For Ireland, the share of investment has been highest in the services and other sectors. 'Services' in Ireland is likely to include the very highly productive ICT sector which is dominated by global firms. It is therefore unsurprising that the services sector has such a high share of investments in digital activity.

In a comparative context, up until 2020 Ireland's investment share in digital activities was greater than the average for the EU and it was particularly strong in the other sectoral categories. However, the share of digital expenditure in total investment fell between 2020 and 2021 in all sectors in Ireland, but the drop was most pronounced in manufacturing and services areas. For these sectors, the expenditure as a proportion was actually lower in Ireland than for the basket of other countries in 2021, which is a concerning reversal. The proportion of overall investment in digitalisation is higher for small relative to larger firms for all countries which is notable. For medium and large firms, the share of digitalisation expenditure has trended downward quite sharply between 2019 and 2021 and is now lower than the level for other European countries.

While the share declined in 2021, it may not have fallen in level terms (rather other activities increased). Considering the level of investment, we find the average investment per employee across the EU was €3,000 in 2021, compared to €2,000 per employee in Ireland. The highest was in Italy at just under €27,000 per employee. Austria and Sweden also had levels above €24,000 per employee. The lowest was in Bulgaria, Slovakia, Malta and Cyprus. Investment per employee is notably lower than some of the countries that could be seen as comparable in terms of size, economic structure and trade openness (like Belgium, Austria, Denmark), where the spend is double the Irish rate. Considering differences across size classes and firm types, in general, expenditure per employee has been lower for small and medium-sized firms in Ireland than in other countries over the period 2016 to 2020. For large and medium sized firms, the level of investment expenditure per employee was notably larger than for other countries before 2019. It has dropped to a position similar to other countries in 2021.

A final element in the research was to consider selected obstacles to long-term investment that might be correlated with digital activities. We consider the broader digital infrastructure which is reported as an obstacle to long-term investment by more Irish firms than their EU counterparts, and this holds across the size distribution. Secondly, there is also an upward trend in terms of finding sufficiently skilled staff being reported as an obstacle both in Ireland and in the EU. However, neither of these aspects has a strong correlation with the investment per employee in digitalisation. We do find a positive correlation with digital skills as measured by the percentage of specialists in total employment and a negative correlation with firm-level interest rates. These correlations suggest that more skilled digital staff and lower costs of finance can boost investment in digitalisation.

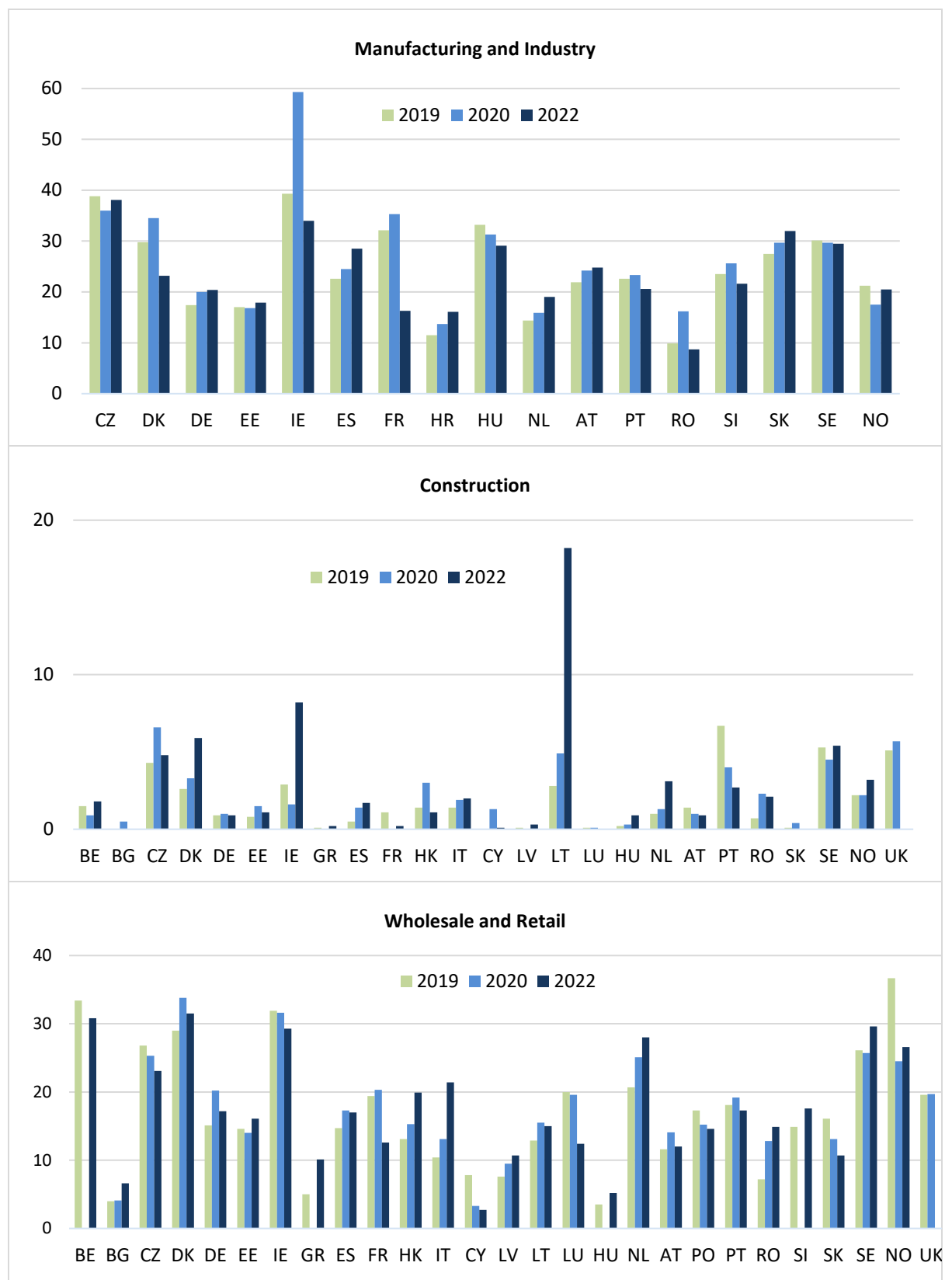
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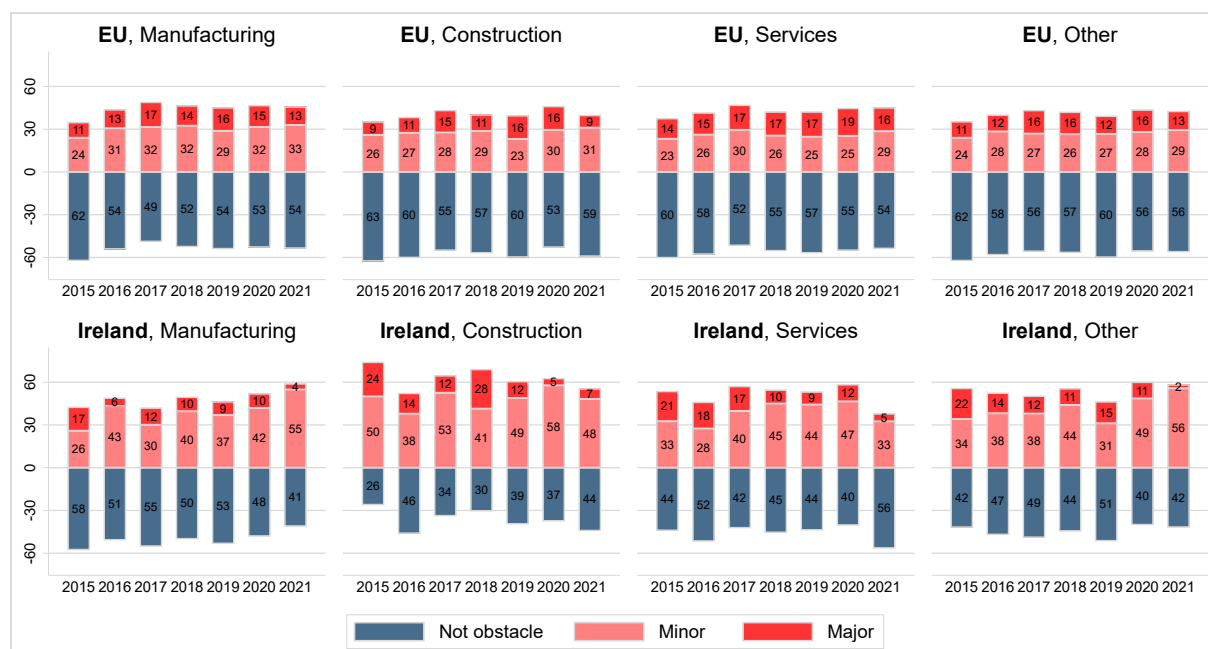
APPENDIX A – ADDITIONAL DATA

FIGURE A.1 CROSS-COUNTRY COMPARISONS OF E-COMMERCE SALES – SECTORAL BREAKDOWN (% OF SALES)



Source: Eurostat, Survey of ICT Usage.

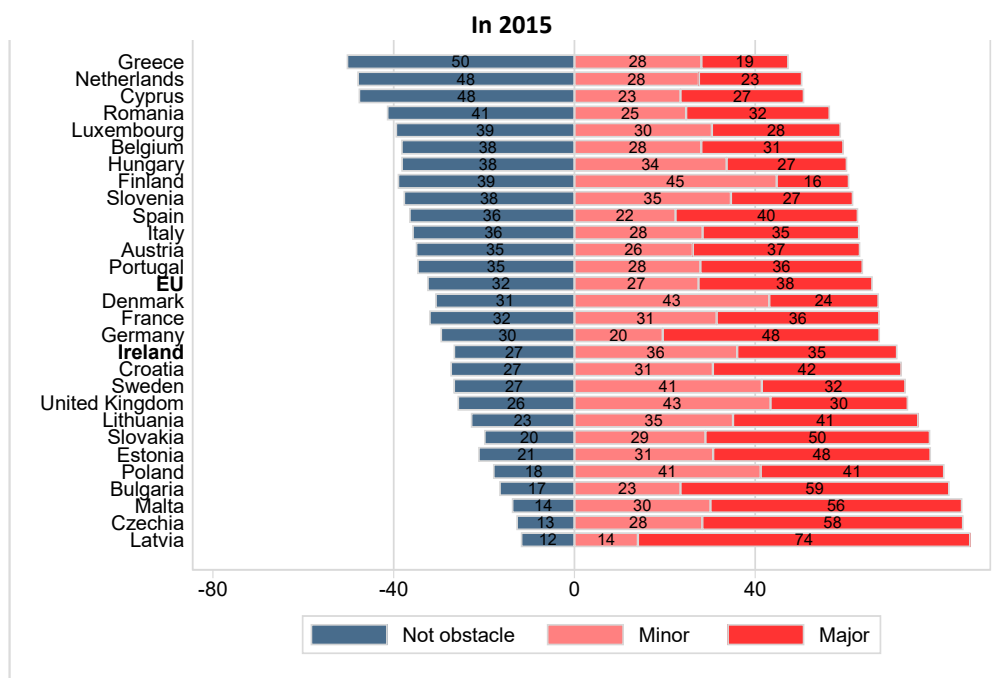
FIGURE A.2 DIGITAL INFRASTRUCTURE AS AN OBSTACLE – BY SECTOR



Source: EIBIS Data

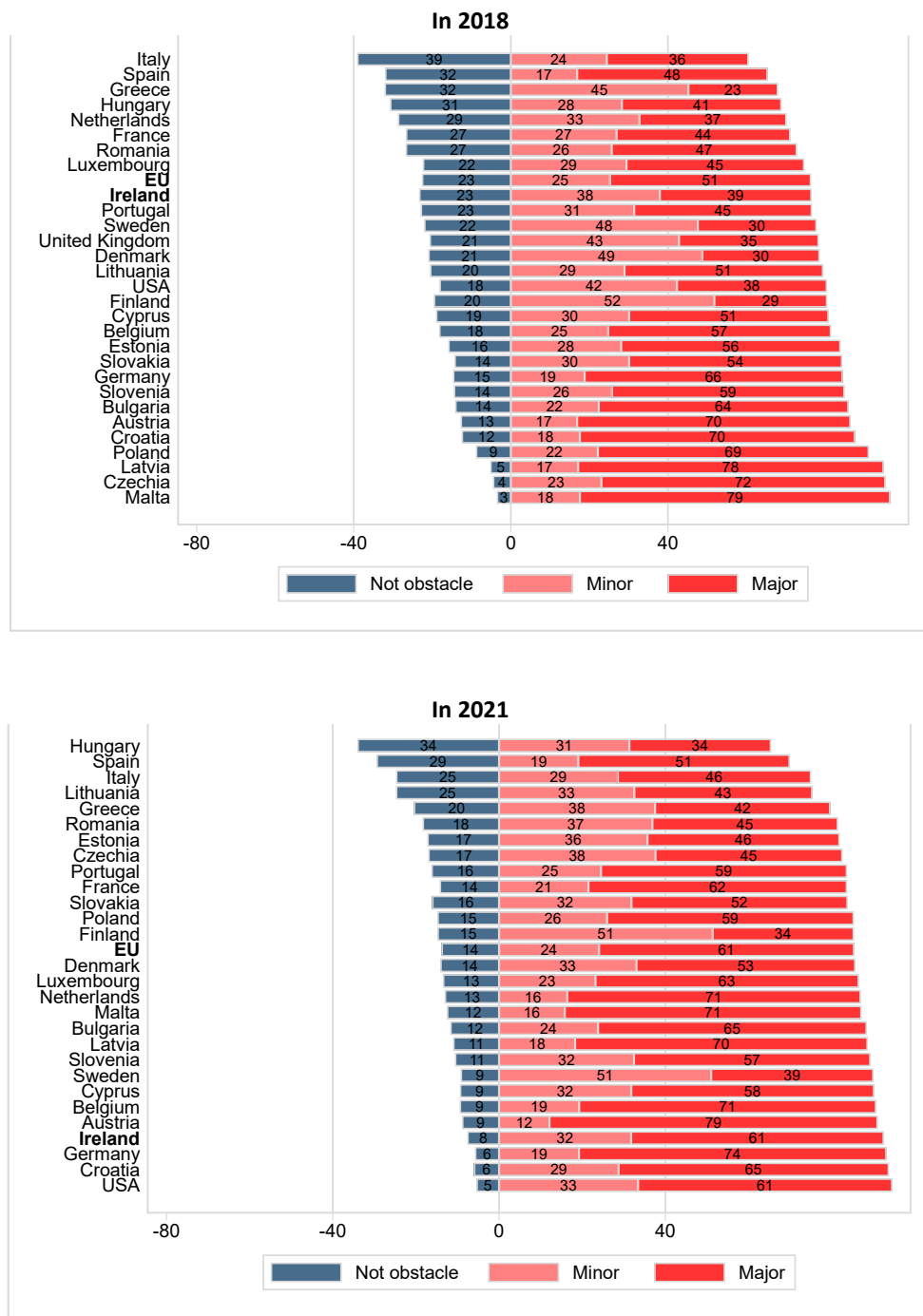
Notes: Access to digital infrastructure as a factor impacting long-term investments decisions. All size categories total.

FIGURE A.3 AVAILABILITY OF SKILLED STAFF AS AN OBSTACLE – CROSS-COUNTRY



Contd.

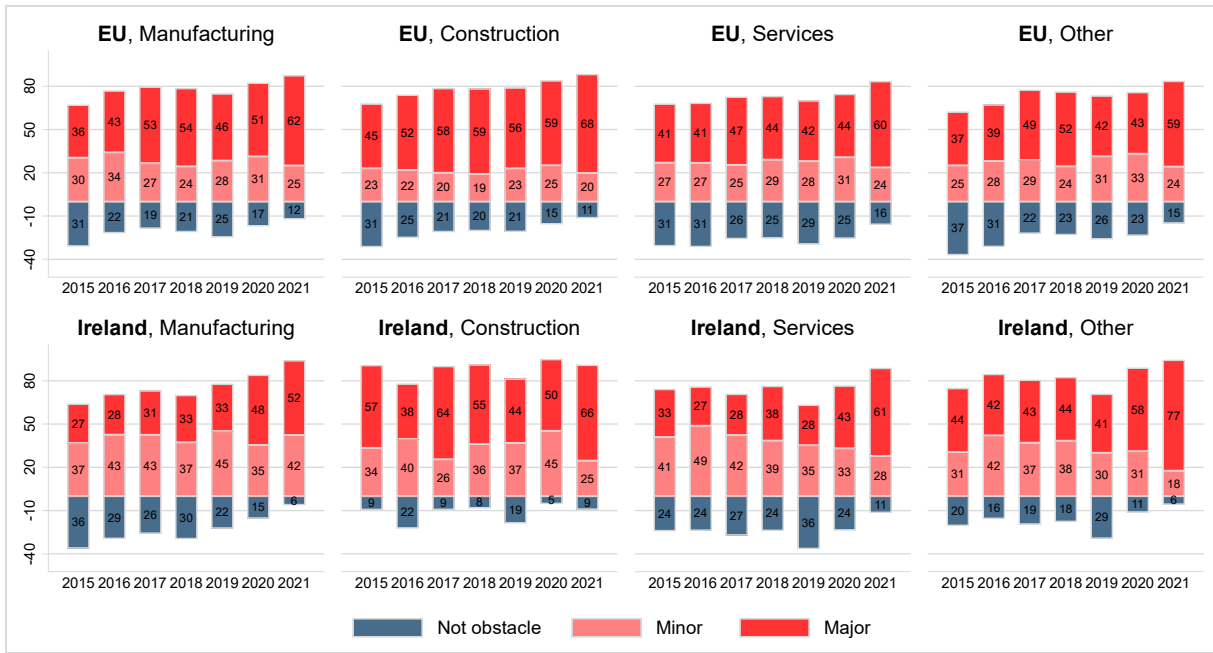
FIGURE A.3 CONTD.



Source: EIBIS Data.

Notes: Availability of staff with the right skills as a factor impacting long-term investments decisions. All size categories total.

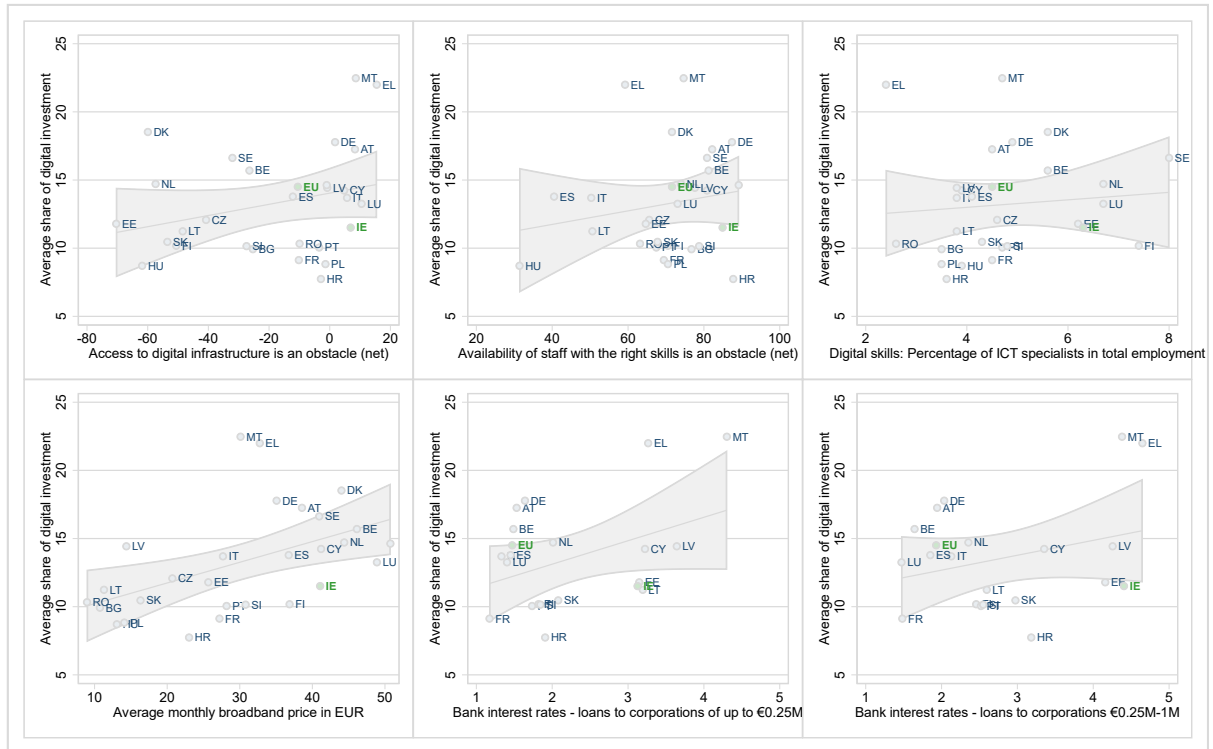
FIGURE A.4 AVAILABILITY OF SKILLED STAFF AS AN OBSTACLE – BY SECTOR



Source: EIBIS Data.

Notes: Availability of staff with the right skills as a factor impacting long-term investments decisions. All size categories total.

FIGURE A.5 SCATTER PLOTS- SHARE OF DIGITAL INVESTMENTS IN 2021



Source: EIBIS Data.