

Innovation Diffusion in the Northern and Western Region of Ireland

A Regional Approach



**Information Note:**

This report was prepared as part of an OECD project to develop a self-assessment toolkit for barriers to regional innovation diffusion that aims provide policy makers a tool to assess strengths and weaknesses of innovation diffusion channels in their regions. It is based on data analysis, surveys and workshops among stakeholders and further desk research. The report was prepared by OECD officials as a background document and should not be reported to reflect the views of OECD member countries or those of the European Union who co-finance the project.

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1 Introduction

1.1. The concept of innovation diffusion

Innovation is of crucial importance for countries and regions, to strengthen economic growth, improving a region's productivity levels, fostering competitiveness and find solutions to societal challenges. Innovation does not only take place by "creating" knowledge (for instance through research and development) but also by learning from others. Such learning processes enable the diffusion of innovation, and can help companies, regions or countries to catch-up to higher productivity levels. Innovation diffusion is of particular importance for small and medium-sized enterprises (SMEs) and start-ups and reflects the process through which these firms gather knowledge, information and innovations from outside the organisation and use them to introduce their own innovative products or processes. It refers for instance to the adoption of new-to-the-firm technologies, the introduction of new management techniques, the digitalisation of certain processes, or the introduction on the market of a new product.

1.2. What drives innovation diffusion?

Innovation diffusion is a complex phenomenon that relates to three key sets of factors:

- The local and national **framework conditions**, which affect firms' incentives and capacities to adopt innovations. Examples of framework conditions are the regulatory framework, market conditions, access to finance and skills, and infrastructure.
- The functioning of the **channels** through which the diffusion can take place. These channels include supply chains, workers careers and mobility, academic-business collaboration or knowledge intensive business services.
- The presence and functioning of a variety of **intermediary organizations** that help companies build the capacity for innovation adoption, identify external resources, and share knowledge among peers. Intermediaries include peer-network building intermediaries (e.g. employer associations, chambers of commerce, managed clusters, science & technology parks), partnership-building intermediaries (e.g. technology transfer offices, RTOs, investment promotion agencies), and capacity-building and funding agencies.

Understanding innovation diffusion in a region, and the potential to foster this, requires an assessment of the strengths and weaknesses in these three sets of factors (framework conditions, diffusion channels and intermediaries), and the possibilities for policies to strengthen this.

1.3 Purpose and overview of the report

The aim of this report is to apply the concept of innovation diffusion and provide insights into its enablers and barriers within the Northern and Western Region of Ireland, in particular with respect to SMEs and start-ups.

This report is divided into four different sections. After the introduction, Section 2 discusses the framework conditions that impact the creation and spread of knowledge in the Northern and Western Region of Ireland, followed by an overview of the main channels through which innovation diffusion takes place and the main intermediaries that support innovation diffusion in the Northern and Western Region. Section 3 brings together relevant suggestions for policy that have been brought forward by the project. Finally, further background on the analytical framework, methodologies and data used, as well as on the digitalisation of SMEs – a topic of specific interest during the pilot - can be found in Annex A and B.

1.4. Wider project context

The output is part of a wider European Commission-OECD project to develop an interactive policy self-assessment toolkit on innovation diffusion across regions and cities. The aim of this overall project is to help policy makers in the European Union and beyond to gain a view of the strengths and weaknesses of their regional innovation challenges and policy support that is provided.

The self-assessment toolkit will provide each region with a regional innovation profile (relative to other OECD and EU-27 regions), quantifying the strengths of different innovation diffusion channels in the region and allowing policy makers to engage local stakeholders to gather their views on the (regional) innovation system that the toolkit summarises and consider actions for improvement.

Regional innovation diffusion processes and obstacles in the Northern and Western Region of Ireland have been assessed as part of this exercise with the support of regional authorities, innovation partners, enterprise agencies, Higher Education Institutes (HEIs), and other stakeholders including SME's. Interactions with key regional stakeholders and the main findings of this report will serve as an important input into developing the proposed toolkit. It will also support the Northern and Western Region of Ireland to design future regional innovation policies based on an evidence-based assessment and stakeholder consultation.

1.5. Process and methodology

A number of consultation meetings, discussions and workshops between the OECD and relevant stakeholders from the Northern and Western Region of Ireland took place in the first half of 2021, underpinning this report. Contacted stakeholders include policy makers in the region, representatives of HEIs, cluster organisations, accelerators and incubators, entrepreneurs and business owners. The process included:

- Establishing of a **core stakeholder group** of innovation providers and experts and a further group of sectoral and local enterprise stakeholders to provide specific insights and advice through the consultation and research. In total there were over 30 stakeholders contacted and engaged in the process.
- The filling-in of a **background survey** by the regional counterparts and stakeholders, with information on the innovation ecosystem, intermediary organisations and existing policies, in combination with desk research by OECD staff.
- Three **virtual workshops** on innovation diffusion in the region, focused on i) the functioning of regional innovation diffusion in the region, ii) the impact and functioning of innovation diffusion channels, and iii) the digitalisation of SMEs. In total, over 30 stakeholders participated in the workshops; with these workshops moderated by the OECD. The workshops generated valuable insights on innovation diffusion through structured discussion and polls on aspects of innovation diffusion among participants.

- A detailed **questionnaire** was used to collect information on the framework conditions for innovation diffusion, the different actors and how they interact, the channels through which innovation diffusion takes place, and the relevant policy initiatives, from different levels of government in this area. More than twenty responses were received. Half of respondents indicated that they were from the public sector while the remaining respondents were from private sector, academic, and other types of institutions.

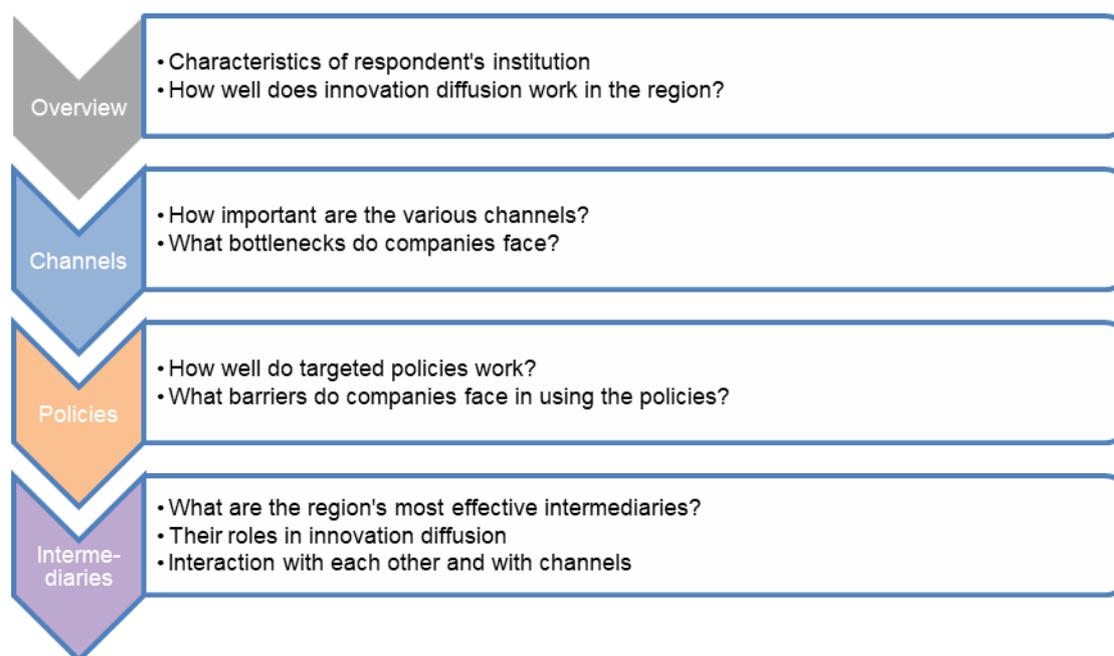
The information that was collected in this manner was processed and evaluated by analysts of the Centre for Entrepreneurship, SMEs, Regions and Cities (CFE) at the OECD. This report reflects their insights and opinions, complemented by desktop research and independent analysis.

Stakeholder questionnaire

A stakeholder questionnaire was developed and tested during the pilot study. The survey includes questions on the state of innovation diffusion in the region, the functioning of innovation diffusion channels, and views on intermediaries and policies in support of innovation diffusion (Figure 1.1).

Figure 1.1. Survey overview

Questionnaire about innovation diffusion sent to stakeholders in a region



Innovation diffusion indicators

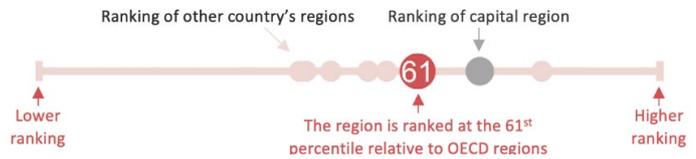
The report shows a variety of indicators related to innovation diffusion. Below is a guide to interpreting the regional-level and national-level graphs, which illustrate the position of the region relative to other OECD regions for each indicator.

The closer a region's designated dot is to the right of the line bar, the higher the recorded ranking is for the region in question. In contrast, the closer a region's designated dot is to the left of the line bar, the lower the recorded ranking is for the region in question. Regional visual definitions provided below.

- **Red** plain dot indicates the considered region
- **Light red** dots indicate the other regions of the country
- **Grey** dot indicates the capital region of the country

Regional indicators: one dot per region

The region is in position 3/8 (above the median) of all regions in the country; it is in the top 40% compared to the OECD.



In the case of Ireland, the Northern and Western Region is compared to the other NUTS 2 Regions of Ireland, namely the Eastern and Midland Region and the Southern Region.

National indicators: one dot only

The country is in the top 10% compared to the OECD. There is no data on the region's position within the country.

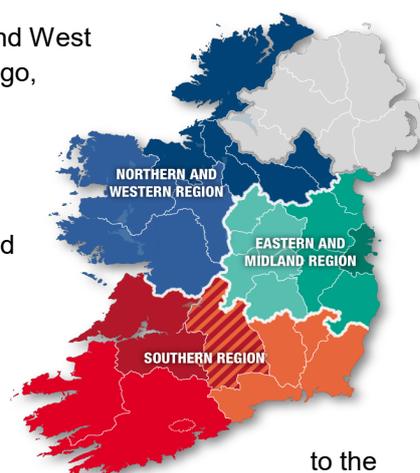


2 Assessing innovation diffusion in the Northern Western Region in Ireland

2.1 Background and setting

Economic structure

The Northern and Western Region of Ireland consists of the Border and West regions, covering 8 counties (Galway, Mayo, Roscommon, Leitrim, Sligo, Donegal, Monaghan and Cavan). In total the region's population is estimated to be 884,900 inhabitants as of 2021¹, with the region predominantly classified as a rural oriented region. GDP per capita in 2019 (PPS) stood at EUR 24,300, which is lower than that of other Irish regions (EUR 63,100 and EUR 74,900 in the Eastern and Midland Region and the Southern Region, respectively), and the EU average (EUR 31,200).²



The share of agriculture and manufacturing in the regional GDP is larger than that for Ireland as a whole or the EU average. According to the European Commission 2021 Regional Innovation Scoreboard, the Northern and Western Region is a moderate innovator, the only region on the island of Ireland to hold such a status³. Furthermore, the Northern and Western Region has changed from a “More Developed Region” to a “Transition Region” in the European Commission classification for cohesion policy post-2020⁴, while the European Parliament’s Committee on Regional Development has categorised the region as a “Lagging Region”, which is a region characterised by extremely low growth which is divergent from the rest of its country.⁵

¹ <https://data.cso.ie/table/PEA04>

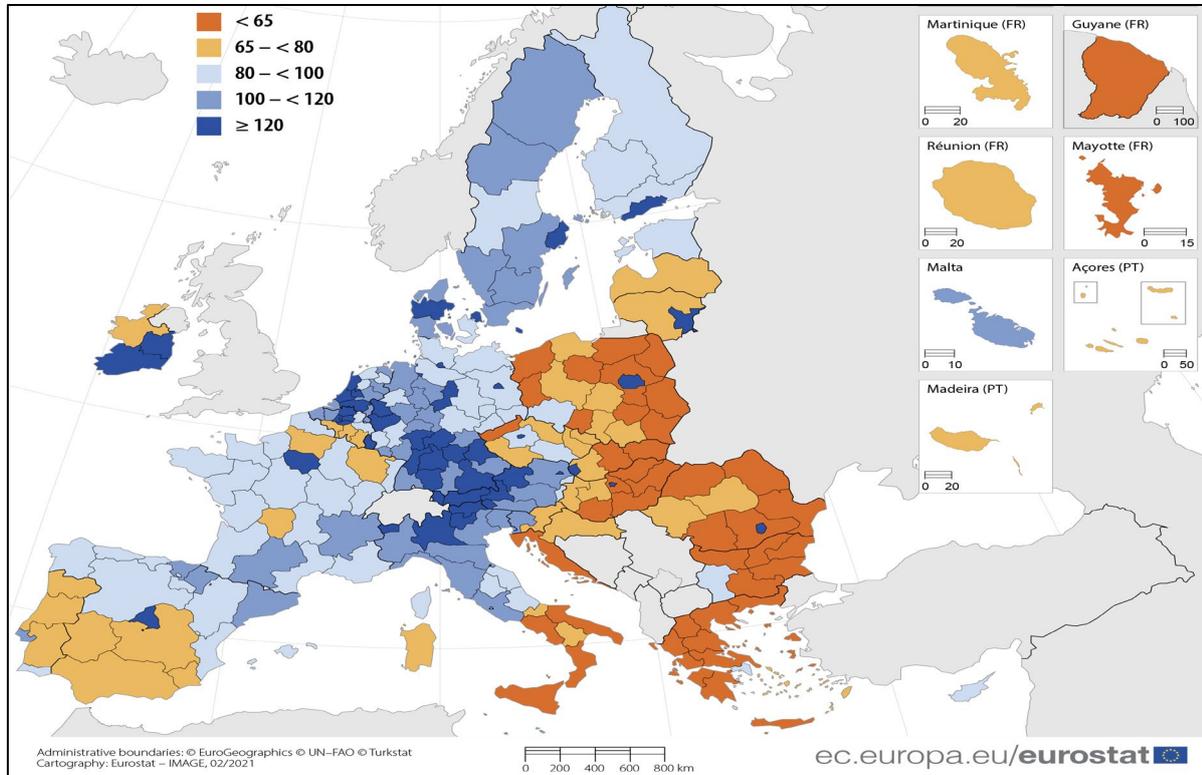
² <https://ec.europa.eu/eurostat/web/regions/data/database>.

³ https://ec.europa.eu/growth/industry/policy/innovation/regional_en

⁴ <https://www.gov.ie/en/press-release/17e02-minister-mcgrath-appoints-regional-assemblies-to-erdf-managing-authority-roles/>

⁵ [https://www.europarl.europa.eu/RegData/etudes/STUD/2020/652215/IPOL_STU\(2020\)652215_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/STUD/2020/652215/IPOL_STU(2020)652215_EN.pdf)

Figure 2.1. GDP per capita in EU Regions (% of EU 27 average) (PPS) 2019



Source Eurostat

As elsewhere in the OECD, the COVID-19 pandemic is causing further challenges, in particular for SMEs. The NWRA, the region's governing body and management authority, has the ambition to further boost regional development and to strengthen the region's performance by supporting the region to become more urban, smart, specialised, connected, green and focused on people and places.⁶

The region gives home to a diverse range of companies, including a number of multinational corporations (MNCs) in life sciences, software development, telecommunications, food, advanced manufacturing, engineering and the games industries, as well as services. A variety of Higher Education Institutes are based in the region, including the Institutes of Technology in Letterkenny, Sligo, Galway-Mayo Institute of Technology (GMIT) and the National University of Ireland, Galway (NUIG), as well as a number of research centres: including the Insight Centre for Data Analytics; the National Centre for Biomedical Engineering Science (NCBES); the Regenerative Medicine Institute; the Network of Excellence for Functional Biomaterials (NFB); the Centre for Chromosome Biology (CCB) and the Galway Medical Technologies Centre (GMedTech).⁷ The three institutes of technology in the region are currently in the process of a strategic amalgamation into the Connaught Ulster Alliance Technology University which will bring significant innovation and research capability and benefits through integration and investment.

It is worth noting that some research centres from outside the region play a significant role in the regional innovation system as well. For instance, Dundalk Institute of Technology, while not in the region, has

⁶ <https://www.nwra.ie/>

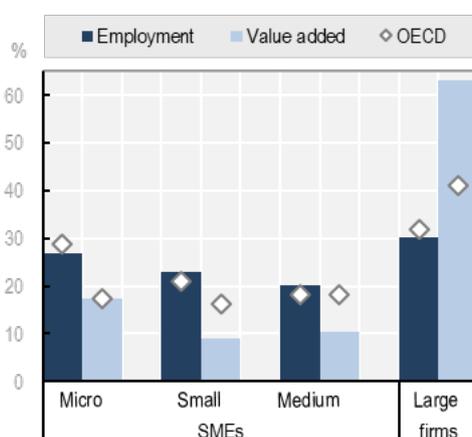
⁷ See Annex C for an overview of research centres in the region.

strong reach into the counties of Cavan and Monaghan. Similarly, Athlone Institute of Technology has a Technology Gateway which provides valuable innovation resources to SMEs and has a strong reach into Roscommon and Galway.

SMEs

Ireland has an active SME population with many more small firms than the average OECD region or EU average (OECD, 2021^[1]). Within the SME population, there is a large population of very low-productivity SMEs that co-exist with highly-productive large firms. The Irish SME sector contributes to 70% of employment but only 37% of value added (compared to OECD averages of 68% and 59%, respectively) (Figure 2.2). Put differently, large firms in Ireland account for a much larger share of output in Ireland than elsewhere in the OECD (OECD, 2021^[1]). As of 2018, the total number of SMEs based in the Northern and Western Region amounted to 45,245, with the number of people engaged in these enterprises totalling 172,813.⁸

Figure 2.2. Size of the SME sector in Ireland

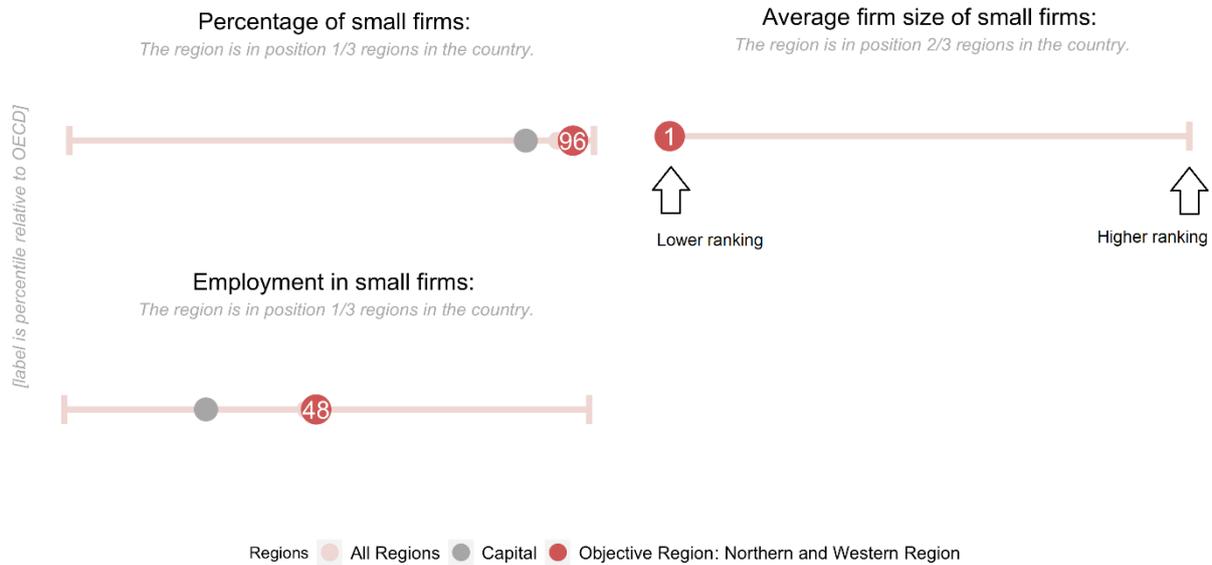


Source: (OECD, 2021^[1])

The average size of SMEs in Northern and Western Region of Ireland is very small compared to other places in the OECD but similar to the rest of Ireland (Figure 2.3).

⁸ <https://www.cso.ie/en/releasesandpublications/er/bd/businessdemography2018/>. People engaged includes employees, proprietors and family members.

Figure 2.3. The role of small firms (regional data)



Note: In this exercise, the Northern and Western Region is being compared to the other NUTS 2 Regions of Ireland, namely to the Eastern and Midland Region and to the Southern Region. The capital is in the Eastern and Midland Region.

Source: Small firm size and employment from OECD Regional Business Demography database

https://stats.oecd.org/Index.aspx?DataSetCode=REG_BUSI_DEMOG; Administrative regulations from OECD Product market regulation indicators <https://www.oecd.org/economy/reform/indicators-of-product-market-regulation>

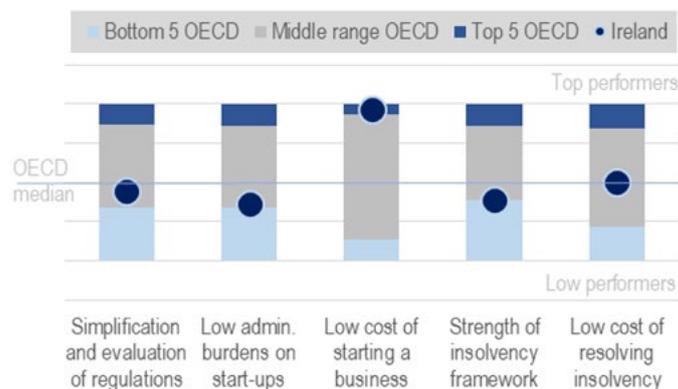
Irish SMEs are relatively innovative compared to their peers in other OECD countries. They display the third-highest share of new-to-market production innovation in OECD economies and their share of business R&D stood at almost 40% in 2015, above the OECD average of 35% (OECD, 2021^[1]). However, this innovation activity does not translate into high levels of SME productivity growth; for example, challenges remain in the adoption of technologies by SMEs. Based on the Regional Innovation Scoreboard, the Northern and Western Region performs quite strongly in terms of innovative SMEs collaborating, relative to both the Irish and EU averages (Figure 2.19).

Start-ups

Start-ups can embody innovation diffusion because innovative entrepreneurship often brings existing ideas to new places or industries. A higher rate of new business creation can therefore indicate higher innovation in a given region if it involves innovative start-ups.

The costs of starting a business are low in Ireland, but administrative procedures for start-ups and the insolvency regime could be improved. According to the 2020 OECD Economic Survey of Ireland, reducing barriers to firm entry will prompt productivity-enhancing technological adoption (OECD, 2020^[2]).

Figure 2.4. Entrepreneurship regulatory framework Ireland

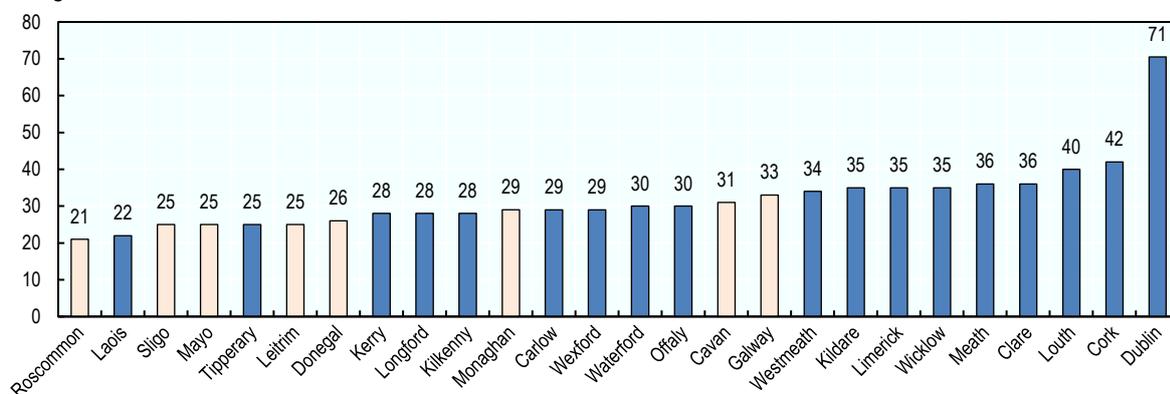


Source: (OECD, 2021^[1])

For Ireland as a whole, start-up rates are relatively low relative to the rest of the OECD; start-ups comprise 10% of Irish businesses compared to 25% across the OECD.⁹ At the same time, Ireland is successful in generating high growth enterprises (OECD, 2019^[3]). Figure 2.5 shows that new company formation rates – per 10 000 of the population – in the Northern and Western Region's counties (in orange) are fairly low relative to the rest of Ireland.

Figure 2.5. New company formation rates, by county

Average 2015-2017



Note: Rates are per 10 000 of the population.

Source: (OECD, 2021^[1]), CSO

Data from the Global Entrepreneurship Monitor show that indicators regarding early stage entrepreneurship in Ireland are positive, ranking 10th across the OECD and 4th within Europe.¹⁰

Productivity and wages

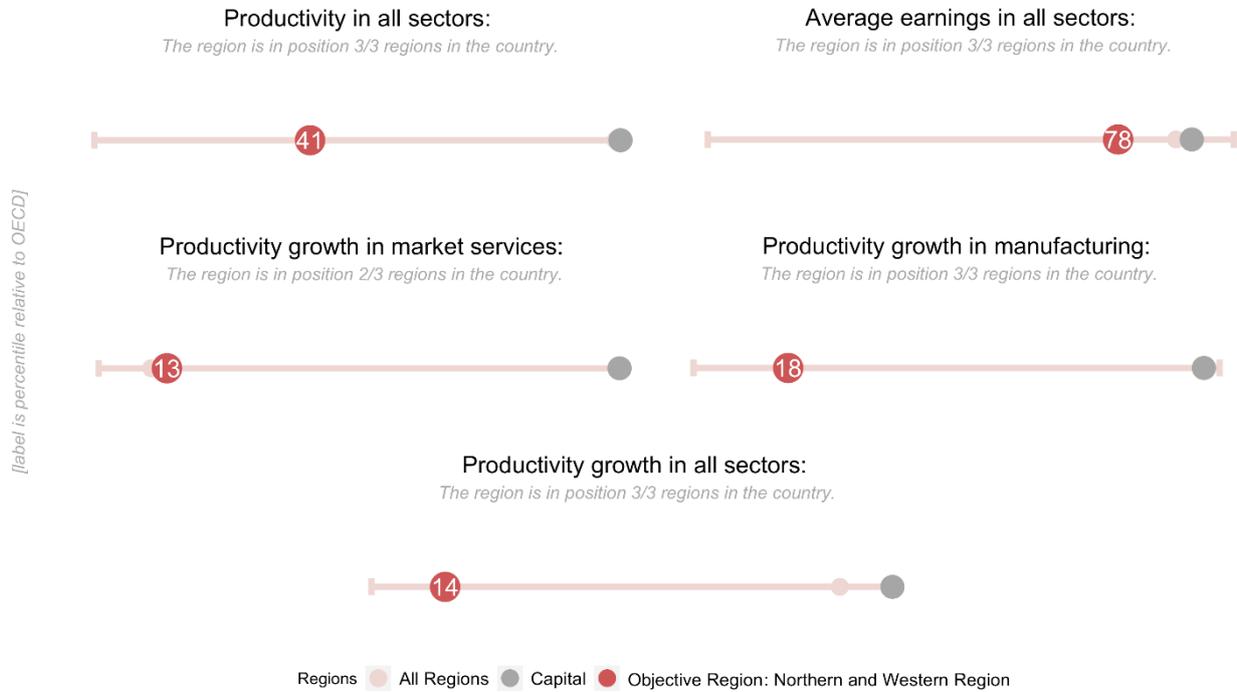
The Northern and Western region of Ireland has close to median productivity of OECD regions. However, despite the region's high educational attainment (Figure 2.17) and high wages, productivity in the non-

⁹ https://www.oecd-ilibrary.org/industry-and-services/enterprise-birth-and-death-rates_e0ec418d-en

¹⁰ <https://www.gemireland.com/wp-content/uploads/2020/06/GEM-2019.pdf>

financial services sector is in the bottom one third of OECD regions; productivity growth in the sector is especially sluggish relative to the rest of the OECD (Figure 2.6).

Figure 2.6. Productivity and wages

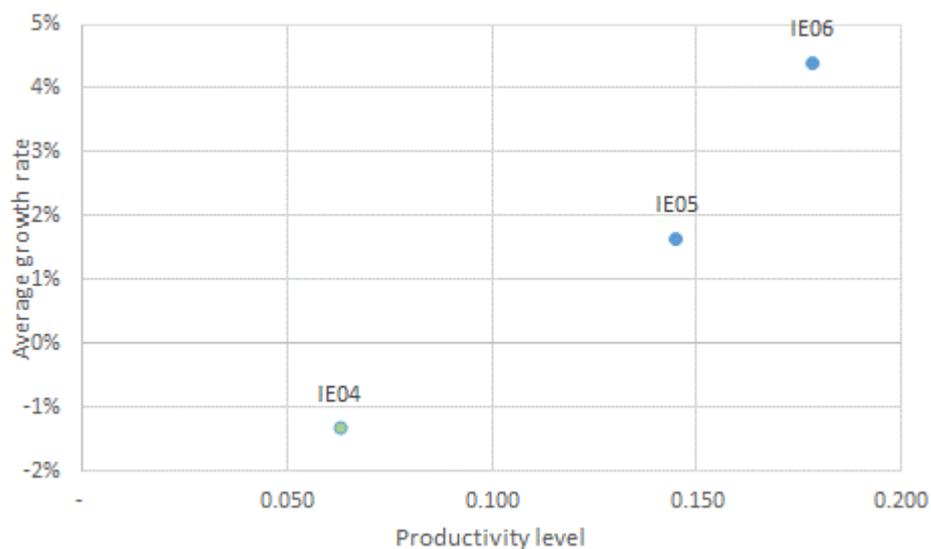


Note: Each dot represents one of Ireland's three NUTS 2 regions but some dots overlap with each other (i.e. in both the Eastern and Midland Region and the Southern Region of Ireland, productivity in all sectors and productivity growth in manufacturing are in the top 1-3% of OECD regions). Productivity and wage measures are for 2017 and exclude financial services. Growth is the annualised rate for 2007-2017.

Source: OECD calculations based on Regional Economy database https://stats.oecd.org/Index.aspx?DataSetCode=REGION_ECONOM

According to the 2019 OECD review of SME and entrepreneurship policies, SME productivity growth is stagnant in Ireland, despite SMEs being relatively innovative as stated before (OECD, 2019^[3]). With both lower productivity levels and growth in the Northern and Western Region compared to other Irish regions, the Northern and Western region of Ireland (region IE04) is currently not catching up (Figure 2.7), which is reflected in the new European Commission classification as a “Transition Region” instead of a “More Developed Region”.

Figure 2.7. Productivity growth versus productivity levels by region



Note: Productivity is adjusted for exchange rate and purchasing power parity differences across OECD regions (reported in real USD).

Source: OECD calculations based on Regional Economy database (2017) https://stats.oecd.org/Index.aspx?DataSetCode=REGION_ECONOM

2.2 The functioning of innovation diffusion

The initial block of questions in the OECD survey asks respondents about their general views on innovation diffusion. These questions capture the subjective experiences and perceptions of the region's stakeholders.

On average, respondents indicated that the Northern and Western Region of Ireland has good innovation diffusion performance relative to the rest of Ireland (score 5.2/10) and relative to the rest of the EU (score 4.8/10) Figure 2.8. The range of answers was larger for the Northern and Western Region's performance relative to the rest of the EU, with some respondents selecting relatively high scores. For SMEs, innovation diffusion was seen as middling (average score 5/10) in the Northern and Western Region, with some variation across respondents. Industries where (in particular large) companies excelled in adopting innovations that were developed elsewhere include e-Commerce, FinTech, food, ICT, MedTech, pharmaceuticals, retail, technology companies and some manufacturing. MedTech was cited as a particular strength. Galway City is a leading centre in the Medtech industry with eight of the top ten MedTech companies worldwide having a presence in Galway.¹¹

¹¹ Hart, Giblin, and Levie. "Joining the Dots: Business Clusters in Galway, Mayo and the UK". Enterprise Research, UK, December 2020. <https://www.readkong.com/page/joining-the-dots-business-clusters-in-galway-mayo-and-the-uk-3617422>

Figure 2.8. Stakeholder views on innovation diffusion in the Northern and Western Region of Ireland

Survey responses to the question, “How well does innovation diffusion work in your region...”



Source: OECD Stakeholder survey

During the workshops, opinions on the question if innovation diffusion works well in the region were equally divided between positive and negative views, with over one third taking a neutral position. Participants in particular were positive about local companies benefiting from innovation diffusion from universities (over 50%), more than from MNCs (40%), although in both cases a considerable minority (25%) was less positive. Participants saw a strong skill base as the most important asset of the region in innovation diffusion, followed by the quality of universities and of public and private support services. Various participants mentioned that large regional differences exist within the Northern and Western Region of Ireland with regard to innovation diffusion.

At various occasions during the workshops, it was noted that enterprises – particularly SMEs and start-ups – did not have the capability to benefit from innovation diffusion or any relevant supports in this regard.

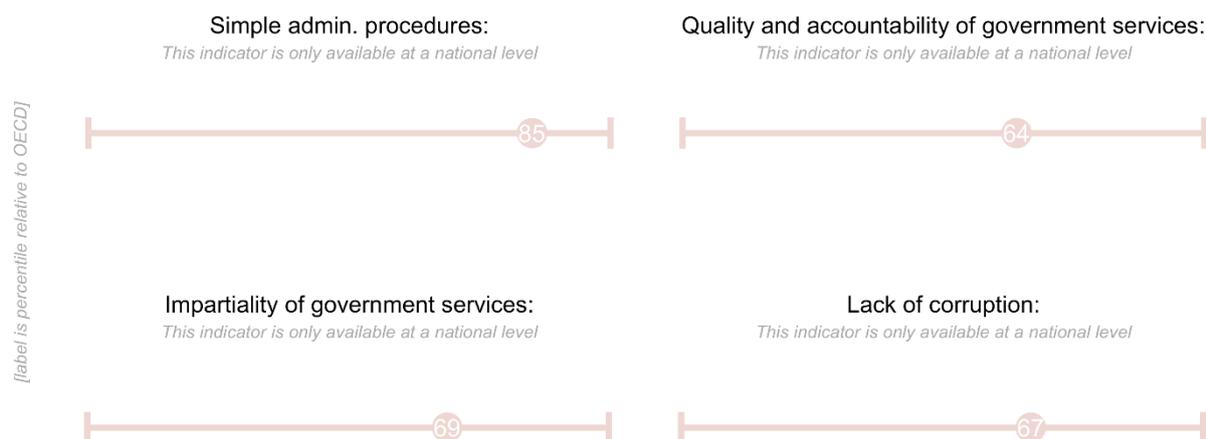
2.3 Framework conditions

Framework conditions in a region influence the pace and probability of innovations being widely disseminated and adopted by firms. Important framework conditions include the availability of finance for SMEs and start-ups, access to foreign and domestic markets, availability of skilled labour, digital infrastructure and entrepreneurial culture. The most pertinent of these issues will be discussed below.

Institutions and physical infrastructure

Ireland ranks in the top 40% regarding the **quality of government**, and has (as stated before in Section 2.1 on Start-ups) low administrative procedures. However, in the workshops it was mentioned that the Northern and Western region may lack a sufficiently favourable environment for private investment because of regulatory obstacles, for instance in Med Tech.

Figure 2.9. Institutions in Ireland (national data)



Source: Administrative regulations from OECD Product market regulation indicators <https://www.oecd.org/economy/reform/indicators-of-product-market-regulation/>; European Regional Competitiveness Index data (Quality of Government Index, University of Gothenburg) https://ec.europa.eu/regional_policy/en/information/maps/regional_competitiveness/

However, the Northern and Western Region of Ireland ranks in the bottom 10% regarding the length of motorway per capita, reflecting the challenges that its dispersed geography poses for **transport** connectivity (Adler et al., 2020^[4]). Workshop participants noted that the region's lack of infrastructure, like motorway connections, is a persistent barrier.

Stakeholders in the workshops also emphasised the spatial disadvantages of the region relative to other parts of Ireland and the EU in terms of the weak urban structure, lower levels of concentration in industry and weaker clustering effects. It was noted that more stimulus and networking initiatives will be important to catalyse and support regional innovation diffusion in the future to compensate for the lack of spatial concentration in the region.

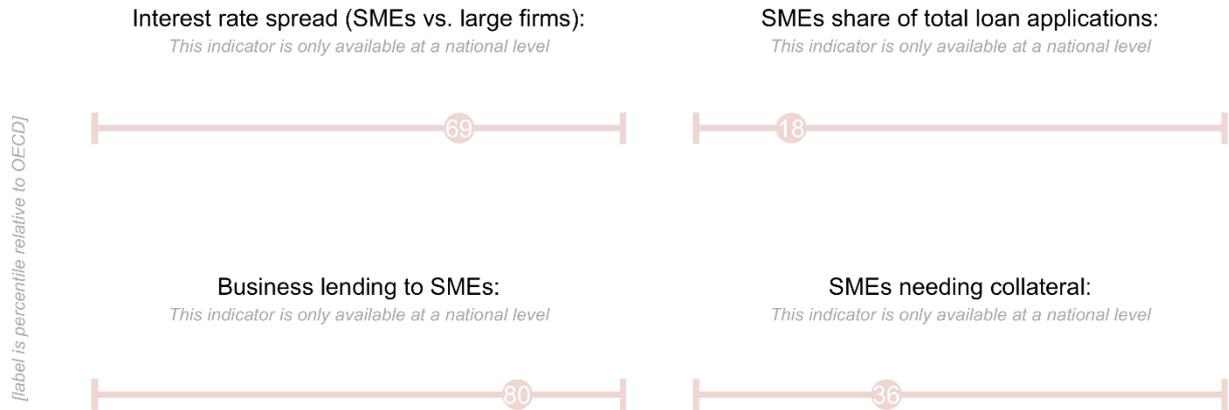
A number of stakeholders noted the need for graduated steps for SME's to engage with the innovation process as their organisational capacity will always be limited. It was suggested that the Innovation Voucher scheme is a good example of a 'taster' that could lead to deeper Innovation Partnerships and other structured innovation activity and investment among SMEs.

Financing conditions appear somewhat restrictive for SMEs. This data (which is only available at a national level) indicates that SMEs throughout Ireland pay relatively high rates for access to credit (Figure 2.10). The data on SME loan volumes is mixed and, according to the OECD SME and Entrepreneurship Policy Review of Ireland, incentives could be strengthened for investment in SMEs and entrepreneurship (OECD, 2019^[3]).

However, the main barrier for innovation diffusion that workshop participants identified was not so much access to finance but the mismatch between the supply of finance and support measures on the one hand

and SME needs and demand on the other, with various participants also mentioning a lack of awareness among SMEs of what is on offer.

Figure 2.10. Financing conditions in Ireland

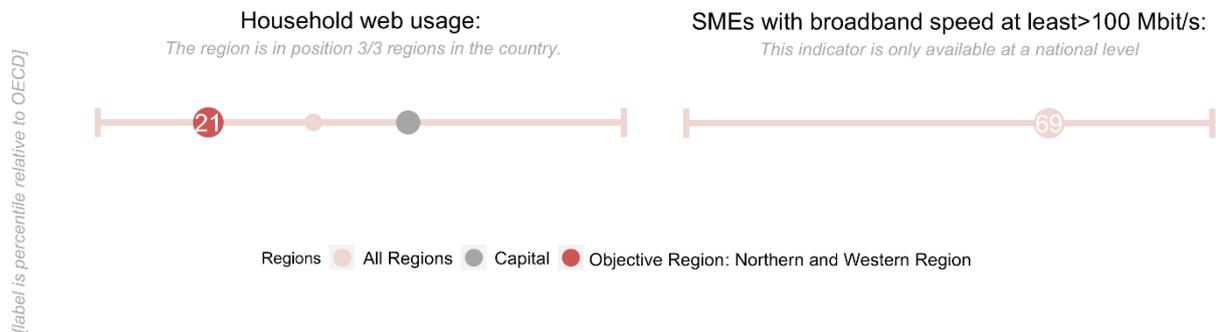


Source: OECD SME Financial Scoreboard, https://stats.oecd.org/Index.aspx?DataSetCode=SMES_SCOREBOARD#

Digital infrastructure

Small firms in Ireland are moving fast towards new digital practices, leading in different aspects of the digital transformation (OECD, 2019^[5]). However, digital infrastructure emerges as an area of improvement in Ireland and the Northern and Western Region in particular. Broadband access for SMEs throughout Ireland is better than the average OECD region but household broadband access is only slightly above the OECD average (Figure 2.11). For the main indicator with regional variation, the percent of households using the internet, the Northern and Western Region is low relative to the rest of Ireland and to the OECD.

Figure 2.11. Digitisation of households, firms, and SMEs



Sources: Household internet measures from OECD Regional Statistics <http://dx.doi.org/10.1787/region-data-en>; SME broadband from OECD ICT adoption database, https://stats.oecd.org/Index.aspx?DataSetCode=ICT_BUS; Employment from OECD Regional Innovation database https://stats.oecd.org/Index.aspx?DataSetCode=REGION_INNOVATION;

Within the innovation diffusion pilot study for the Northern and Western Region, the topic of **SME digitalisation** was explored in a dedicated workshop (Box 2.1).

Box 2.1. SME digitalisation challenges and policy solutions in Northern and Western Region, Ireland

As part of the project, a deep dive into the issue of the digitalisation of SMEs in relation to innovation diffusion was undertaken. The successful digitalisation of SMEs depends on their ability to take up digital technologies, whereas better-digitised small businesses may be better able to benefit from knowledge and innovation developed elsewhere.

Irish SMEs are progressing well in the adoption of digital technologies (see Annex B for background data). They are in the top group for adoption of cloud technologies, even though they have more limited access to high-speed broadband than their peers elsewhere within the OECD. For other technologies, SMEs are in the top quarter of social media use (70% of small businesses in Ireland use social media), and rank highest in the use of websites for e-commerce. Irish SMEs also perform well in the use of big data as compared to SMEs elsewhere, although they lag behind larger firms. Finally, a relatively high percentage of SMEs in Ireland has adopted digital security measures (50%) as compared to other countries, although again less so than larger businesses.

Despite a relatively good digital performance of Irish SMEs, the workshop nevertheless identified this as a big challenge. Policy approaches towards SME digitalisation need to be needs and user driven and take differences among SMEs well into account. Many SMEs find digitalisation an overwhelming problem. One of the issues is a lack of awareness and capacity among some SMEs to understand how digital technologies can help them. The development and use of digital diagnostic tools was mentioned several times as a means to help solve this.

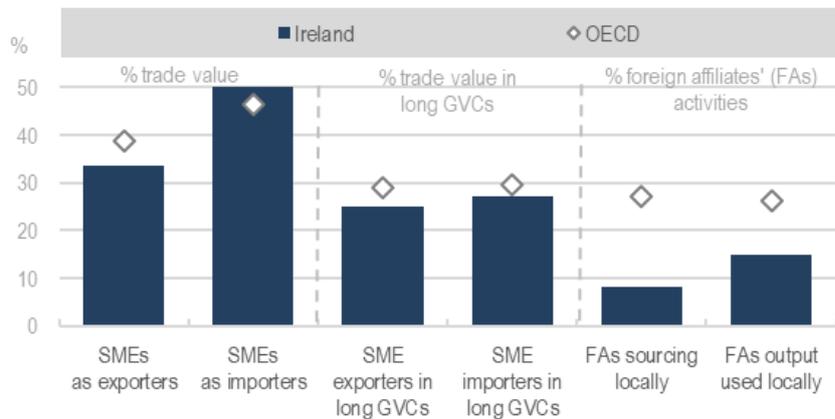
Trust and taking away the ‘fear factor’ regarding digital technologies as well as skills (management skills in particular) are also essential, according to participants. Strengthening the links between industry and academia, including through student apprenticeships and digital champion programmes were also mentioned, as well as the question of whether and how funding should be provided to support SME digitalisation (EIB, 2020^[4]). Existing innovation and trading online voucher schemes were seen as effective and flexible, and could in slightly modified form, support wider SME digitalisation in the Northern and Western Region of Ireland. Regarding skills, the development of local mentorship programmes was discussed, where entrepreneurs are helped to articulate their needs and identify solutions. The need for approaching SME digitalisation through clusters and digital/innovation hubs was widely acknowledged as crucial.

Source: OECD ICT adoption database, https://stats.oecd.org/Index.aspx?DataSetCode=ICT_BUS

Global value chains

Ireland has a highly open economy, with exports and imports of both goods and services as a percentage of GDP amounting to 122% and 89% respectively, significantly above the OECD average (OECD, 2020^[2]). Incoming **foreign direct investment (FDI)** is also high, with foreign firms directly or indirectly accounting for 1 in 5 jobs in Ireland (OECD, 2020^[2]). According to the latest OECD Economic Survey, the high share of foreign-owned firms in Ireland is a great asset but also a downside risk to the economy. Such businesses are typically much more productive than their locally-owned counterparts. However, they often have weak supply-chain links with domestic firms. This is the case in Ireland as a whole, where local activities by foreign affiliates are considerably less than the OECD average (Figure 2.12, right side).

Figure 2.12. International trade and Global Value Chain (GVC) exposure of SMEs



Source: (OECD, 2021^[1])

The left side of Figure 2.12 shows that the **participation of Irish SMEs** in direct and indirect exports is lower than in other OECD countries. This highlights the importance of fostering technological adoption and productivity in domestic firms, particularly smaller firms, as well as further skill improvements in the workforce (OECD, 2020^[2]).

Based on export intensity data from the Central Statistics Office of Ireland, the Northern and Western Region is not as export-oriented compared to the national norm. As per the latest available statistics (2015-2017), the export intensity¹² of the Northern and Western Region was about 4 percentage points below the corresponding State average of 77% in 2017.¹³

Innovation assets

R&D spending indicates the extent to which the public and private sector invests in the production and diffusion of innovation. At a national level, Ireland is in the top 40% of OECD regions for business sector R&D, which can boost innovation diffusion. However, R&D activity in Ireland's higher education institutions is in the bottom 40% of OECD regions (Figure 2.13).

At a regional level, the total level of private sector expenditure on R&D recorded in the Northern and Western Region stood at EUR 277.3 million in 2019, representing a decline of EUR 50.1 million or 15% relative to the corresponding base year in 2017.¹⁴ Out of the three NUTS 2 Regions in Ireland, the Northern and Western Region was the only region to record a decline in expenditure over this time period.

Furthermore, per head of population, total private sector expenditure on R&D in the Northern and Western Region amounted to EUR 318.58 per head of population in 2019, down from the corresponding ratio of EUR 385.20 that was recorded in 2017. The Northern and Western Region's ratio in this regard was also lower relative to the subsequent ratios registered for Ireland (EUR 661.65), the Southern Region (EUR 488.96) and Eastern and Midland Region (EUR 900.77) in 2019.

¹² Export intensity is the degree to which turnover in exporting enterprises can be directly credited to exports. See <https://www.cso.ie/en/releasesandpublications/ep/p-eeii/exportingenterprisesinireland2017/backgroundnotes/>

¹³ <https://www.cso.ie/en/releasesandpublications/ep/p-eeii/exportingenterprisesinireland2017/region/>

¹⁴ <https://www.cso.ie/en/releasesandpublications/er/berd/businessexpenditureonresearchdevelopment2019-2020/>

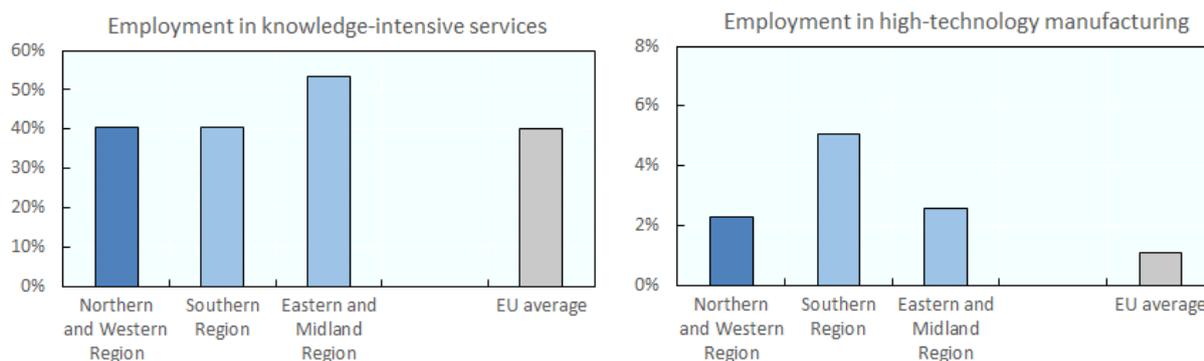
Figure 2.13. R&D expenditures



Source: OECD Regional Innovation database https://stats.oecd.org/Index.aspx?DataSetCode=REGION_INNOVATION; EU Regional Innovation Scoreboard data https://ec.europa.eu/growth/industry/policy/innovation/regional_en

The Northern and Western Region of Ireland has a similar share of employment in knowledge-intensive services compared to the EU average and a higher share than the EU average in high-technology manufacturing (Figure 2.14). However, other regions of Ireland outperform the Northern and Western Region on both measures.

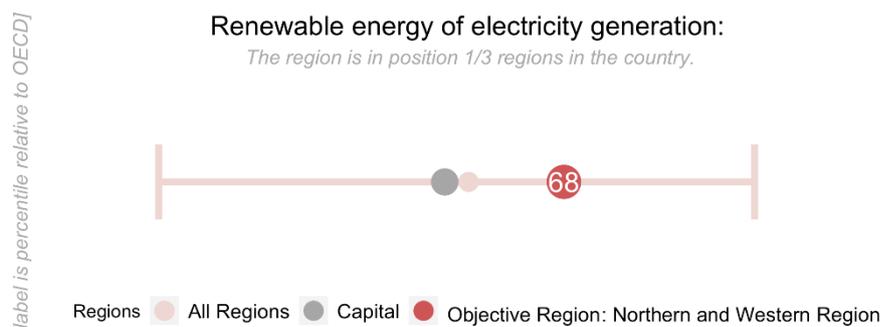
Figure 2.14. Employment in knowledge-intensive services and high-technology manufacturing



Source: Eurostat, employment by NACE sector https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=htec_emp_reg&lang=en

The Northern and Western Region is especially strong on environmental progress as measured by the share of energy from renewables (Figure 2.15).

Figure 2.15. Sustainable environmental outcomes



Source: OECD Regional Innovation database https://stats.oecd.org/Index.aspx?DataSetCode=REGION_INNOVATION

Entrepreneurial culture

Entrepreneurship can embody innovation diffusion because business creation often brings existing ideas to new places or industries. Therefore, the rate of new business creation can indicate a higher rate of innovation in a region. An active entrepreneurial culture is both an outcome and a driver of a strong innovation ecosystem.

The rate of business formation varies within Northern and Western Region of Ireland and across Ireland’s 26 counties: two of the counties in the Northern and Western Region of Ireland, namely Galway and Cavan, have higher rates of businesses formation relative to population, while the rest of its counties have rates that are lower than the median county in Ireland (Figure 2.5).

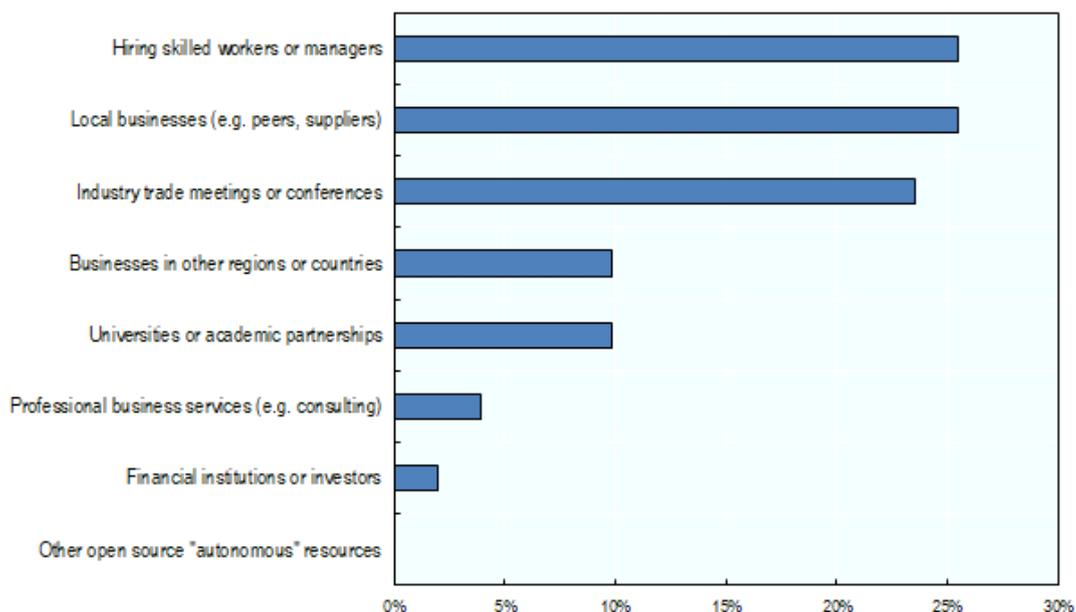
2.4 Channels

Knowledge and ideas can flow through different channels. These channels include diffusion of knowledge between higher education institutions (HEIs), public research institutions (PRIs) and firms (including through university spin-off enterprises); collaboration between firms in supply chains (including linkages between SMEs and foreign direct investors (FDI)), and workers changing jobs among firms, HEIs and PRIs as well as graduates joining the labour force.

Based on responses to the OECD survey, stakeholders in the region identify skilled workers as the most important channel of innovation diffusion (Figure 2.15). Local businesses were also highly-regarded sources of information, followed by conferences and industry trade meetings. Regarding workers, stakeholders noted that ‘talent retention’ in the region as a relative weakness and a barrier to an efficiently functioning innovation system. It was also noted that the move toward virtual and remote working may help the region compete more evenly in future in terms of attracting and retaining talent and skills that support the innovation process.

Figure 2.16. Importance of channels in the Northern and Western Region of Ireland

Weighted average of stakeholders’ ranked survey responses



Source: OECD Stakeholder survey

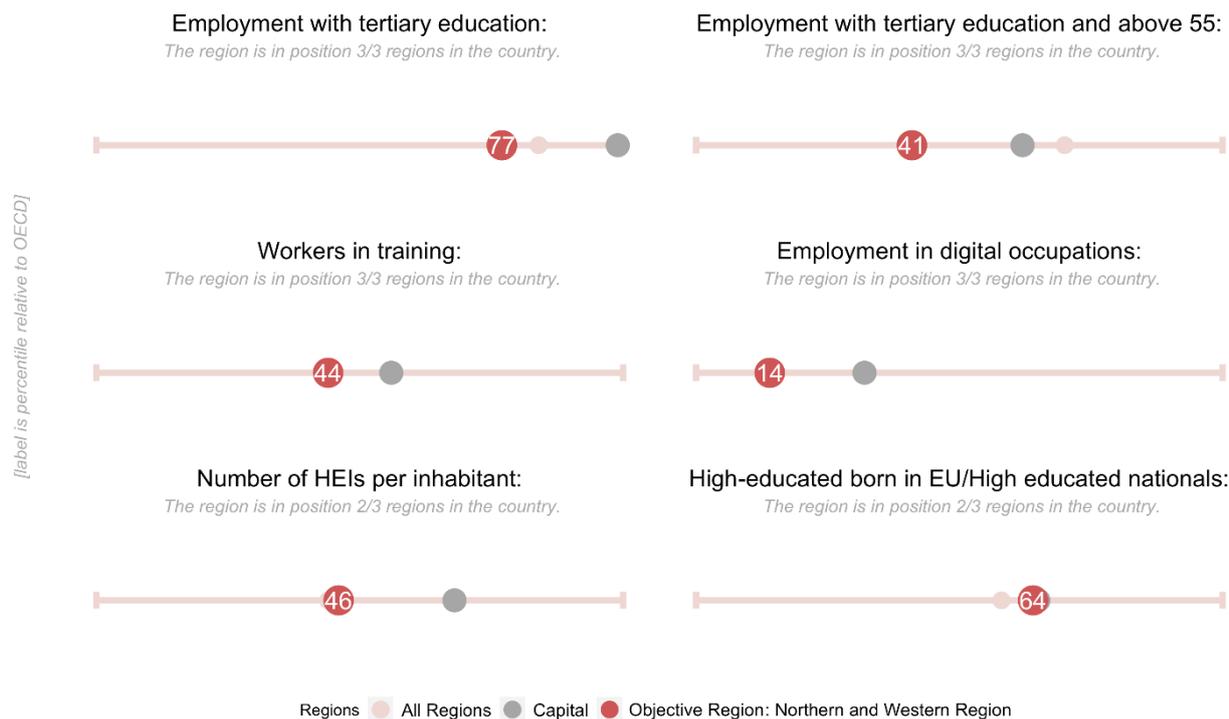
One workshop focused specifically on the functioning of the channels for innovation diffusion in the region. The workshop discussed various cooperation, networking and cluster type measures in place, with the different knowledge institutes in the region and other stakeholders. The issue of awareness and access of these for SMEs and start-ups was highlighted as a challenge.

In particular, participants underlined the systemic functioning and interaction of channels within entrepreneurial ecosystems, in part due to the speeding up of innovation processes.

Hiring skilled workers

The Northern and Western Region’s **tertiary education** rate is in the top 25 percent of OECD regions, although the education rate of older workers lags behind other places in the OECD (Figure 2.17). In terms of worker **mobility**, both in-migration and out-migration of highly-educated workers is high throughout Ireland. However, other measures of skills such as worker training and the share of workers in digital occupations are below (or much below) the OECD average, particularly in the Northern and Western Region of Ireland .

Figure 2.17. Educational attainment; worker skills and mobility

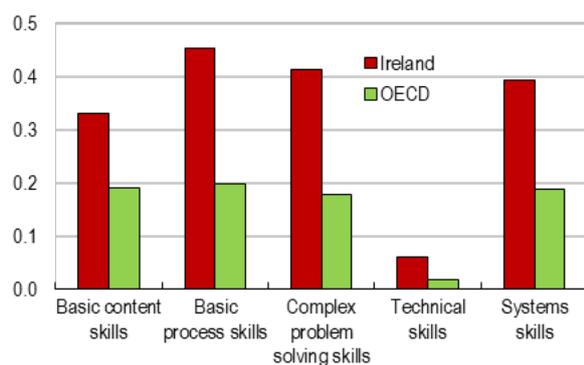


Source: OECD calculations from EU Labour Force Survey data and European Tertiary Education Register (ETER)

The challenge of **brain drain**, with skilled workers leaving the region, and the need to retain skilled workers was mentioned several times during the workshops. Although workshop participants marked skills as an important asset for the region, the risk of skills shortages in Ireland is growing, as indicated in Figure 2.17. Nearly all respondents in the survey said that there were bottlenecks in finding skilled workers. Respondents were split in the impediments they identified: many said that skilled workers are difficult to find while many other respondents identified high cost as the main bottleneck.

Figure 2.18. Skills shortages in Ireland and OECD

Skill shortages index (1=maximum OECD country)



Note: Positive values represent shortages, with the range of values among OECD countries normalised to [-1, 1].

Source: (OECD, 2020₍₃₎)

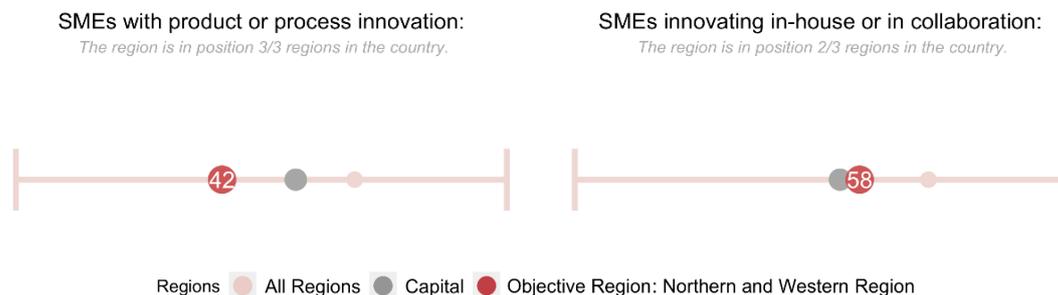
Learning from other businesses

While the number of patents per capita reflects a region's frontier innovations, places with effective innovation diffusion also have more patenting activity. Co-patenting patterns can capture the degree of research and innovation collaboration across firms and with other innovating entities.¹⁵ Since innovation knowledge is often local, places that produce patents can also help encourage adoption. Moreover, the production of patentable inventions often requires substantial knowledge about previous innovations; thus successful patents indicate spillovers of embodied knowledge from other places.

Despite low R&D expenditure, Ireland has adequate **patenting** and even better **collaboration** between public and private sector entities. For example, according to the 2021 Regional Innovation Scoreboard, the Northern and Western region ranks close to the median EU region in terms of patent design applications and above the median region in terms of public-private co-publications. Moreover, the share of SMEs with collaborative innovation activities is above the OECD average in all regions of Ireland, including the Northern and Western Region (Figure 2.19).

¹⁵ Patent applicants can be registered in different locations; therefore, for each region one can calculate the shares of patent co-applicants registered in the same region, different regions of the same country, and those registered in foreign countries.

Figure 2.19. Innovation and collaboration relative to EU regions



Source: EU Regional Innovation Scoreboard https://ec.europa.eu/growth/industry/policy/innovation/regional_en

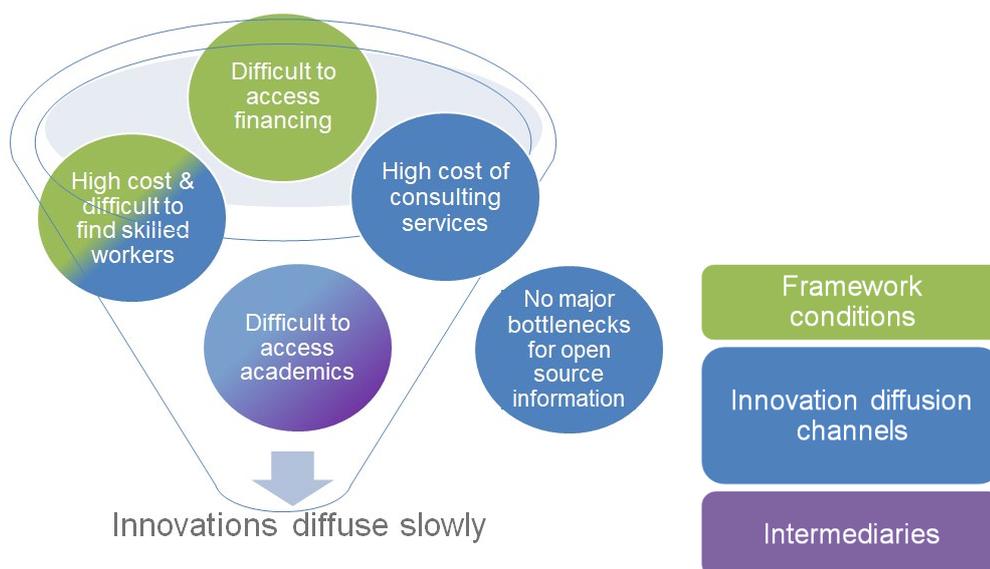
During the workshops, cooperation between companies, as well as with universities and HEIs, was widely discussed, with various participants indicating that effective learning for SMEs involves learning from other businesses. Various examples of clustering were mentioned in the same light.

Academics, consulting, and open sources

The OECD survey asked stakeholders to identify specific bottlenecks in innovation diffusion. Respondents indicated that there were bottlenecks in most of the channels, except accessing open sources for innovation information. The main innovation bottlenecks are identified in Figure 2.20.

Figure 2.20. Main bottlenecks in the channels of the Northern and Western Region of Ireland

Based on modal survey responses



Source: OECD Stakeholder survey

2.5 Intermediaries and policies

This section explores the role of innovation diffusion intermediaries, i.e. organisations that are key in facilitating the transfer of innovation, such as chambers of commerce and business associations, public business support providers, technology transfer offices and accelerators, incubators and technology parks. Key attention is paid to how these organisations link different actors together and allow innovation to flow from one segment of the economy to another.

The Northern and Western Region of Ireland has nine intermediaries that were explored in its workshop and survey, detailed in Table 2.1. Three of these intermediaries are focused on SMEs, while others are generally focused on innovation or business and regional development. While some intermediaries are specific to the region, many also have significant presences in other regions of the Republic of Ireland.

Table 2.1. Intermediaries - Northern and Western Region of Ireland

Organisation name	Type	Website
INTERMEDIARIES IN SURVEY QUESTIONS:		
Chambers Ireland	Chambers of commerce	https://www.chambers.ie/
Enterprise Ireland	SME-focused agency	https://www.enterprise-ireland.com/en/
Intertrade Ireland	Business development agency (all Island remit)	https://intertradeireland.com/
Local Enterprise Offices	Micro-enterprise and SME-focused agency	https://www.localenterprise.ie/
Northern & Western Regional Assembly	Local/regional development agency	https://www.nwra.ie/
Universities, Institutes of Technology and Gateways (LKIT / Sligo IT / GMIT / DKIT / Athlone IT / NUIG)	Universities/HEIs	https://www.lyit.ie/ https://www.itsligo.ie/ https://www.gmit.ie/ https://www.dkit.ie/ https://www.ait.ie http://www.nuigalway.ie/
Udarás na Gaeltachta (Gaeltacht Authority)	SME-focused agency in Gaeltacht designated areas	https://udaras.ie/en/
WestBIC	Innovation agency	https://www.westbic.ie/
Western Development Commission (WDC)	Local/regional development agency	https://westerndevelopment.ie/

INTERMEDIARIES NOT IN SURVEY QUESTIONS include Science Foundation Ireland (research centre support), IDA (multinational companies), and Teagasc (agriculture sector support)

On a national level, **Enterprise Ireland** is an enterprise and innovation agency with a regional structure and strategy focus. **Intertrade Ireland** promotes cross-border trade between the Republic of Ireland and Northern Ireland; it is an innovation development agency that supports SMEs through training, knowledge transfer, and funding.

On a sub-national level, **Local Enterprise Offices** (LEOs) are the “first stop shop” for anyone seeking information and support on starting or growing a business in Ireland. There are 31 LEO offices across the

republic of Ireland. **Údarás na Gaeltachta** meaning "Gaeltacht Authority" is a regional state agency that is responsible for the economic, social and cultural development of Irish-speaking regions of Ireland.

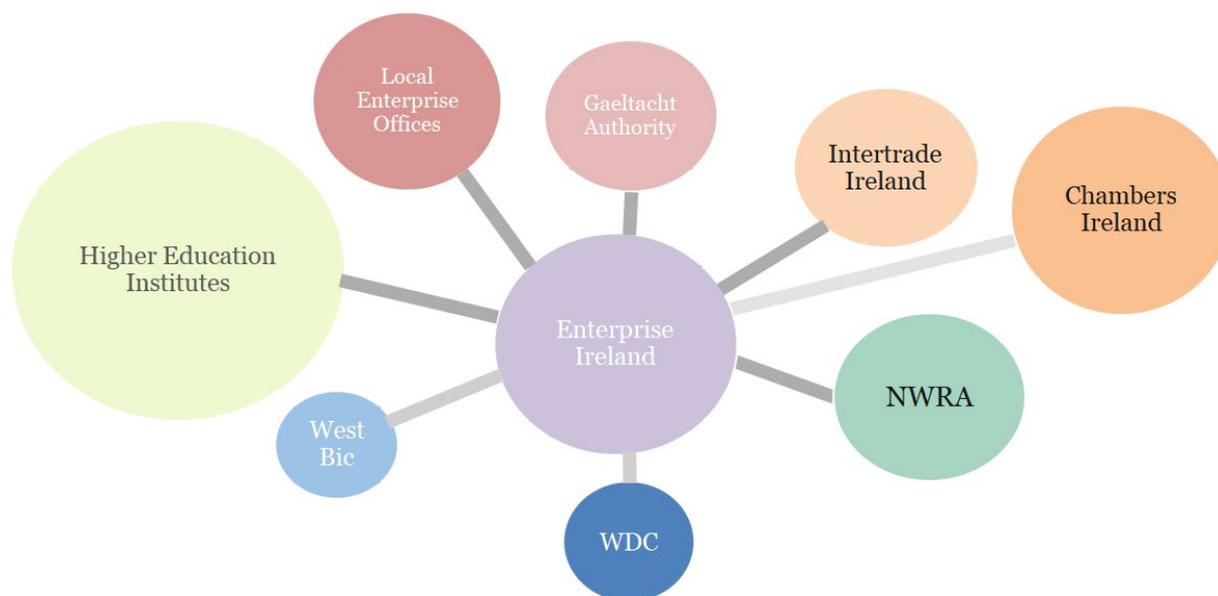
The region's four Higher Education Institutes (HEIs), together with Dundalk Institute of Technology and Athlone Institute of Technology generally provide technology transfer and R&I supports to regional SME base through a variety of channels and schemes (e.g. industry collaboration, Innovation Partnerships and Innovation Vouchers). **Technology Gateways**, run by Enterprise Ireland, work in partnership with the universities and Institutes of Technology to deliver innovation expertise and solutions for Irish businesses.

Other intermediaries include the chambers, NWRA, WDC, and WestBic. **Chambers Ireland** is Ireland's largest business network on the island of Ireland; it is the umbrella group for local affiliated chambers. Each chamber consists of local business representatives who join together to promote the economic and social development of their community in order to make it a better place in which to live, work and do business. **NWRA** is the coordinating government body for a range of regional policies and for EU Funding administration. **WDC** is a quasi-statutory organisation with a remit for regional development support, research and the operation of the Western Investment Fund for venture finance. Finally, **WestBIC** provides tailored, high-level supports to entrepreneurs who are converting their innovative ideas into a commercial reality and looking for financial investors.

The stakeholder survey asked about links between Enterprise Ireland and many other intermediaries. The responses, illustrated in Figure 2.21, show that all of these intermediaries have links to Enterprise Ireland, with some links appearing stronger than others.

Figure 2.21. Intermediaries' links to Enterprise Ireland

Based on frequency of survey responses indicating links between intermediaries



Source: OECD Stakeholder survey

Table 2.2. Policy documents and strategies

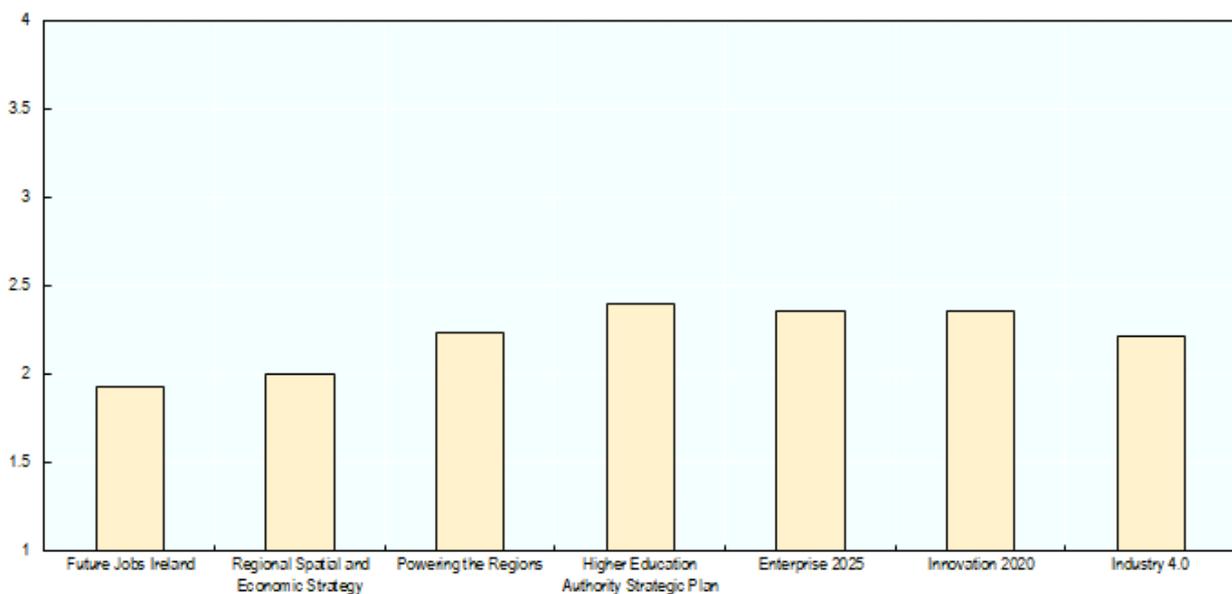
Policy / Innovation Support	Leading intermediary	Website
Agile Innovation Fund	Enterprise Ireland / Local Enterprise Office	https://globalambition.ie/supports/innovation-support/the-agile-innovation-fund/

Co-Innovate	InterTradelreland	https://co-innovateprogramme.eu/
Feasibility Grant & Technical Support for Innovation	Enterprise Ireland / Udaras na Gaeltachta / Local Enterprise Office	https://www.enterprise-ireland.com/en/Funding-Supports/Company/Eestablish-SME-Funding/Feasibility-Study.html
Horizon 2020 / HEu	InterTradelreland	https://intertradeireland.com/innovation/horizon-2020
Innovation Boost (Formerly called 'Fusion Programme')	InterTradelreland	https://intertradeireland.com/innovation/innovation-boost
Innovation Voucher	Enterprise Ireland & HEIs	https://www.enterprise-ireland.com/en/research-innovation/companies/collaborate-with-companies-research-institutes/innovation-voucher.shortcut.html
Innovation Partnership	Enterprise Ireland & HEIs	https://www.enterprise-ireland.com/en/Research-Innovation/Companies/R-D-Funding/Innovation-Partnerships.shortcut.html
KTI Online Portal	Knowledge Transfer Ireland	https://www.knowledgetransferireland.com
Research, Development & Innovation (RD&I) Fund	Enterprise Ireland	https://www.enterprise-ireland.com/en/funding-supports/Company/Eestablish-SME-Funding/R-D-Fund-Large-Projects.html
Trading Online Voucher Scheme	Local Enterprise Office	https://www.localenterprise.ie/Discover-Business-Supports/Trading-Online-Voucher-Scheme-/

When asked about the role of **policy documents and frameworks** in innovation diffusion, most stakeholders had lackluster views (Figure 2.22). Stakeholders mentioned the following policy frameworks, which were not assessed in the survey, as important: namely the AEC Hubs project, Regional Enterprise Plan, LEADER local partnership companies, Accelerator Programmes & Incubation Centres, and REDF- and BEDF-funded projects (Regional Enterprise Development Fund / Border Enterprise Development Fund).

Figure 2.22. Stakeholder views of policy documents and frameworks

Stakeholders' average assessment of effectiveness for *innovation diffusion*



Note: The minimum score was=1; the maximum score was=4.

Source: OECD Stakeholder survey

Stakeholders had more positive views about the effectiveness of **policy instruments** for innovation diffusion (Figure 2.23). The stakeholder survey and workshop revealed that voucher policies in which companies identify their technological needs are perceived to be particularly effective. These policies include the Trading Online Voucher scheme administered by Local Enterprise Offices and the Innovation Voucher scheme run through the IOT/iHub network.

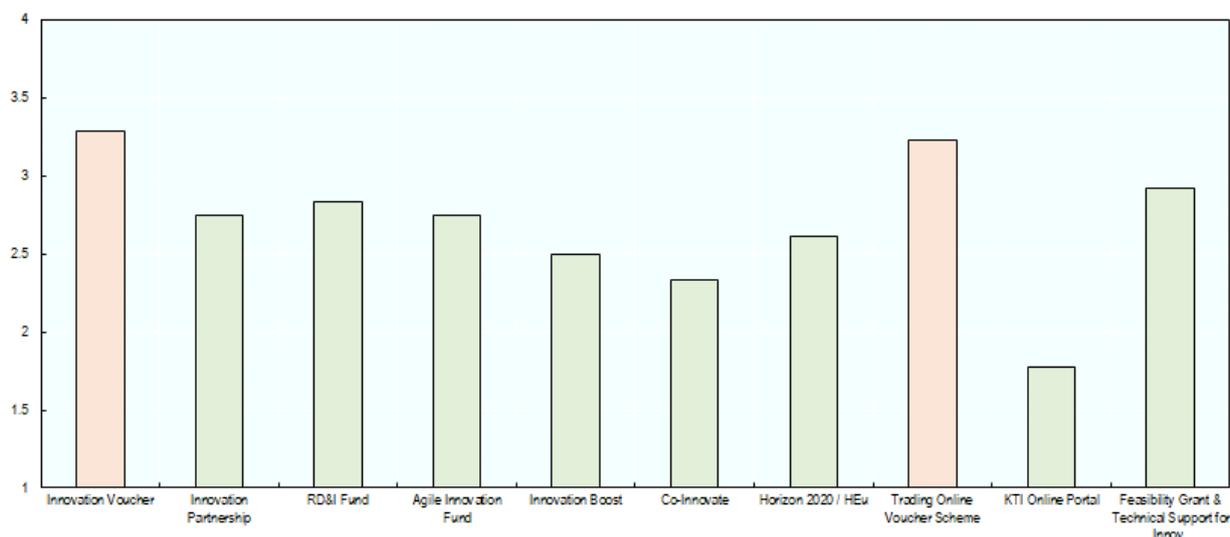
In addition to the policy instruments assessed in the survey, stakeholders mentioned the following as relevant to innovation diffusion: namely the Department of Further and Higher Education, Research, Innovation and Science three-year strategy; National Planning Framework Ireland 2040; Rural Development Programme; National SME and Entrepreneurship Growth Plan (Report of the SME Taskforce). In terms of bottlenecks, they often cited the participation requirement for companies as a main bottleneck in policy instruments.

The functioning of policies and intermediaries was also discussed during the workshops. Views on the question of whether the government supports innovation diffusion differed widely among participants, with slightly more participants indicating this is not the case. Most participants think there are too many (40%) or enough (30%) policy instruments to support innovation diffusion, with less than one fifth suggesting there were too many. This is in line with the views expressed during the workshops, that the main barriers for innovation diffusion are a lack of awareness of the support available and a potential mismatch between what is offered and what SMEs ask or need.

Stakeholders were asked to assess, in the survey, intermediaries' roles in innovation diffusion. They indicated that Enterprise Ireland and Local Enterprise Offices both provide strong prominent support for innovation diffusion while the region's other intermediaries also provide some support for diffusion. However, workshop participants emphasised the need for further collaboration among intermediaries.

Figure 2.23. Stakeholder views of policy instruments

Stakeholders' average assessment of effectiveness *for innovation diffusion*

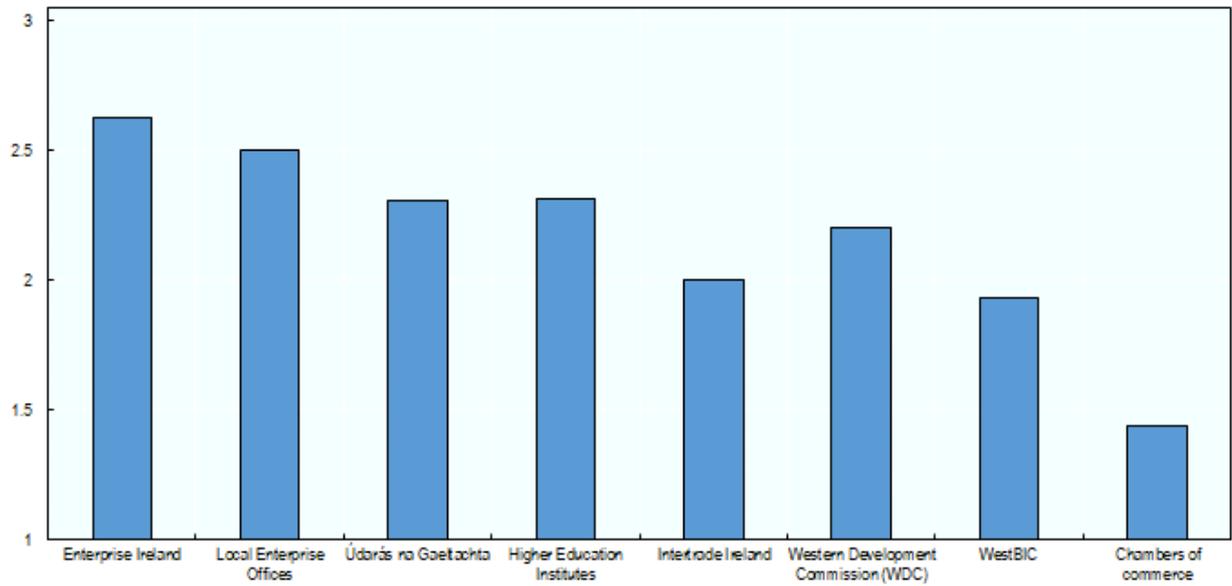


Note: The minimum score was=1; the maximum score was=4.

Source: OECD Stakeholder survey

Figure 2.24. Stakeholder views of intermediaries

Stakeholders' average assessment of how prominent *innovation diffusion* is in the intermediary's services



Note: The minimum score was=1; the maximum score was=3.

Source: OECD Stakeholder survey

3 Conclusion and policy discussion

Innovation diffusion in the Northern and Western Region of Ireland functions well overall...

The pilot has shown that innovation diffusion in the Northern and Western Region of Ireland functions well, slightly better than in Ireland as a whole and slightly below the EU. In particular, diffusion from Higher Education Institutes to the private sector is seen as important, with skills representing a key factor. The region has a diverse ecosystem including Higher Education Institutes, research centres and large (domestic and foreign) companies and SMEs, with a vibrant and innovative SME population. The uptake of digital technologies by SMEs in Ireland is relatively advanced compared to other OECD countries.

...although a number of challenges exist

However, there are also points for improvement. With low productivity levels and growth (including for SMEs) the region is struggling to catch up, a challenge that stakeholders recognise. Access to finance and the digital infrastructure could be further strengthened. Furthermore, start-up rates are relatively low. Although Ireland has a highly open economy, participation of SMEs in direct or indirect trade is relatively modest. Skills are seen as an important asset for innovation diffusion, but the Northern and Western Region of Ireland faces challenges such as brain drain and skills shortages, particularly in SMEs. Views on the question if the government supports innovation diffusion well differed widely among participants in the workshops.

An ambitious agenda focused on connections...

Given these challenges, the Northern and Western Regional Assembly is ambitious in taking the region to the next level in the next smart specialisation strategy (S3) programming period. Making the region the most connected region in Europe is a part of that. Strengthening the region's capabilities to deal with ongoing and upcoming challenges regarding digitalisation, net zero carbon emissions and recovery from COVID-19 further underscores the ambition. At various instances during the pilot the need for leadership was emphasised, that helps overcome possible fragmentation and 'silo perspective' and through a joint missionary approach helps to reformulate strategies and deliver innovative results.

...that helps strengthen cluster formation and the further development of innovative and digital hubs

During the pilot, many stakeholders underlined the need for better functioning clusters in various technology areas between Higher Education Institutes, research institutes, large and small business and start-ups, which was emphasised as a key driver for innovation diffusion and productivity growth. Various participants emphasised that such linkages and collaboration need more than (successful) innovation or digital vouchers, but require a more systemic approach, including the involvement of all stakeholders and policy perspectives. This would include improving framework conditions (for instance for start-ups) and the improvement of digital and physical infrastructure to the further development of partnerships. Such a perspective is key for the realisation of the ambition to be recognised as an innovation and digital hub in the context of European innovation and industrial policy.

Skills, skills, skills

To realise these ambitions, the importance of strengthening the skills base of the region was seen as essential. Skills shortages and a mismatch between the supply and demand for skills represents a challenge for Ireland as a whole, but also for the Northern and Western Region of Ireland. This requires the development of lifelong learning, the improvement of management skills for entrepreneurs, finding ways to better retain skilled workers for local firms and avoid a brain drain, and better connecting the supply and demand for skills at local and regional level. Many participants underlined a one-size-fits-all approach is unlikely to deliver this, and suggested a more place based approach that takes local and regional differentiation into account.

Capabilities and peer learning

At various occasions during the workshops, it was noted that enterprises – particularly SMEs – did not have the capability to benefit from innovation diffusion or any relevant supports in this regard. There was a strong consensus that the best way to deliver on such capabilities, was via peer learning and networking among entrepreneurs and dedicated mentoring schemes that support that.

A “needs based approach” – including for SME digitalisation

Schemes that aim to enhance capabilities should adopt a “needs based approach” that recognises the differences between SMEs. This was particularly emphasised in the workshop on SME digitalisation, where the need for support that helps entrepreneurs identify where and how digital technologies can create value for them was underlined several times.

SMEs, trade and global value chains

Whereas Ireland has a very open economy, the inclusion of SMEs therein is limited, with relatively few SMEs trading and SME linkages with foreign MNCs being limited. Exploring ways how SMEs can be better enabled to establish such linkages and trade could be important for Northern and Western Region of Ireland to consider. Similarly, as stated before, retaining talent for the region is key to avoid a further brain drain of much needed high skilled labour.

Multilevel governance, with a clear regional perspective

Innovation policy in Ireland is to a significant degree a central government responsibility, even though there are various actors that operate at regional, district and local level. Coherence in approach is of importance, as was emphasised in the OECD SME and entrepreneurship policy review for Ireland (OECD, 2019^[3]). During the pilot, the need for central (and regional) government approaches to innovation diffusion to be well aware of local and spatial differentiation was brought forward several times, including between cities and rural areas.

Annex A. Methodology and data sources

Methodology and analytical framework

Innovation diffusion can be defined as the process through which firms gather knowledge, information and innovations from outside and use them to introduce their own innovative products or processes. It is a broad concept, referring, among other things, to the adoption of new-to-the-firm technologies, the introduction of new management techniques, the digitalisation of certain processes, or the introduction on the market of a new product.

According to the Oslo Manual 2018 “*innovation diffusion encompasses both the process by which ideas underpinning product and business process innovations spread (innovation knowledge diffusion), and the adoption of such products, or business processes by other firms (innovation output diffusion)*”. (OECD/Eurostat, 2018).

Innovation diffusion is a complex phenomenon that relates to three sets of factors:

- The local and national **framework conditions**, which affect firms’ incentives and capacities to adopt innovations.
- The functioning of the **channels** through which the diffusion can take place.
- The presence and functioning of a variety of **intermediary organizations** that help companies build the capacity for innovation adoption, identify external resources, and share knowledge among peers.

Framework conditions

Local and national framework conditions shape the environment for innovation diffusion. These conditions affect firms’ incentives and capacities to adopt innovations. The six framework conditions for innovation diffusion are:

1. The **institutional and regulatory framework** (e.g. judicial system, patents, taxes, administrative rules) for business investment.
2. **Market conditions**, such as product demand (domestic and foreign), along with uncertainty and interest rates.
3. **Access to financing** for firms in general and start-ups and SMEs in particular (e.g. loans, debt, various forms of equity).
4. Physical and digital **infrastructure** (e.g. transportation and logistics networks; fast, reliable internet connections, and digital assets such as retailing platforms and cloud computing).
5. **Access to skills**, which includes managerial skills, technical and digital skills and entrepreneurial know-how.
6. Presence of **innovation assets** such as R&D and innovative businesses that contribute to an entrepreneurial culture.

The first three framework conditions characterise the business or regulatory environment; the other three conditions describe infrastructure and innovation assets. The business/regulatory environment affects firms’ costs and benefits of adopting innovations. Infrastructure and innovation assets are another

important factor for innovation diffusion, as they shape firms' technological capacity and define the quality of their interactions with other companies, workers, and markets. These framework conditions all form a region's innovation ecosystem that determines firms' ability and willingness to learn about and adopt existing innovations.

Channels

Innovation diffusion channels are sources of information that firms may encounter in their normal business operations. Channels expose companies to new ideas and help them develop (or find) the know-how to source and implement the innovations. They represent direct ways through which businesses acquire ideas from outside and use them to adopt innovations.

This report highlights five channels:

1. **Workers' career mobility** through which workers and managers changing jobs or firms can draw upon the knowledge acquired in previous jobs to the benefit of their new firms.
2. **Supplier relationships** through which firms exchanging products or services can share their knowledge with each other to increase the competitiveness of the supply chain. Customers can also provide critical feedback that make firms aware of innovations at the frontier.
3. **Academic-business collaboration (ABC)** that helps firms source the knowledge needed for R&D.
4. **Knowledge-intensive services** (e.g. consulting, IT, accounting), which can help firms identify and adopt innovative practices.
5. **Autonomous learning**, which relies on open knowledge, and as such does not typically require direct interaction with other firms or innovating entities. It could be websites, publications, or indirect observation and imitation of competitors.

Intermediaries

The final pillar of innovation diffusion, intermediaries, consists of entities that facilitate the diffusion of innovation without being directly involved in its production or adoption. Instead, intermediaries facilitate connections between companies and diffusion channels and also support collaboration. The three types of intermediaries are:

- a) **University and research-related intermediaries** facilitate knowledge transfer from higher education institutions (HEIs) and public research institutions (PRIs) to businesses and other actors in the surrounding innovation ecosystem. Indeed universities and HEIs perform a variety of functions for innovation diffusion; some host incubators or accelerators that play all three roles in supporting diffusion. Governments can use policy to encourage the formation and success of university and research-related intermediaries.
- b) **Public sector innovation and local development agencies** aim to increase the innovation output and uptake of technologies by the business sector. A survey of innovation agencies in ten different countries finds that the main tasks of innovation agencies are providing support to other intermediaries such as business incubators or science and technology parks, and organising capacity- and institution-building activities. In Europe these agencies are often partly or jointly responsible for administering innovation vouchers aimed at encouraging academic-business collaboration (ABC) partnerships.¹⁶

¹⁶ Specifically, innovation vouchers are "small lines of credit provided by governments to small and medium-sized enterprises to purchase services from public knowledge providers with a view to introducing innovations (new products, processes or services) in their business operations".

- c) **Private sector-led intermediaries** include many types of “enterprise-led” networks. These networks include chambers of commerce, science parks and cluster associations. Large “anchor” firms can also serve as intermediaries that coordinate private sector businesses within the regional innovation system.¹⁷ Industry clusters and science and technology parks often play multiple roles in diffusion.

Intermediaries help connect firms to innovation channels but they are not institutions that companies necessarily encounter during their normal business operations. Unlike individual businesses, intermediaries may be very responsive to policy interventions because their missions are usually connected to innovation creation and diffusion. Their roles in diffusion include:

- a) **Funding.** Some intermediaries specialise in mediating academic-business or business-business investment relationships for small and large businesses. Other intermediaries administer public funding to promote innovation production and diffusion.
- b) **Capacity building.** Many public agencies and higher education institutions provide advice and workshops to support business development, especially for smaller businesses.
- c) **Networking.** Employer associations and chambers of commerce often help businesses learn about innovations and share knowledge with their peers. In addition, public sector and academic institutions and even individual firms — ranging from small entrepreneurs to large established “anchor” firms — can serve as intermediaries.

Sources of data

The analysis relies on different sources of data that are generally available at the subnational level, using NUTS2 (also known as TL2) regional classifications. The measures displayed in the report were chosen in part based on data availability because some measures are not available for particular countries or regions.

Framework conditions

A broad range of indicators can be used to measure the strength of framework conditions at the regional level (Table 3.1). These indicators reflect the business and regulatory environment and a variety of infrastructure and innovation assets that are relevant for innovation diffusion at a regional level. Measures of regulations are generally based on survey responses while the other measures are based on economic indicators such as trade patterns, labour force characteristics, financing conditions, and R&D expenditures.

Table 3.1. Indicators measuring framework conditions in regions

Name of indicator	Notes	Data sources (see table note)
Institutional and regulatory framework		
Quality of government and institutional fairness	Regional indicators of governance quality. Measures are based on surveys administered by the University of Gothenburg and include (1) Lack of corruption; (2) Quality and accountability; and (3) Impartiality.	RCI

¹⁷ The presence of a large, R&D-intensive “anchor” firm helps the regional innovation system better absorb university research output and stimulate local R&D.

Administrative burdens on start-ups*	Component of the composite index "Barriers to domestic and foreign entry". Covers the administrative burden on joint-stock companies and personally-owned enterprises, as well as administrative burden related to licenses and permits procedures. Higher values indicate lower administrative burdens.	PMR
Complexity of regulatory procedures*	Composite index that captures the government's efforts to reduce and simplify the administrative burden of licenses and other administrative procedures. Higher values indicate less complexity.	PMR
Quality of judicial process*	The quality of judicial processes index measures whether each economy has adopted a series of good practices in its court system in four areas: court structure and proceedings, case management, court automation and alternative dispute resolution. Higher values indicate a more sophisticated and streamlined court structure.	DBI
Market conditions		
Trade openness	(Imports + Exports)/ GDP	Reg
Share of exports by SMEs**	Exports by SMEs/Total exports	TBE
Barriers to trade facilitation*	The barriers to trade facilitation index captures the extent to which a country recognizes foreign regulations, uses international standards and has international transparency of domestic regulation. Scores from most to least restrictive.	TFI
Services Trade Restrictiveness*	Composite index that quantifies restrictions on trade in services across five standard categories: 1) restrictions on foreign entry, 2) restrictions on the movement of people, 3) barriers to competition, 4) regulatory transparency, and 5) other discriminatory measures. Scores from completely closed to completely open.	STR
Public procurement market**	Expenditure on public procurement/GDP	GG
Infrastructure		
Population accessible via highways	Total population residing in the neighbouring regions of a given region where regions count in a way that is inversely related to their reciprocal distance.	Adler
GDP accessible via highways	Ibid.	Adler
Employment accessible via highways	Ibid.	Adler
Share of population ...		
...with internet broadband access	Population with internet broadband access/Total population	Reg
... with download speed greater than 200mbps	Population with download speed greater than 200mbps/Total population	Reg
... using internet	Population using internet /Total population	Reg
Access to skills		
Share of prime-age population with tertiary education	Population between 25 and 64 years old with tertiary education/Population between 25 and 64 years old	Reg
Share of young adult population with tertiary education	Population between 25 and 34 years old with tertiary education/Population between 25 and 34 years old	Reg
Share of population within 10km of a higher education institution	Population near a higher education institution (within 10km)/Population	ETER
Share of workers with tertiary education	Workers with tertiary education/Total employment	LFS
Share of workers that received training in the past four weeks	Workers that received training in the past four weeks/Total employment	LFS
Difference between SMEs (including self-employed) and the entire economy in...		
... the share of workers with tertiary education	SMEE Employment with tertiary education/SMEE Employment - Employment with tertiary education/Employment	LFS
... the share of workers that received training in the past four weeks	SMEE Employment that received training in the past four weeks/SMEE Employment - Employment that received training in the past four weeks/Employment	LFS

Shortage of digital workers	Ratio between the number of vacancies in digital occupations and employment in digital occupations	BG & LFS
Access to financing		
Difference between small and large firms in...		
... the implicit tax subsidy rate on R&D expenditure**	Model-based estimates of implied marginal R&D tax subsidy rates	RDTI
... the interest rate on loans	Exact definitions differ by country.	SMEE
Share of total business lending going to SMEs**	Business lending to SMEs/Total business lending (amounts in local currency)	SMEE
Share of total loan applications going to SMEs**	Loan applications by SMEs/Total number of SMEs	SMEE
Access to innovation assets		
R&D expenditure...		
... in the business sector	R&D expenditure in the business sector/GDP	Reg
... in higher education institutions	R&D expenditure in higher education institutions/GDP	Reg
... in the business sector	R&D personnel in the business sector/Total employment	Reg
R&D personnel in higher education institutions	R&D personnel in higher education institutions/Total employment	Reg

Note: (*) = indicator available at national level, (**) = indicator available at national level, could be constructed analogously at the regional level, (***) = not existing indicator, could be constructed – better if at regional level. Labour force survey indicators refer to workers aged between 25 and 64.

Data sources: (Adler et al., 2020_[3]) (**Adler**), Burning Glass Technologies (**BG**), World Bank Doing Business Indicators (**DBI**), **ETER** Database, OECD Government at a Glance (**GG**), OECD **ICT** Access and Usage by Businesses Database, Labour Force Survey (**LFS**), **PATSTAT**, OECD Product Market Regulation Indicators (**PMR**), European Regional Competitiveness Index (**RCI**), OECD R&D Tax Incentive Indicators (**RDTI**), OECD **Regional** Database, Regional Innovation Scoreboard (**RIS**), OECD SMEE Financial Scoreboard (**SMEE**), OECD Services Trade Restrictiveness Indicators (**STR**), OECD Trade by Enterprise Characteristics Indicators (**TBE**), OECD Trade Facilitation Indicators (**TFI**)

Innovation diffusion channels

A variety of indicators can be used to measure the functioning of innovation diffusion channels across regions. These indicators measure trade linkages, worker flows, and the presence of academic institutions and business services that could help companies learn about and adopt innovations (Table 3.2). Most of the measures are available at the regional level.

Table 3.2. Indicators measuring the strength of innovation diffusion channels

Name of indicator	Notes	Data sources (see table note)
Supplier relationships		
Domestic value added content of gross exports	Value added embodied in gross exports of the region divided by total gross exports of the region	Los
Participation in GVC – backward linkages	Intermediate inputs produced abroad embodied in the region's exports	Los
Participation in GVC – forward linkages	Value added produced in the region embodied in trading partners' exports	Los
Inter-regional trade patterns	Export shares and trade in intermediate goods by industry sector. Each region is viewed as independent from other domestic regions.	Regl-O
FDI penetration in terms of GDP***	Ratio between FDI turnover and total turnover in the region	***
FDI penetration in terms of employment***	Ratio between FDI employment and total employment in the region	***

Local linkages with MNE affiliates/subsidiaries***	Share of turnover of SME located in the region exported to local MNE affiliates/subsidiaries	***
Worker and researcher mobility		
Job-to-job transitions***	Share of workers having changed job since the last period	***
Job-to-job transitions from large to small firms***	Share of workers having moved during the last period from a large to a small firm	***
Job-to-job transitions from MNE affiliates/subsidiaries to local firms***	Share of workers having moved during the last period from a MNE affiliate/subsidiary to a small firm	***
Geographical and cross-industry mobility	Share of workers working in year y in a different region (within the same country) or different industry from the one they worked in year y-1	LFS
Share of mobile academics	Share of academics who do not have the nationality of the higher education institution in which they work.	ETER
Share of mobile researchers	Share of researchers who do not have the nationality of the higher education institution in which they work.	ETER
Share of mobile students	The share of students who have physically crossed a national border for their tertiary degree studies	ETER
Academic-business collaboration		
Access to higher education institutions	Number of HEIs per capita	ETER
Access to higher education institutions with high student mobility	Number of HEIs with high student mobility (per capita). Mobile students are those studying in a different country than their previous residence.	ETER
Share of university-industry patent applications	Number of patent applications filed jointly by (at least) a university and (at least) a business/Total number of patent applications	PATSTAT
Public-private co-publications per capita	Number of public-private co-authored research publications (excluding medical and health industries) divided by total population.	RIS
Share of academic start-ups**	Number of start-ups with at least an academic among its co-founders/Total number of start-ups	
Knowledge-intensive business services		
Share of employment in knowledge-intensive services	Number of employees in knowledge-intensive services divided by total employees	Reg

Note: (*) = indicator available at national level, (**) = indicator available at national level, could be constructed analogously at the regional level, (***) = not existing indicator, could be constructed – better if at regional level.

Sources: European Tertiary Education Register (ETER), Labour Force Survey (LFS), Los and Chen, 2016^[5] (Los), PATSTAT, OECD Regional Database, Regional Innovation Scoreboard (RIS), Regional Input-Output Data for Europe (RegI-O)

Innovation diffusion outcomes

A number of indicators can be used to measure the extent of regional growth and sustainable progress (Table 3.3) and the strength of innovation diffusion at the regional level (Table 3.4).

Table 3.3. Indicators measuring the extent of regional growth and sustainable progress

Name of indicator	Measures	Data sources (see note)
Productivity		
Productivity level	Total economy; Manufacturing; Services (all ex-finance)	Reg
Productivity growth rate (ten-year annualised)	Total economy; Manufacturing; Services (all ex-finance)	Reg
Wages and earnings		
Average wages (Total compensation per employee)	Total economy; Manufacturing; Services (all ex-finance)	EUROSTAT
Environmental progress		

Renewable energy generation	% capacity used of renewable energy generation	Reg
Greenhouse gas emissions	GHG from generated electricity per capita	Reg

Data sources: EUROSTAT SBS, OECD Regional Database

The table below shows indicators of innovation production and adoption of existing innovations. It uses the Oslo Manual definition to group innovation adoption indicators into those that are: (a) not at the frontier but (b) build on outside knowledge. Finally, many of the outcome indicators relate to the activity of SMEs because smaller firms play important roles in a region's innovation diffusion ecosystem and typically have a great need to catch up to larger firms.

Table 3.4. Indicators measuring the extent of regional innovation diffusion, especially for SMEs

Name of indicator	Does it capture (1) innovation that is (a) not at the frontier but (b) builds on outside knowledge?	Data sources (see table note)
Adoption of products or processes with no or little modification		
Average share of small and medium enterprises...		
... selling orders via computer networks**	a, b	ICT
... with broadband speed at least >100 Mbit/s**	-	ICT
... purchasing cloud computing services**	a, b	ICT
... using electronic SCM systems**	a, b	ICT
... selling orders via computer networks**	a, b	ICT
Innovation building on but differing substantially from products or processes offered or used by other firms		
Number of patents per capita	1, b	Reg
Share of SMEs introducing a product or process innovation	1	RIS
Share of SMEs introducing a marketing or organisation innovation	1	RIS
Share of workers in digital occupations	-	BG
Difference between the share of workers in digital occupations among SMEs and self-employed and the share of workers with tertiary education across the entire economy	-	BG & LFS
Share of SMEs collaborating in research and innovation	1, b	RIS
Share of patent applications...		
... filed together with other patent applicants	1, b	Reg
... filed together with applicants located outside of the region	1, b	Reg
... filed together with applicants located outside of the country	1, b	Reg
... citing other patents	1, b	PATSTAT
... citing other patents filed also outside of the region	1, b	PATSTAT
... citing other patents filed also outside of the country	1, b	PATSTAT

Number of patents per capita in specific high-tech fields (biotech, nanotech, medical, ICT, pharmaceuticals)	1, b	Reg
Entrepreneurship		
Birth rate of employer firms	1	Reg
Growth rate of young firms	-	Reg

Note: (*) = indicator available at national level, (**) = indicator available at national level, could be constructed analogously at the regional level,
Data sources: Burning Glass Technologies (**BG**), OECD **ICT** Access and Usage by Businesses Data, Labour Force Survey (**LFS**), **PATSTAT**

Annex B. Background documentation SME digitalisation

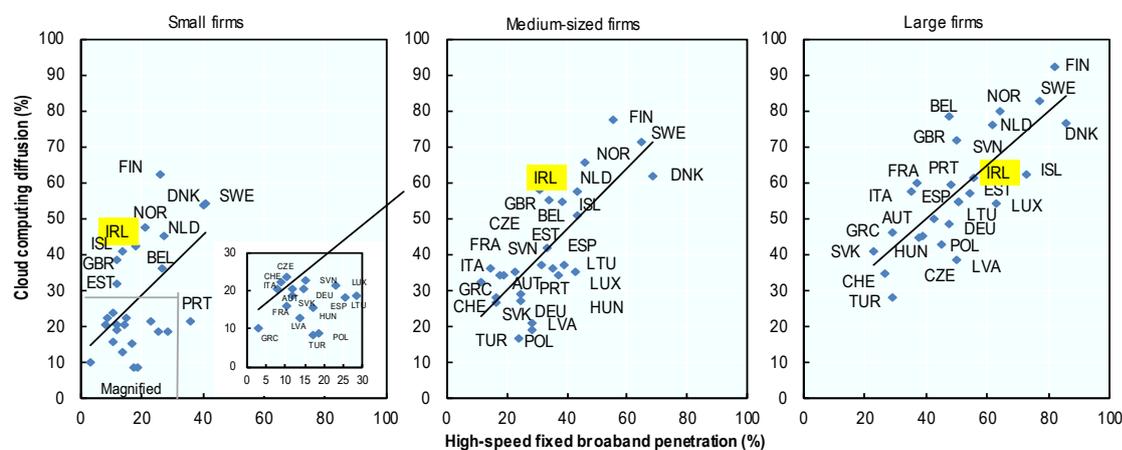
The digitalisation of SMEs has been a priority within OECD work in recent years. The report *SMEs and the Digital Transformation* (OECD, 2021^[7]) documents various aspects of digitalisation, including for instance cyber security, and presents a variety of comparative graphs cross country that shows the uptake of various digital technologies.

The OECD has also launched the Digital for SME (D4SME) Global initiative, as a platform for cooperation to support the digitalisation of SMEs.¹⁸

The following graphs document aspects related to digital performance, as discussed in Box 2.1.

Figure A B.1. High-speed fixed broadband and cloud computing penetration rates

By firm size class, 2018



¹⁸ <https://www.oecd.org/going-digital/sme/>

Figure A B.2. Social media use by firm size class

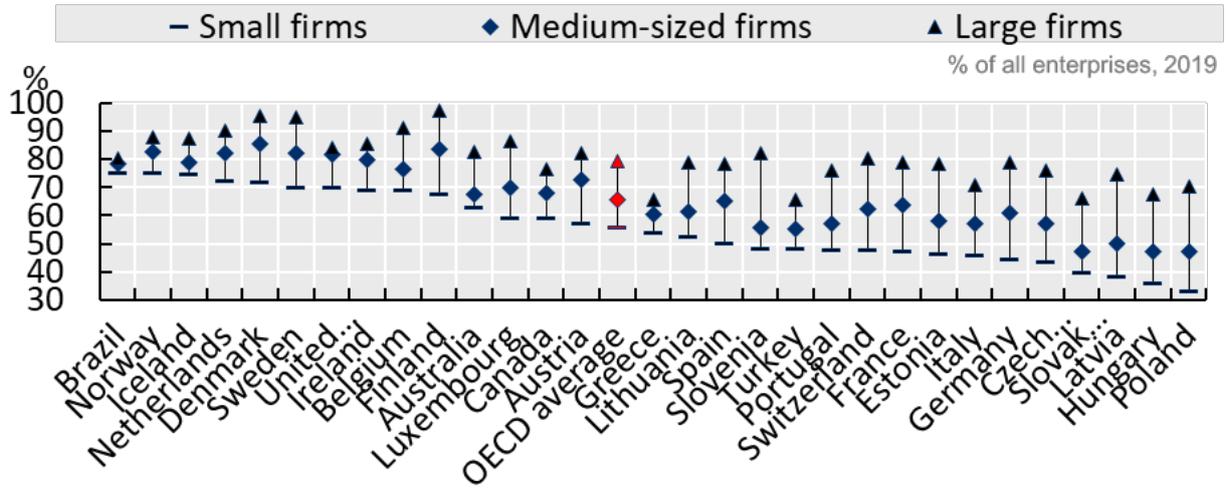


Figure A B.3. E-Commerce use by firm size class

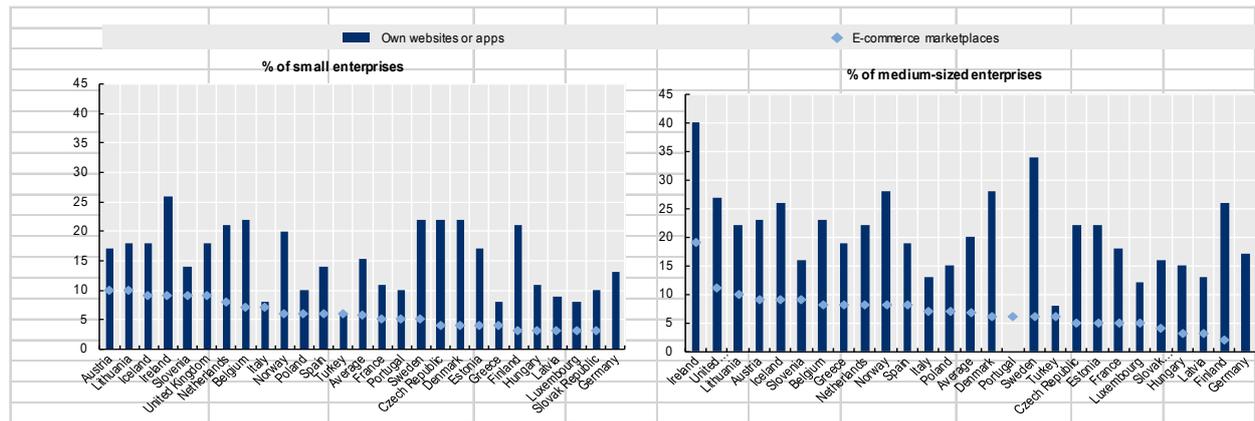
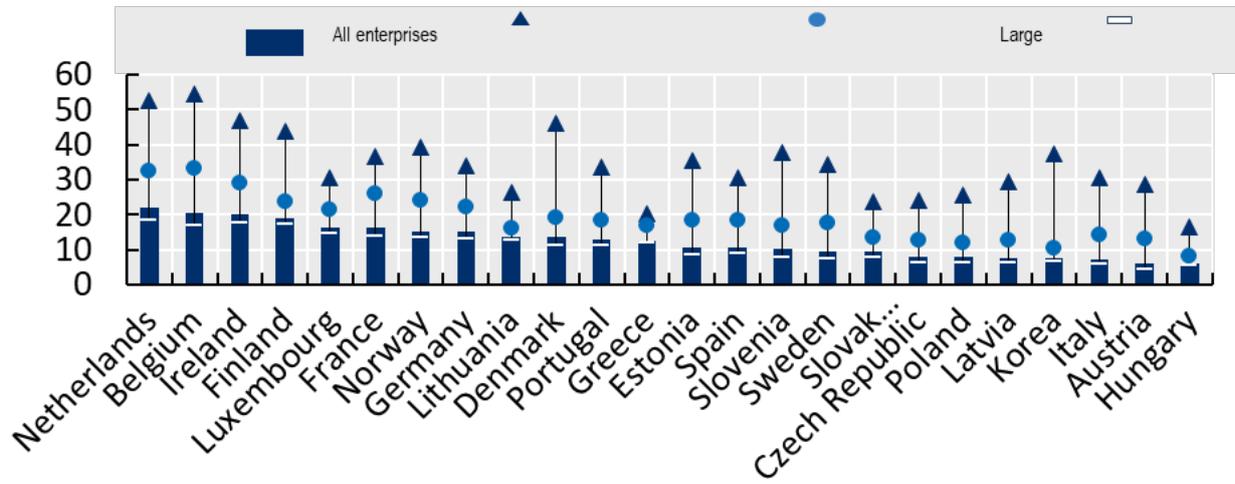


Figure A B.4. Use of big data by firm size class



Annex C. Overview of research centres in the region

- CÚRAM, SFI Research Centre for 'Smart' Medical Devices
- INSIGHT, SFI Research Centre for Data Analytics
- ICHEC, National centre for High-Performance Computing
- WiSAR, EI Technology Gateway for Wireless Solutions
- PEM, EI Technology Gateway for Precision Engineering and Manufacturing
- MET, EI Technology Gateway for Medical and Engineering Technologies
- National Centre for Laser Applications (NCLA)
- Centre for Chromosome Biology (CCB)
- Regenerative Medicine Institute (REMEDI)
- National Centre for Biomedical Engineering Science (NCBES)
- Network of Excellence for Functional Biomaterials (NFB)
- Whitaker Institute
- Ryan Institute
- Power Electronics Research Centre
- St Angela's Food Technology Centre
- Centre for Research in Social Professions (CRiSP)
- Centre for Environmental Research Innovation and Sustainability (CERIS)
- EpiCentre
- Wind Energy Centre
- Cavan Institute
- Marine and Freshwater Discovery Centre
- Centre for Integrated Sustainable Energy Technologies
- Monaghan Institute

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