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Making Innovation Benefit All: **Policies for Inclusive Growth**

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EXECUTIVE SUMMARY

Inequalities are one of today's most pressing challenges facing OECD countries. Over the past three decades, income disparities have risen to unprecedented levels, with the richest 10% in the OECD area earning almost ten times more than the poorest 10%. People who are economically disadvantaged often also fall behind in other non-income dimensions of well-being. Fostering inclusive growth – that is to say, economic growth that creates opportunities for all population segments and distributes the dividends of increased prosperity fairly across society – is a key policy objective across OECD countries.

Digital innovations affect inclusive growth as they support welfare and disrupt the way markets operate

Innovation has long been recognised as a key driver of economic growth, but it can also promote social inclusion. Today, innovations stemming from information and communication technologies (ICTs) can contribute towards inclusive growth in several ways. Welfare gains arrive through the increasing flow of more affordable products and services of higher quality. This includes also products and services in the health and education sectors, both of which are critical dimensions of well-being. For instance, Massive Online Open Courses, or MOOCs, provide individuals opportunities to learn via the web, often for free and at any time.

ICTs have also had fundamental impacts on the economy, disrupting not only key products but also the way markets operate – possibly changing competition dynamics, labour supply requirements and opportunities for individuals to create value. Further technological change, including notably artificial intelligence and robotics, may still accentuate these changes. All these "digital innovations", defined as new products and processes, in and beyond IT industries, based on or embodied in software code and data, are giving rise to extreme scale economies and network effects which in turn allow winner take all

market structures. Such concentrated markets are a source of innovation-based rents, which are then redistributed to shareholders, senior managers and key staff, hence increasing the income share of the top income groups, to which these categories of the population usually belong.

While overall regional gaps in innovation capacities have narrowed, significant disparities persist within OECD countries

Regions within OECD countries show significant differences in their innovation capabilities and investments. In spite of the increased investments in such factors within OECD countries, aimed at facilitating the local development of new technologies and other advances leading to innovations and productivity growth, productivity gaps across regions have been widening over the past 20 years. Questions have been raised about how and to what extent policy can help narrow the gap between leading and lagging regions, so as to minimise differences in productivity and well-being across geographic areas in a country.

The intensity of spatial concentration of innovation capacities varies depending on what measure of innovation is used and the country analysed. Between 20% and 65% of total R&D activities take place in the top 20% of regions, depending on the country. Also found in these regions are around 30% of tertiary-educated workers and about half of the patent applications of their respective countries. Regional concentration of innovation-related activities within OECD countries has shown a slight decline over 2000-13 – mostly due to the lesser performing regions within those countries growing faster ("catching-up" dynamics) – but remain fairly stable overall. Countries display different trends in the evolution of regional disparities.

These trends highlight considerations regarding current policy practices:

- Traditional STI policies might unintentionally favour leading regions by rewarding excellence. Such policies should take account of the impact these policies have on opportunities in laggard regions. This could be done by explicitly introducing alternative policies that focus on developing excellence in laggard regions.

- In adopting different strategies to address regional disparities, countries have tended to place greater emphasis on capacity development to ensure their success. Efforts range from improving the S&T policy capacities of regional government to supporting the regional skills base.

Innovation policies can play a crucial role in fostering inclusive growth

Innovation policies can boost the capacities and opportunities of disadvantaged individuals to engage in innovation activities, including research and entrepreneurship. Innovation policies can also support the development of new products and services that address the challenges of those facing social disadvantage.

Countries are increasingly implementing "inclusive innovation policies" – a specific set of innovation policies that aim to boost the innovation capacities and opportunities of individuals and social groups that are underrepresented in innovation, research and entrepreneurship activities. Their goal is that all segments of society have opportunities to successfully participate in and benefit from innovation (here termed "social inclusiveness"). Women, ethnic minorities, migrants and residents in poor neighbourhoods, among other groups, are systematically underrepresented in these activities in most countries, mainly due to lower capacities or skills and less access to opportunities, for example due to discrimination in the labour markets, the persistence of stereotypes, or barriers to entrepreneurship faced by certain social groups.

The particular features of a country's production system also play a central role in shaping inclusive growth. The distribution of capacities and opportunities to participate in innovation activities across firms/sectors (referred to here as "industrial inclusiveness") and regions ("territorial inclusiveness") might be the most important of these features. The industrial and territorial dimensions are closely linked to social inclusiveness. When innovation capacities are not widely distributed across sectors and regions, the well-being of individuals working in less innovative sectors and/or living in less innovative regions is affected; they suffer from multiple types of disadvantage (e.g. low skills, low income), as they are less able to move to more innovative activities.

While rationales for implementing inclusive innovation policies vary, they all share a core goal which is to tackle the misallocation of resources in the economy caused by exclusion. Correcting that misallocation is critical, both for economic growth and for job creation.

Inclusive innovation policies are complementary to other policies in promoting social inclusiveness – particularly education policies aimed at ensuring

equal access to high-quality education (from early childhood education to tertiary education) and promoting high educational attainment by all segments of society.

Higher education systems can foster inclusive growth and technology trends can support the process

Higher education systems can foster inclusive growth by enhancing more inclusive participation in education. Three mechanisms can be highlighted:

- *Offering entry to students from disadvantaged backgrounds* – If as a result of capacity limitations the tertiary education system limits entry to students with the highest qualifications and therefore does not accommodate all demand for tertiary education, individuals from disadvantaged backgrounds are more likely to be excluded.

- *Raising the availability of tertiary education in remote areas* – Solutions range from the locating (or relocating) of university campuses to the development of new distance learning services.

- *Offering financial incentives both for higher education institutions to enrol students from underrepresented groups, and for students from these groups to enrol*.

Several ongoing technology trends continue to create wider opportunities for inclusive innovation in education. ICTs bring to education the capacities both to reach massive audiences with consistent quality of content and to target groups with specialised needs. The impact of ICTs is twofold. First, these technologies may help significantly to increase delivery and coverage of educational services to the different segments of society, by offering more varied and flexible programmes and by responding to an increasing and diversified demand. For example, Massive Open Online Courses (MOOCs) allow students to engage with learning regardless of their geographical location, often for free and at any time. Second, they may have a considerable impact on the quality of education, considering that they transform the traditional teaching-learning process.

OVERVIEW OF THE REPORT

Inequalities are one of today's most pressing challenges facing OECD countries. Over the past three decades, income disparities have risen to unprecedented levels, with the richest 10% in the OECD area earning almost ten times more than the poorest 10%. Wealth today is even more concentrated than income: in 2012, the richest 10% controlled half of all total household wealth, while the poorest 40% held only 3% of the total across 18 OECD countries[1] (OECD, 2016a). People who are economically disadvantaged often also fall behind in other non-income dimensions of well-being. They often have lower educational attainment, are more likely to be unemployed or dissatisfied with their jobs, and report worse health. Certain social groups are persistently overrepresented in the lower end of income distributions, pointing to the nexus between economic disadvantage and certain social identity dimensions (such as gender, age, ethnic origin and place of residence).

High levels of inequality not only affect the well-being of the most vulnerable segments of the population, but also undermine the performance of economies generally. As those more disadvantaged generally have fewer resources to invest in skills and education, they have fewer opportunities to access more productive and rewarding jobs. Consequently, human resources in the economy are not used to the fullest degree, which negatively affects productivity growth in the long run (OECD, 2015a). In addition, widening income gaps have a negative impact on social cohesion and diminish trust in institutions, which can contribute to social and political instability.

Fostering inclusive growth – that is to say, economic growth that creates opportunities for all population segments and distributes the dividends of increased prosperity fairly across society – is a key policy objective across OECD countries. Innovation has long been recognised as a key driver of economic growth, but it can also promote social inclusion. Throughout history, innovation

has played a key role in increasing living standards and improving general well-being. Today, innovations stemming from information and communication technologies (ICTs) can contribute towards inclusive growth in several ways. Welfare gains arrive through the increasing flow of more affordable products and services of higher quality – including in the health and education sectors, both of which are critical dimensions of well-being.

The extent to which individuals can participate in and benefit from the innovation economy in part depends on the extent to which regions are home to innovation-intensive local sectors that are competitive.

Innovation policies can boost the capacities and opportunities of disadvantaged individuals to engage in innovation activities, including research and entrepreneurship. Innovation policies can also support the development of new products and services that address the challenges of those facing social disadvantage. Education policies have an important complementary role to play when it comes to building capacities; access to higher education especially is critical.

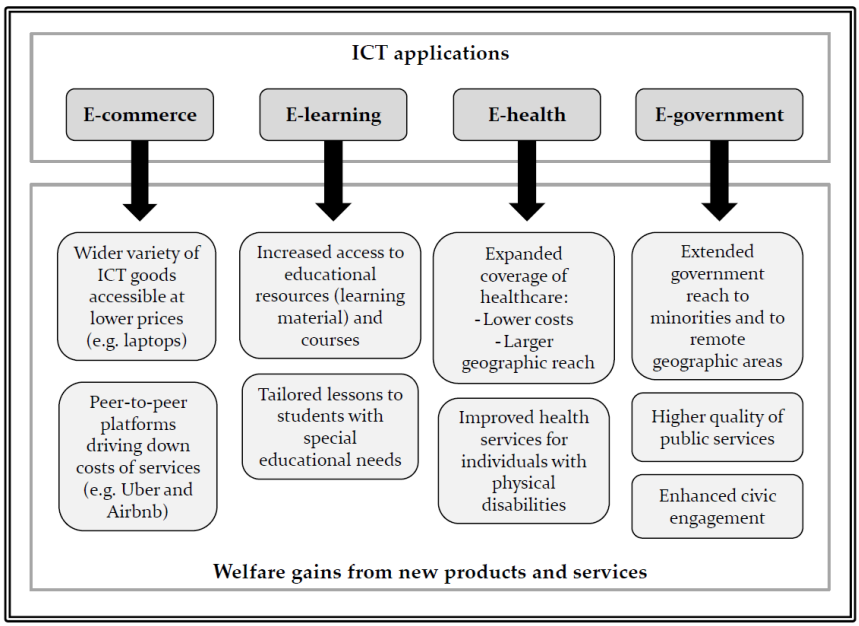
Digital innovations contribute to social inclusiveness by improving the well-being of disadvantaged groups

Throughout history, technological change and innovation have fuelled massive socio-economic transformations that have greatly raised living standards across societies. Drastic changes in the way people live and work have been propelled by the advent of general purpose technologies such as the steam engine and electricity. In recent decades, ICTs have similarly driven productivity and economic growth.

Specific benefits for disadvantaged individuals arise from new goods and services. As prices in ICT products have declined with technological progress, these become available to more consumers, including those who could not afford them before. Digital innovations may improve their welfare either directly by improving their quality of life, or indirectly by providing opportunities for education at lower costs that eventually lead to higher capabilities to generate income. For instance, Massive Online Open Courses, or MOOCs, provide individuals opportunities to learn via the web, often for free and at any time.

Digital technologies have improved opportunities for consumers to find best products at affordable prices, and have also improved education, health and government services in ways that have favoured social inclusion (Figure OR.1). Measuring the impacts of such applications has proved difficult, given the largely non-monetary nature of welfare gains associated to digital innovations. Digitalisation has increased the wedge between metrics of production and welfare, reinforcing the need to complement GDP with other indicators such as consumer surplus (Ahmad and Schreyer, 2016). In particular, while the production value of free digital products is captured by the underlying financing sources bearing their costs (e.g. advertising and big data), this production value does not reflect the consumer value (or welfare) generated by these products.

Figure OR.1. Selected ICT applications and associated benefits for inclusiveness



Further contributions that emerging digital technologies are making toward inclusive growth include:

- the Internet of Things (IoT) – devices and objects that can be manipulated via the Internet, with or without active human involvement

- Big data analytics – a set of techniques used to interpret large volumes of data generated by the increasing digitisation of content, greater monitoring of human activities, and the spread of the IoT

- Artificial intelligence (AI) – the ability of machines and systems to acquire and apply knowledge and to carry out intelligent behaviour

- Blockchain – a database that enables value transactions within computer networks and without the necessity of a central institution or third party.

Policy makers could leverage the potential of digital innovations further by:

- Incentivising IoT, big data and AI applications in healthcare and education that benefit disadvantaged and excluded groups. Many prospective applications are led by the public sector. For instance, in the IoT this includes not only the development of connected equipment (diagnostic devices) in public hospitals, but also the underlying digital infrastructures (e.g. databases). Potential efficiency gains in healthcare also motivate the consideration of IoT and AI technologies in R&D and innovation-funding schemes.

- Employing and experimenting with big data tools for policy design and implementation. These tools offer possibilities for gathering information about target groups in disadvantaged conditions; for better tracking of the factors leading to social exclusion; and for monitoring policy implementation.

- Continuing efforts to reduce the digital divide – i.e. narrowing inequalities in access to ICT and disparities in the skills necessary to effectively use these technologies. With regard to Internet access, countries can extend broadband coverage by encouraging investment and competition in the private sector (OECD, 2016b). This also requires ensuring that individuals have adequate skills to leverage opportunities of ICTs.

At the same time, ICTs have drastically changed firm activities such as organisational processes, manufacture, and service delivery. These technologies bring with them opportunities for new business models: micro-entrepreneurs for instance already employ peer-to-peer platforms to find employment.

The extent to which new business models result in inclusive growth more broadly depends on whether individuals and firms are able to adapt to those changes and make the most of them. Regional conditions (e.g. human capital endowments and the institutional setting) critically impact on individuals' and firms' capacities to remain highly productive and innovative in contexts of technological change.

The increased importance of digital innovation may also challenge inclusive growth

Digital innovations have introduced changes to society and economic systems of a magnitude similar to prior industrial revolutions. ICTs have had fundamental impacts on the economy, disrupting not only key products but also the way markets operate – possibly changing competition dynamics, labour supply requirements and opportunities for individuals to create value. Further technological change, including notably artificial intelligence and robotics, may still accentuate these changes.

All these "digital innovations", defined as new products and processes, in and beyond IT industries, based on or embodied in software code and data, are giving rise to extreme scale economies and network effects which in turn allow winner take all market structures. Such concentrated markets are a source of innovation-based rents, which are then redistributed to shareholders, senior managers and key staff, hence increasing the income share of the top income groups, to which these categories of the population usually belong.

While overall regional gaps in innovation capacities have narrowed within OECD countries, significant disparities persist

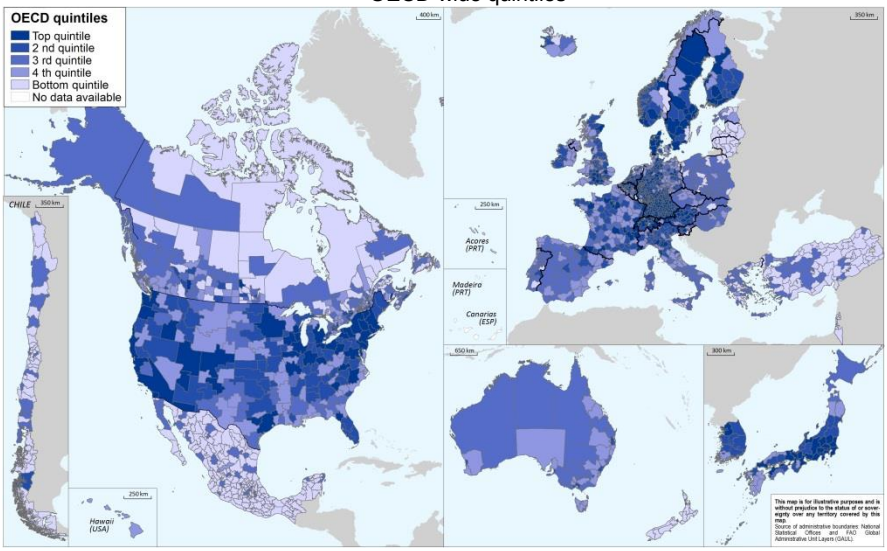
Regions within OECD countries show significant differences in their innovation capabilities and investments. In spite of the increased investments in such factors within OECD countries, aimed at facilitating the local development of new technologies and other advances leading to innovations and productivity growth, productivity gaps across regions has been widening over the past 20 years. Questions have been raised about how and to what extent policy can help narrow the gap between leading and lagging regions, so as to minimise differences in productivity and well-being across geographic areas in a country.

The intensity of spatial concentration of innovation capacities varies depending on what measure of innovation is used. Between 20% and 65% of total R&D activities take place in the top 20% of regions, depending on the country. Also found in these regions are around 30% of tertiary-educated workers and about half of the patent applications of their respective countries (Figure OR.2).

Figure OR.2. Regional patenting intensity in OECD countries (average 2011-2013)

Patents per million inhabitants, TL3 regions

OECD-wide quintiles



Note: Regions within OECD countries are classified on two territorial levels reflecting the administrative organisation of countries. The OECD large (TL2) regions represent the first administrative tier of subnational government, for example, the Ontario Province in Canada. The OECD small (TL3) regions are contained in a TL2 region.
Source: Calculations based on the OECD Regional Database.

Regional concentration of innovation-related activities within OECD countries has shown a slight decline over 2000-13 – mostly due to the lesser performing regions within those countries growing faster ("catching-up" dynamics) – but remain fairly stable overall. This has especially been the case with R&D spending (total, business, public), as well as with R&D personnel and tertiary-educated workers. Exceptions include the number of workers in knowledge-intensive services, where the trend showed an increase in

concentration for a small majority of countries. Overall, while there is some movement in the ranking order of regions over time, leaders are more likely to stay at the top and lesser-performing regions at the bottom.

Countries display different trends in the evolution of regional disparities. In France, for example, regional disparities between the top and bottom 20% have narrowed in terms of total R&D expenditures (as a percentage of GDP), while they have widened with respect to the share of the labour force employed in high-tech manufacturing. In the United States, for public and business R&D expenditures (as a percentage of GDP), the gap between top and bottom 20% regions saw a slight increase, whereas the gap for tertiary-educated workers decreased.

These trends highlight considerations regarding current policy practices:

- Traditional STI policies might unintentionally favour leading regions by rewarding excellence. Such policies should take account of the impact these policies have on opportunities in laggard regions. This could be done by explicitly introducing alternative policies that focus on developing excellence in laggard regions.

- In adopting different strategies to address regional disparities, countries have tended to place greater emphasis on capacity development to ensure their success. Efforts range from improving the S&T policy capacities of regional government to supporting the regional skills base.

Innovation policies can play a crucial role in fostering inclusive growth

Countries are increasingly implementing "inclusive innovation policies" – a specific set of innovation policies that aim to boost the innovation capacities and opportunities of individuals and social groups that are underrepresented in innovation, research and entrepreneurship activities. Their goal is that all segments of society have opportunities to successfully participate in and benefit from innovation (here termed "social inclusiveness").

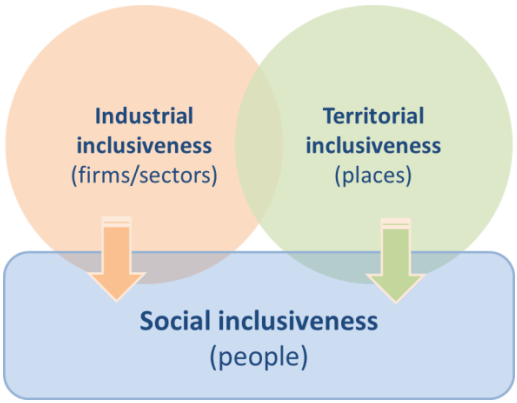
Women, ethnic minorities, migrants and residents in poor neighbourhoods, among other groups, are systematically underrepresented in these activities in most countries, mainly due to:

- lower capacities or skills (e.g. entrepreneurial and managerial skills, digital literacy, technical skills, creative competence) for example due to insufficient levels of formal education, vocational education and/or on-the-job training

- less access to opportunities, for example due to discrimination in the labour markets, the persistence of stereotypes, or barriers to entrepreneurship faced by certain social groups.

The particular features of a country's production system also play a central role in shaping inclusive growth. The distribution of capacities and opportunities to participate in innovation activities across firms/sectors (referred to here as "industrial inclusiveness") and regions ("territorial inclusiveness") might be the most important of these features. The industrial and territorial dimensions are closely linked to social inclusiveness (Figure OR.3). When innovation capacities are not widely distributed across sectors and regions, the well-being of individuals working in less innovative sectors and/or living in less innovative regions is affected; they suffer from multiple types of disadvantage (e.g. low skills, low income), as they are less able to move to more innovative activities.

Figure OR.3. Interactions among social, industrial and territorial inclusiveness



Innovation policy instruments for inclusive growth can be categorised under three distinct policy objectives: i) fostering the integration of disadvantaged groups in innovative activities; ii) addressing barriers to entrepreneurship encountered by disadvantaged groups; and iii) enhancing innovation in lagging

regions (Table OR.1). These share a common focus on improving the well-being of more disadvantaged groups by connecting them with new opportunities; strengthening their capacities to participate in more productive activities; and reducing social inequalities.

Table OR.1. Overview of innovation policy approaches to foster inclusiveness

Inclusive innovation policies to:		
Foster the integration of disadvantaged groups	Address barriers to entrepreneurship encountered by disadvantaged groups	Enhance innovation in lagging regions
Building capacities • Access to high-quality science education for disadvantaged groups • Schemes for communication and popularisation of S&T • Entrepreneurship education • Grants for researchers from disadvantaged groups • Funds to research institutions for implementing plans to improve the research environment for disadvantaged groups *Addressing discrimination and stereotypes* • Campaigns to raise awareness of the business potential of activities of disadvantaged groups • Mentoring programmes and provision of role models to incentivise disadvantaged groups *Providing incentives to invest in (inclusive) innovation* • Grants • Repayable grants	*Facilitating access to finance* • Microcredit (micro-loans) • Equity financing • Educating in finance *Providing support for business development* • Information to entrepreneurs • Coaching and mentoring • Business counselling/advice to entrepreneurs • Assistance to access new markets • Technology transfer assistance *Promoting networks involving industry, academia and the financial sector* • Innovation vouchers • Entrepreneurial networks *Improving access to talent by small businesses* • Grants to SMEs to recruit researchers/experts to implement innovation projects • Providing SMEs with access to specialised online job portals	*Accessing global knowledge and technology* • Demonstration of new technologies and training by S&T specialists • Financial support to projects that use STI solutions to address local challenges *Maximising the potential of existing assets* • Identification of sectors with potential in a region and training of potential regional entrepreneurs in those sectors • Intellectual property protection in traditional sectors • Support for regional governments to implement STI projects and develop research capabilities *Attracting innovative firms to peripheral regions* • Technology parks • Special economic zones • Grants for business R&D in peripheral regions

While rationales for implementing inclusive innovation policies vary, they all share a core goal which is to tackle misallocation of resources in the economy caused by exclusion. Correcting that misallocation is critical, both for economic growth and for job creation. Other specific rationales are presented in Table OR.2.

Table OR.2. Summary of goals of implementing inclusive innovation policies

Social inclusiveness	Industrial inclusiveness	Territorial inclusiveness
• Reduce discrimination in the labour markets by fostering the potential of certain social groups and changing the attitudes of employers and investors towards them. • Foster social mobility and inclusion by integrating disadvantaged groups in more productive activities of the economy. • Promote diversity in research and business teams to support inclusion and growth.	• Tackle the problem of a dual economy (i.e. one divided into highly innovative/productive sectors and traditional/low production sectors) by improving the competitiveness of less innovative firms. • Promote entrepreneurship from disadvantaged groups so as to foster the emergence of new economic activities (e.g. activities addressing previously underserved needs).	• Foster the development of more productive and innovation-intensive activities in lagging regions, offering better opportunities for people living in those areas. • Increase the chances of other initiatives (e.g. investment in R&D, transport infrastructure) having their intended effects on innovation performance and growth. • Strengthen regions' economic resilience and reduce their dependence on transfers from the central government.

Country experiences in inclusive innovation policies point towards a range of specific implementation challenges that do not apply to the same extent to innovation policies more generally. Table OR.3 presents an overview of those challenges and suggests some policy responses.

Table OR.3. Inclusive innovation policies: Implementation challenges and proposed policy responses

Implementation challenges	Proposed policy responses
Ensuring the involvement of the target group in policy programmes	• Design a tailored outreach strategy. • Engage the targeted group in programme design and/or implementation. • Communicate the programme's objectives, activities and benefits to the targeted group through a member of the same community/group. • Promote interaction among the target group, the STI community and government actors. • Provide information about the benefits of S&T, research and innovation. • Streamline and simplify administrative processes linked to the programme.
Establishing appropriate criteria to select the target group and support innovation activities	• Establish selection criteria that consider the motivation and potential of applicants in parallel to their skills, capabilities and previous performance. • Clearly define the scope of activities that could be supported and plan monitoring activities to ensure effective implementation. • Establish criteria to select firms with potential to become profitable businesses and create jobs. • Provide public support that is conditional on the participation of the private sector in financing the programmes. • Involve experts and the target group itself in the design of the programme structure (e.g. application procedure, eligibility rules, award criteria).
Building capabilities for the target group to undertake activities promoted by the programme	• Tailor programmes to the capabilities of the target group. • Invest in capacity-building activities. • Invest in universal, high-quality basic scientific education.
Building adequate expertise of public sector officials and experts deploying the programmes	• Provide assistance to regional authorities to enhance their capacities to design and execute projects. • Involve third parties in addition to regional authorities in the design of specific projects.

	• Set up a targeted recruitment process to select experts to deploy programmes. • Provide tailored training to experts and advisors prior to implementating the programme. • Recruit experts that already have experience with the target group or geographic area.

Inclusive innovation policies are complementary to other policies in promoting social inclusiveness – particularly education policies aimed at ensuring equal access to high-quality education (from early childhood education to tertiary education) and promoting high educational attainment by all segments of society.

Education and skills are crucial for innovation. Access to higher education continues to expand in most OECD countries, but inequalities persist

Higher education institutions have engaged in efforts to address inequalities in access to higher education, but challenges remain. In recent decades, many OECD countries experienced rapid expansion and diversification in higher education systems, supported by governments through increases in the number of publicly funded university places. However, differences in access to higher education persist in that quality education is often only accessible to students from advantaged backgrounds. These qualitative differences among programmes within an educational level are one of the factors that contributes most to perpetuating inequality.

Higher education systems can foster inclusive growth by enhancing more inclusive participation in education. Three mechanisms can be highlighted:

- *Offering entry to students from disadvantaged backgrounds* – If as a result of capacity limitations the tertiary education system limits entry to students with the highest qualifications and therefore does not accommodate all demand for tertiary education, individuals from disadvantaged backgrounds are more likely to be excluded. To address this, Chile has in place a strategy to reserve guaranteed places in public higher education for well-performing students from underrepresented groups.

- *Raising the availability of tertiary education in remote areas* – Solutions range from the locating (or relocating) of university campuses to the development of new distance learning services.

- *Offering financial incentives both for higher education institutions to enrol students from underrepresented groups, and for students from these groups to enrol*.

Several ongoing technology trends continue to create wider opportunities for inclusive innovation in education. ICTs bring to education the capacities both to reach massive audiences with consistent quality of content and to target groups with specialised needs. The impact of ICTs is twofold. First, these technologies may help significantly to increase delivery and coverage of educational services to the different segments of society, by offering more varied and flexible programmes and by responding to an increasing and diversified demand. For example, Massive Open Online Courses (MOOCs) allow students to engage with learning regardless of their geographical location, often for free and at any time. Second, they may have a considerable impact on the quality of education, considering that they transform the traditional teaching-learning process.

Notes

1 . The countries in question are Australia, Austria, Belgium, Canada, Finland, France, Germany, Greece, Italy, Korea, Luxembourg, the Netherlands, Norway, Portugal, the Slovak Republic, Spain, the United Kingdom and the United States. In the case of the United Kingdom, the geographical coverage of the data is limited to Great Britain (excluding Northern Ireland).

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CHAPTER 1. DIGITAL INNOVATION AND INCLUSIVE GROWTH

Covering recent digital innovations and key technology trends, this chapter explores the ways innovation can lead to inclusive growth. It discusses the different mechanisms through which ICTs may have effects on social inclusion via the possible impacts of ICTs on labour demand and market dynamics. It next describes how innovations based on these technologies, namely the Internet of Things, big data analytics and artificial intelligence can foster inclusiveness. The chapter concludes by presenting the ways policies can harness the potential of digital innovation for inclusive growth.

Introduction

Technological change and innovation are drivers of economic growth. The history of human development is characterised by periods of massive socio-economic development brought about by innovation. Drastic changes in the way people live and work have been propelled by general purpose technologies. Steam power fuelled the first industrial revolution in the late 19th century and, together with the internal combustion engine, revolutionised transportation and shifted populations towards cities. Electricity enabled the assembly line and mass production of consumer goods that characterised the second Industrial Revolution in the transition to the 20th century. More recently, since the 1970s, information and communication technologies (ICTs) have set the stage for a multitude of digital innovations, i.e. new products, services and processes facilitating the codified storage, manipulation and transfer of information.

Digital innovations have introduced changes to society and economic systems of a magnitude similar to prior industrial revolutions. ICTs have had fundamental impacts on the economy, disrupting not only key products but also the way markets operate – possibly changing competition dynamics, labour supply requirements and opportunities for individuals to create value. Further technological change, including notably artificial intelligence and robotics, may still accentuate these changes. All these "digital innovations", defined as new products and processes, in and beyond IT industries, based on or embodied in

software code and data, are giving rise to extreme scale economies and network effects which in turn allow winner take all market structures. Such concentrated markets are a source of innovation-based rents, which are then redistributed to shareholders, senior managers and key staff, hence increasing the income share of the top income groups, to which these categories of the population usually belong.

This chapter discusses the impacts of digital innovations on inclusive growth, including through new digital products and services that raise consumer benefits and through emerging business models for micro-entrepreneurs. Covering recent digital innovations and key technology trends, the chapter explores the ways innovation supports inclusive growth but can also hamper it. Section 1.1 gives an overview of how ICTs may affect the distribution of income inclusive growth. Section 1.2 discusses the impacts of digital innovation on labor demand and market dynamics and its possible impacts on inclusive growth. Section 1.3 describes how innovations based on digital technologies can also foster social inclusiveness. The chapter concludes with Section 1.4, which presents the challenges and policy options involved in harnessing digital innovation for inclusive growth.

1.1. How does innovation affect the well-being of disadvantaged and excluded groups?

Over the past three decades, OECD countries have experienced an increase in income inequality along with widening gaps in wealth and other types of well-being. Income disparities have grown as a result of long-term structural factors besides technological progress, including changes in product and labour market regulations, institutions and policies. In member countries, the Gini coefficient (a standard measure of inequality) increased from 0.29 in the mid-1980s to 0.32 in 2010. The richest 10% in these countries had an income 9.5 times larger than that of the poorest 10% in 2010, against 7 times 30 years ago (OECD, 2015a). The distribution of wealth is more uneven than that of income, and has probably worsened since the 2008 financial crisis. There are also significant disparities in dimensions of well-being that go beyond income and wealth (OECD, 2015b). In coming years, the dispersion of such indicators is likely to increase given several large-scale socio-economic trends (see Box 1.1).

Box 1.1. Megatrends and their impact on well-being inequalities

Inequalities have been rising in recent decades; will this trend carry on in the future? The *OECD STI Outlook 2016* considered a set megatrends expected to have a strong impact on the global economy and on the financing of innovation, on society and its relationship with STI, and on the modern state and future STI policy. Megatrends describe large-scale social, economic, political, environmental and technological changes that are slow to form but which, once they have taken root, exercise a profound and lasting influence on many if not most economic activities, processes and perceptions. The following megatrends are bound to exert additional pressure on overall well-being and inequalities.

- **Population growth patterns and climate change may spur migration to OECD countries, raising the need for inclusive growth**. The world population will continue to grow in the 21st century and is expected to nudge the 10 billion mark in the 2050s. Developing countries largely account for this growth, which will generate significant youth bulges that may lead to migration to OECD countries, requiring inclusion efforts to avoid exclusion of immigrants. Climatic changes increase the risk of severe damage to infrastructure and threaten agricultural incomes, food security and water supply. Adverse effects of climate change may result in additional migration to developed countries, as people flee homes rendered inhospitable and farmers lose arable land because of droughts (lower agricultural productivity and deteriorated food security). In addition, with fewer births and increased life spans, OECD countries will have increasingly ageing societies, bringing new health challenges specific to senior citizens.

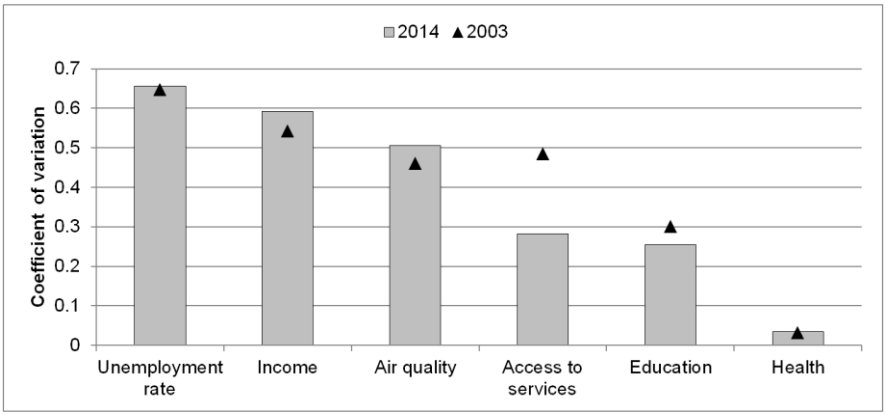
- **The increasing international fragmentation of production in global value chains, assisted by digitally enabled logistics, telecommunications and the integration of business services and global trade, may affect returns to labour and capital**. These trends in returns affect individuals' income streams, possibly threatening exclusion of groups with skills that are less required in the labour market. Depending on how wages evolve, the aging of populations, how the workforce re-skills to new labour market needs, and how fast economies create new jobs to replace those that have been eliminated, employment opportunities for some groups may be scarce.

- **Trends in urbanisation, the growth of international tourism and global migration raise additional challenges in countering both some infectious diseases and non-communicable diseases**. While these disparities are more pronounced in developing countries, where healthcare systems are less well structured, they also exist in developed economies. Within OECD countries, lower-income groups consistently report higher unmet needs for medical examination and lower perceived health status compared to higher income groups.

Sources: OECD, 2015c, 2016a; Kelley et al, 2015.

Disparities between regions are considerable (OECD, 2016b). Figure 1.1 shows the evolution of well-being inequalities across regions in OECD countries. The highest dispersion was observed in unemployment rates, followed by income and air quality, education and health indicators. Data show that during 2003-14 disparities rose in terms of earnings, environmental quality, unemployment and (only slightly) health. Nonetheless, differences among regions in terms of access to services and education were lower in 2014 than in 2003.

Figure 1.1. Regional disparities in the well-being dimension among OECD regions, 2014 and 2003



Source: OECD, n.d. and 2016c.

With regard to income inequality, the main argument for considering inequality good for growth is that it can spur growth-enhancing investments which require savings. If the rich have a higher marginal propensity to save than the poor, transferring income from the poor to the rich can encourage capital accumulation and lead to a higher steady-state level of capital and output per worker. This might be particularly important in early stages of development (Galor, 2011). However, this argument does not hold if the rich do not invest in capital to build up "modern" sectors but instead spend on consumption, including of luxury goods which contribute little to economic development (Arocena and Sutz, 2012).

Several arguments suggest instead that inequality negatively affects innovation-based growth. One is that in the presence of credit market imperfections the lack of access to capital can reduce investments in human

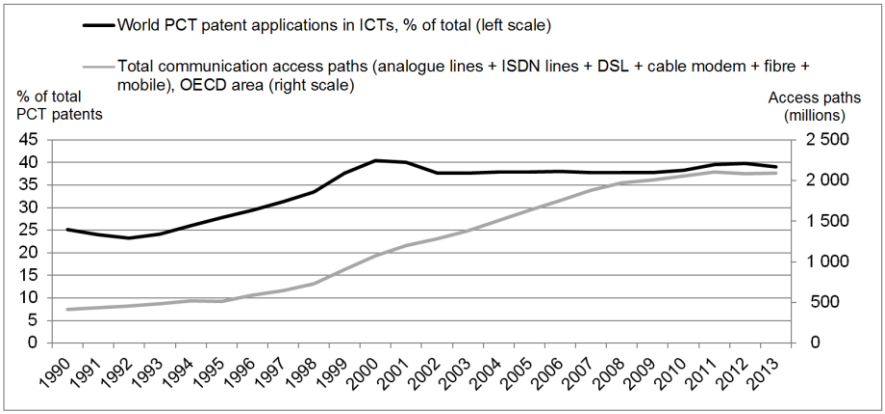
capital (Galor, 2011). Talented individuals who would benefit from further education are excluded; only those with financial resources are educated. Also, if talented but low-income entrepreneurs have limited access to financing, potentially successful projects cannot be realised. If there are production externalities such as learning-by-doing effects and knowledge spillovers, and production is characterised by decreasing returns to *individual* capital investment, then lower inequality fosters growth (Bénabou, 1997). Since capital market imperfections are greater in emerging and developing countries, the downsides to inequality described here are likely to be much more important than in developed countries and to persist over time. Moreover, inequality can lead to conflict, corruption and crime and therefore to policy making that focuses less on fostering growth. Inequality also produces greater scope for discrimination across gender, ethnicity or other criteria and when resources are not allocated according to ability there are costs to the economy.

In addition, it has been argued that inequality is bad for growth because growth-enhancing institutions cannot be developed without a broad middle class (Easterly, 2007). It is also argued that a strong middle class fosters growth and innovation through demand for mass-produced innovative manufacturing goods which the poor cannot afford. The middle class plays a central role in creating domestic markets (Birdsall, 2010). Other contributions of the middle class include fostering entrepreneurship, shaping demand and making it politically more feasible to engage in policy reforms and implement institutional changes and public investments for growth.

Digital technologies have been driving productivity and economic growth in recent decades. Figure 1.2 shows the growth of the ICT sector between 1990 and 2013. During this time, the share of PCT (Patent Cooperation Treaty) patent applications in this field grew by 14 percentage points worldwide: from 25% to 39%. In the OECD area, the number of communication access paths has grown by 5 times during this period, from around 400 million to 2 billion. Evidence shows that between 2001 and 2013, the contribution of ICT investment to annual growth in GDP was between 0.15 and 0.52 percentage points in OECD countries (OECD, 2015e). Positive effects of ICTs on productivity have also been demonstrated at both the industry and firm levels (see e.g. Bresnahan, Brynjolfsson and Hitt, 2002; Stiroh, 2002; Czernich et al., 2011). The extent to which these contributions will continue is a matter of debate (OECD, 2016b). Some predict that emerging innovations in ICTs will fall short of past general purpose technologies, even if the perceived quality of goods increases (see e.g. Cowen, 2011; Gordon, 2016). Others argue that digital innovations continue to transform developed economies

but their impact on productivity metrics is subject to lags (Brynjolfsson and McAfee, 2011).

Figure 1.2. The growth of the ICT sector during 1990-2013

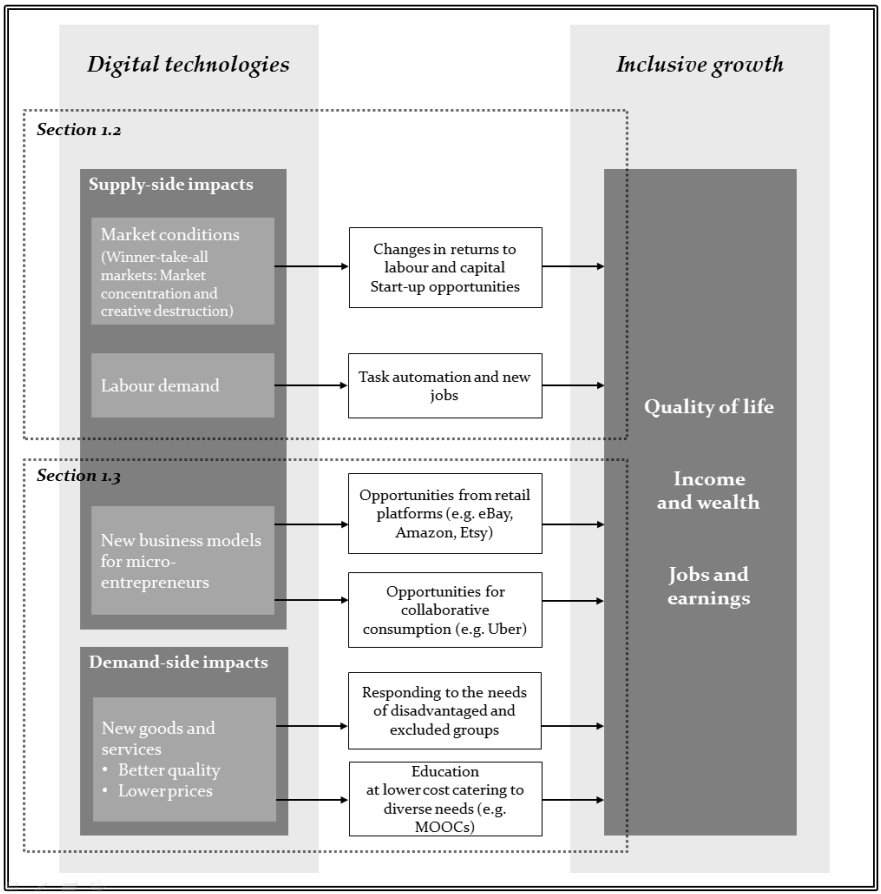


Notes: PCT stands for Patent Cooperation Treaty; ISDN stands for Integrated Service Digital Network; DSL stands for digital subscriber line.

Source: OECD, 2015e.

Digital technologies influence inequalities in a number of ways. Figure 1.3 depicts the different impacts of digital technologies on inclusive growth which can be divided into supply- and demand-side impacts. The former refers to the effects on firms' activities, including entrepreneurship opportunities, organisational processes, manufacture and service delivery. The latter capture the impacts digital products and services have on consumers.

Figure 1.3. Impacts of digital technologies on inclusive growth



1.2. Digital innovation's impacts on markets and implications for inclusive growth

Supply-side effects of ICTs have also important impacts on inclusive growth. Digitalisation has modified competitive advantages in firms by reducing the cost of innovation in certain industries, increasing labour productivity, and enhancing economies of scale. The effects of these impacts in economies and societies were discussed at the 2016 OECD-World Bank Symposium on Innovation and Inclusive Growth (see Box 1.2).

Box 1.2. Symposium on Innovation and Inclusive Growth, 28-29 April 2016

ICTs have facilitated disruptive innovations, fundamentally creating opportunities for productivity improvements, economic growth, and enhanced well-being. This emerging digital economy poses multiple challenges for policy, as it raises doubts about received views on the key underpinnings of economic growth and global competitiveness for developed, emerging and developing countries alike.

In this context, a joint Growth Dialogue, OECD and World Bank event brought together leading experts and policy makers from advanced, emerging and developing economies to discuss the impacts of the main technologies (see OECD and World Bank, 2016a). Among other issues, the symposium explored: i) the potential new technologies have as engines of growth; ii) the extent to which technologies such as automation are disruptive for industry and people; and iii) the salient policy implications. Below are the main messages that emerged from the symposium.

- To date, productivity growth stemming from the latest generation of digital technologies has been weak. This can only partly be explained by inappropriate measurement. Some technologies may not yet be sufficiently mature to transform all industries and bring productivity benefits.
- Innovation generates temporary rents and can foster social mobility through a process of creative destruction. Innovation generates rents particularly for the top 1% of the income distribution. Continuous market competition is required to avoid the formation of interest groups with too much influence capable of swaying government decisions to capture temporary rents, and make them permanent.
- New technologies may result in significant job displacement over the next decades. Policies need to manage the transition, which includes offering opportunities to re-skill workers to meet new demands of labour markets.
- Developing countries have opportunities to leapfrog to new technologies and catch up more quickly with leading economies, but for this to happen they need to invest in infrastructure and human capital.

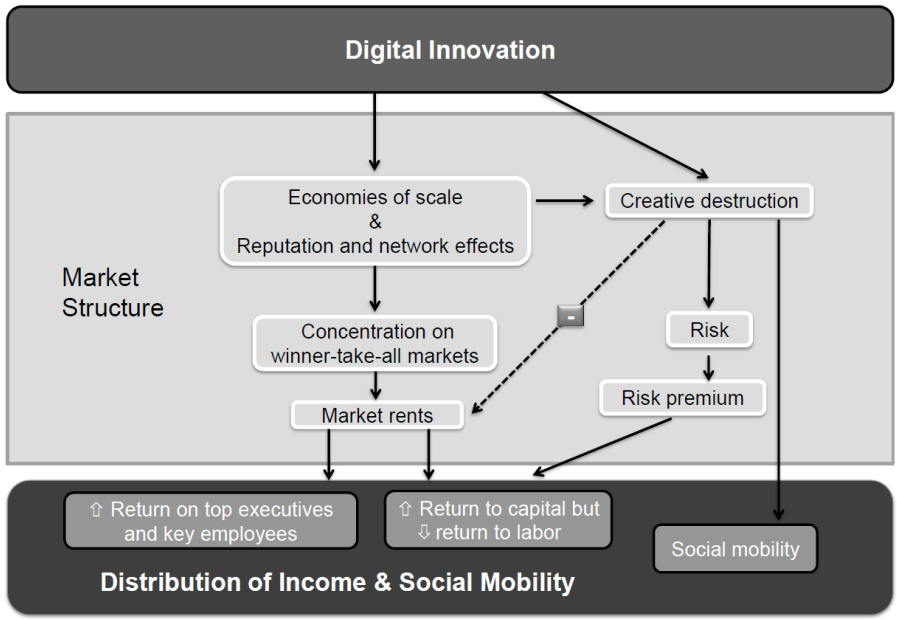
Source: OECD and World Bank, 2016b.

1.2.1. Digital innovation and market conditions[1]

Digital innovations, defined as new products and processes, in and beyond IT industries, based on or embodied in software code and data, are giving rise to extreme scale economies and network effects which in turn allow winner take all market structures. Such concentrated markets are a source of innovation-based

rents, which are then redistributed to shareholders, senior managers and key staff, hence increasing the income share of the top income groups, to which these categories of the population usually belong. Figure 1.4 summarizes the mechanisms.

Figure 1.4. Impacts of digital innovation on market structures and the distribution of income



Source: Paunov and Guellec (2017).

This issue has received surprisingly little attention in spite of mounting evidence of the increasing importance of rents (CEA, 2016) and in spite of evidence that in recent years the evolution of top incomes owes much to increased returns to capital (Piketty et al., 2016). The explanation adds to others that point to globalization, the financialisation of the economy, unskilled-labor-displacing technologies and the weakening of trade unions as causes of growing income inequalities.

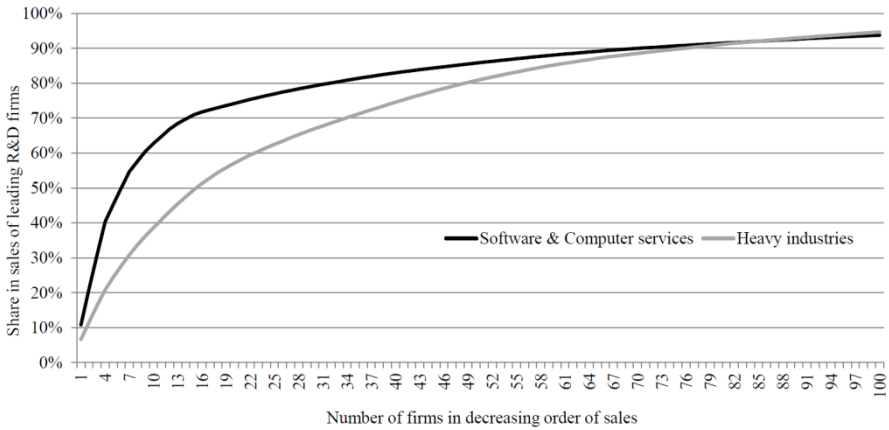
The impact of digital innovation's on the income distribution goes through market structures. It has been recognized since Schumpeter (1911) that innovation requires and generates market rents: Successful innovation endows innovators with a temporary exclusivity over their innovation, based on first-mover advantage, intellectual property rights (IPR) protection, brand reputation, network effects and various types of entry barriers. This exclusivity allows firms to set prices above the marginal cost and gain rents. The non-rivalrous (intangible) nature of knowledge means that the costs of new ideas comes mainly from their development – typically through R&D, design and market research – while costs of implementing and diffusing them are lower than, notably, tangible goods. This gives rise to increasing returns to scale; the more an idea is applied the lower is the average cost. Increasing returns to scale favor concentrated market structures, where in the end only a few companies supply most of the market as large quantities mean lower cost.

With digitalization – i.e. with wider use of information technology (IT), software and data – these effects are magnified. The marginal cost of production of digital products is essentially nil, all the cost is fixed and lays with initial innovation. Increasing returns to scale and the rents that arise are tied essentially to the "intangible" component of a product, hence products which are purely intagible like digital products are subject to extreme returns to sacle ("scale without mass"). These effects apply beyond the IT sector because many products and processes in traditional, tangible industries increasingly include software code and data. Increasing returns to scale give rise in turn to natural monopolies, "winner take all" market structures, in which one firm or at most a few firms supply the entire market. These same dynamics can also facilitate entry and creative destruction. Hence, an increasing number of industries are subject to "winner-take-all" structure (Rosen, 1981). Such market concentration allows the winner to extract a rent, by raising the price of output and/or lowering the price of inputs. Moreover, globalization has allowed successful firms to dominate not only their national market but also the global one, hence increasing the size of their rent.

Assessing the market shares of these global actors is challenging as competition has become global and national-level data only capture resident firms but not all market competitors. As an imperfect proxy, Figure 1.5 contrasts the market concentration in the software & computer services to heavy industries for the subset of R&D spending firms as captured in the EU R&D Scoreboard, showing much larger concentration in the industry most associated with digital innovation. There are of course many other factors influencing market

concentration and further analysis is needed to identify market conditions associated with the digital economy.

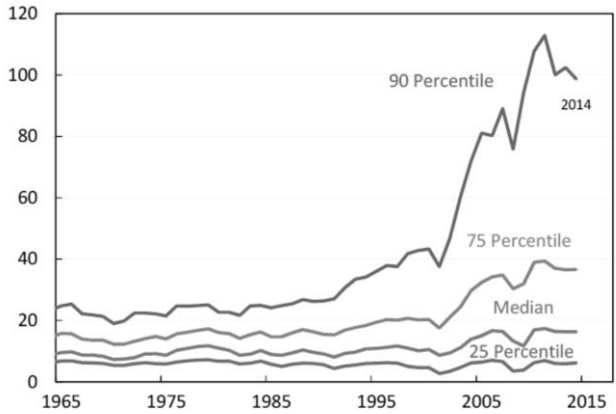
Figure 1.5. Distribution of the 100 largest firms in terms of sales among the top R&D firms within the software and computer series and heavy industries sectors in 2015



Source: Paunov *and Guellec (2017) based on EU R&D Scoreboard 2016.*

The evolution of firm profits is also consistent with increasingly "winner-takes-all" market structures: in the United States the top percentiles of firms ranked by the return on invested capital (ROIC) have grown most significantly, from 40% to 100% while the lowest percentiles (25^{th}) had a constant ROIC and the median increased slightly (Figure 1.6).

Figure 1.6. Return on invested capital excluding goodwill, US publicly traded nonfinancial firms

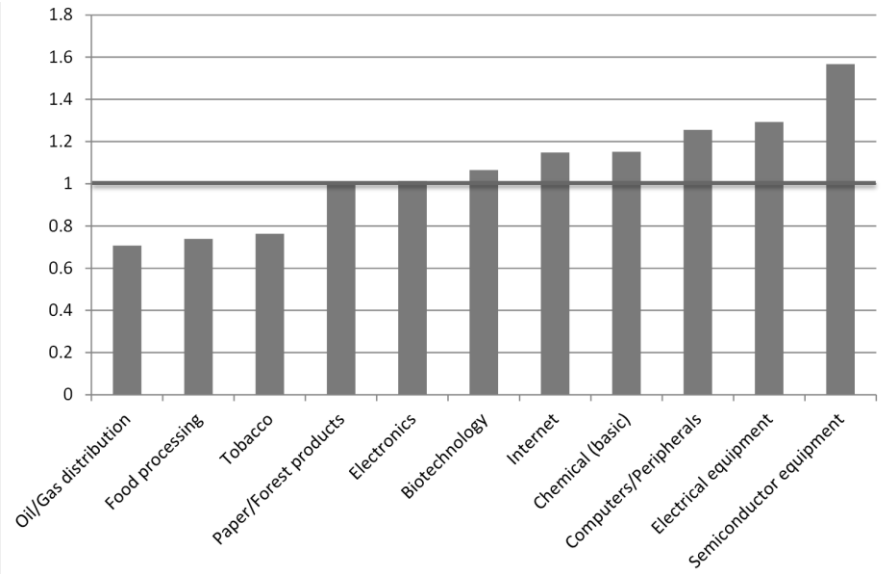


Source: Furman and Orszag, 2015 based on Koller et al. (2015)

On the other hand, digital innovation also raises opportunities for "creative destruction" as it reduces barriers to entry on many markets. The capital requirement for programming software, the core of digital innovation, is much lower than for other types of innovative activities, such as those requiring special facilities to develop innovations (e.g. laboratories and experimental settings in pharmaceuticals). Lower barriers to entry favour the arrival of new innovation, which can superseed established one - creative destruction. The "intangible" nature of knowledge and the easinness to upscale facilitate creative destruction. For instance, all current giants of the Internet have started small and grown fast, generally replacing other companies which were dominant beforehand on the corresponding market.

Volatility measures of financial investments also point to higher risk in more innovation-intensive sectors: betas that estimate investment volatility are higher than 1 (indicating greater risk compared to the entire market) in the biotechnology, Internet, computer and electrical equipment industries while less knowledge-intensive industries, such as food processing and tobacco, display lower in the United States (Figure 1.7). Also, Faurel et al. (2015) show that US firms registering more new trademarks faced higher volatility of stock market return and earnings.

Figure 1.7. Estimates of selected sectors' betas relative to the entire financial market for US firms over 2008-12



Note: The beta of a sector is a measure of the volatility, or systematic risk, of a financial investment in a sector in comparison to the financial market as a whole. The betas are estimated by regressing weekly returns on stock of companies within a sector against a benchmark index representative of the financial market which is the NYSE composite index. Regressions are based on data within a time window of 5 years previous to the reference year. The beta is unlevered by the market value debt to equity ratio for the sector making use of the following formula: Unlevered Beta = Beta / (1 + (1- tax rate) (Debt/Equity Ratio)). The unlevered beta is the beta that would be obtained if the investment was on a company without any debt. The risk of an investment is in general higher when the ratio between debt and equity within a sector is higher. In this way, the focus is on the level of risk, which is only driven by the characteristics of the sector other than the financial structure of companies within the sector. Further details can be found at: http://pages.stern.nyu.edu/~adamodar/ .

Source: Paunov and Guellec (2017) based on data by Aswath Damodaran computed from data from Bloomberg, Morningstar, Capital IQ and Compustat.

Where opportunities for creative destruction arise, the level of risk is much higher than in the past: while on a traditional market, a new, superior product may reduce the market share of incumbents, on a winner-take-all market, new, (even slightly) superior products can result in new suppliers taking over the entire market. Incumbents have a higher market share than firms in other markets, but they run the risk of losing it all. As winner-take-all generates more dispersion in market shares, creative destruction on such markets creates more risk for the

incumbents (they have more to lose than on a traditional, more equally distributed market).

Higher risk leads investors to demand a risk premium, excluding investment with lower expected returns, then increasing the average return to capital. These dynamics are most visible on the venture capital market but they extend to other types of investment as well. This increase in risk explains in part why the average return on capital together with its dispersion between firms have increased over the past two decades (Furman and Orszag, 2015).

How do the rents from digital innovation affect income distribution? They are shared among shareholders of the winning firms, top executives and some key employees. Then these rents have mainly benefitted the top tier of the income distribution (who own capital and managerial and leading positions in firms), hence contributing to increased income inequalities. In the United States shareholders have benefitted from a steady increase in dividends and share price over the past decades. This came with an increased average level and dispersion in profits across firms (that investors can accommodate by pursuing portfolio diversification strategies). The share of capital (vs. labor) in national income has also increased in the United States and other OECD countries, particularly in innovation-intensive economic activities. There are of course also other factors that have played a role. Top executives have benefitted from increased compensation, with the spreading of high powered incentive schemes (like stock options and bonuses), which are aimed at monitoring their decisions in an environment of winner-takes-all dynamics and higher risk (Hall and Liebman, 1998). Evidence for the United States suggests that the ratio of executive compensation relative to net sales to the top 10^{th} percentile of executives is particularly high for IT-related services and innovation-intensive manufacturing.[2] These sectors provide higher pay relative to their sectors' size to the top 90^{th} percentile than finance.

Several pieces of evidence point to the relation of higher pay to executives. Importantly, there is the more intensive use of high-powered incentives such as stocks and stock options that give executives a share in the company's profits, boosting the pay for the winners and, in theory, punishing losers (Lerner and Wulf, 2007; Hall and Liebman, 1998; Murphy, 1998). More than three quarters of executive pay in 2014 were due to non-wage compensations up from more than half in 1992. Also, Gabaix and Landier (2014), show that CEOs have larger rewards in larger-sized firms. Although not identical, firm size and market power are correlated.

One mechanism working in the opposite direction, of reducing the intergenerational transmission of income inequalities, needs to be noticed. Lower entry barriers that facilitate creative destruction also enable increased social mobility, as newcomers can displace incumbents. Turnover in the top income categories has actually increased in recent decades, and is positively related to the intensity of innovation activity (as e.g. across US states in Aghion et al., 2015).

1.2.2. Digital innovation and labour demand

The decreasing cost of computing power and other advances in digital technologies also affects the demand for labour. There is evidence pointing to the impacts of the current wave on technological change on the demand for workers with more education and abstract skills, giving support to the skill-biased technical change (SBTC) hypothesis. Specific attention has been given to the effects of automation on a wide range of manual and repetitive tasks, leading to the displacement of jobs, particularly those of middle-skilled workers (e.g. accounting and clerical work). Displaced workers often shift to low-skill jobs, polarising labour markets and widening wage inequalities as income distributions are hollowed out at the middle.

Evidence suggests that digital technologies have largely favoured skilled workers. For instance, broadband access and computer use have been found to increase the wages of skilled workers (Spitz-Oener, 2008; Grimes et al. 2012; Akerman et al. 2015). The returns to skills observed in wages vary however across countries. One key determinant in this variation is the supply of skilled workers in labour markets. As a wider share of the population possesses higher educational attainment, the wage premium associated to ICTs decreases. The impacts of digital technologies on labour productivity are more evenly shared. Along these lines, evidence indicates that Scandinavian countries, having the highest enrolment rates for undergraduate education, display the lowest returns to skills among OECD member countries (Hanushek et al., 2015).

Computers have displaced jobs particularly those having to explicit (codifiable) routine tasks that follow precise and well-understood procedures such as clerical work (e.g. accounting) and some physical operations in production lines. Middle-skill jobs are commonly intensive in these tasks and thus are particularly affected by automation. Evidence suggests routine manufacturing and clerical jobs in a wide range of sectors are increasingly automatised (Autor et al., 2008; Autor, 2015; Goos and Manning, 2007). Industries with higher investments in ICTs have seen a greater reduction in the proportion of workers performing routine tasks and

an expansion in the share of workers performing non-repetitive intellectual tasks (Autor et al., 2003). Similarly, several studies report job polarisation in many European countries including France, Germany, Greece, Portugal, Sweden, and the United Kingdom (Goos et al., 2014).

At presents, tasks that are hard to describe as a set of steps and are bounded to particular circumstances remain impervious to automation (Autor, 2015). These tasks are more abstract in nature and often involve problem-solving capabilities, intuition, creativity and persuasion. Automation and SBTC trends are polarising the occupational mix and increasing gaps in wages as middle-skilled workers are hollowed out labour markets. These gaps in wages are compounded by a rise in low-skill service jobs that are not substitutable by automation.

However, advances in machine learning and artificial intelligence may increase the range of jobs being displaced (Berger and Frey, 2016). Such progress permits the development of some machine functionalities that rival human performance, even in tasks where humans were long thought to possess a permanent cognitive advantage over machines (Elliott, 2014). Predictions regarding net impacts on employment are still a matter of debate (see e.g. Frey and Osbourne, 2013; Arntz et al. 2016). However, middle-income classes could see additional pressure, as an increasing number of administrative, cognitive and analytical jobs may be performed by data- and AI-empowered applications.

Regarding job creation, historical evidence is overwhelmingly positive regarding the long term economic and labour market effects of technological change. However, history also suggests that transitions to new technological paradigms may take long. Indeed, in the case of the first industrial revolution the shift to higher average living standards took many decades, often longer than the typical working lifetime (Mokyr, Vickers and Ziebarth, 2015).

Digital innovations (including those improving processes in production and services) are also creating new jobs necessary to deliver those innovations. Industries experiencing a fast penetration of ICTs are increasingly demanding workers with analytical and interpersonal skills. However, while these technologies are creating new occupations and industries, they have yet to have a substantial impact on the aggregate demand for skills (Berger and Frey, 2016). The proportion of employment generated by ICTs in the OECD area remains negligible at less than 3% in 2013 (OECD, 2015). The specific types of work brought by new technology are however hard to predict.

Digital technologies have also given an impulse to the emergence of the "gig economy", meaning a change in labour status: an increasing number of workers perform multiple part-time jobs. Digital peer-to-peer platforms (e.g. Uber) provide individuals opportunities to find temporary employment in a wide range of services by linking them to consumers in the relevant markets. While such platforms offer opportunities for self-employment, they raise several challenges regarding the precarious conditions faced by workers along with how this forms of work should be regulated

1.3. Contributions of digital products to social inclusiveness

The following sections focus on demand-side factors, i.e. the impacts on product markets that improve the purchasing power and well-being of disadvantaged and excluded groups. The disadvantaged and commonly excluded groups that stand to benefit include the elderly and the disabled, ethnic minorities, low- and middle-income entrepreneurs, and individuals at the lower end of the distributions of income and wealth. Digital products and services have become less expensive and are often accessible for free to consumers. This is the case with two-sided markets where consumers have free access to a service that is paid for by another client; an example is a Google search funded by advertisements. Low or no cost can be explained by the often negligible marginal cost of producing or distributing an additional unit of software or digital service; the cost of distributing a given mobile app to one or millions of smartphones is virtually the same. Another explanation is the capacity of computing power of microchips (in terms of processor speed and algorithm sophistication), which has doubled roughly every 18 months since the 1950s. This development, known as Moore's Law, has contributed to the rapid decrease in the price of physical goods such as laptops and smartphones. It has also allowed for much cheaper analytics made possible from more rapid processing.

New goods and services and lower prices for consumers have critical impacts upon social inclusion. As prices in ICT products and services decline, consumer surplus[3] increases with respect to such goods. These products may improve the well-being of disadvantaged and excluded groups, either directly by improving quality of life or indirectly, for instance by providing opportunities for education at lower costs that eventually lead to a higher capability to generate income. In the case of several digital products, lower prices also lead to increased access, as goods (and their associated welfare gains) become available to consumers who could not afford them before. An illustrative example is the

growing share of long-distance calls that are placed through Voice over Internet Protocol services such as Skype, FaceTime and WhatsApp.

ICTs have also improved the quality and expanded the variety of a number of available products and services. Platform-based services such as Airbnb provide a wider range of accommodation options compared to hotels, often at lower costs. Such variety provides new types of welfare gains that especially benefit individuals in lower-income groups. The stream of innovations based on digital technologies also produces broader benefits by alleviating socio-economic problems and addressing the needs of those facing disabilities and special medical conditions.

Another important development concerns new business models for micro-entrepreneurs, i.e. self-employed individuals with few if any staff. ICTs' lower transaction costs make it easier for consumers and producers (or service providers) to match and co-ordinate exchanges. This offers opportunities for prospective micro-entrepreneurs from lower income brackets. As described in the following sections, digital technologies generally make it easier for the self-employed to get timely information regarding the demand for products and services in markets. In some instances, Internet platforms connecting buyers and sellers diminish the need to devote resources for market positioning. This is useful for lower-income individuals aiming to engage in commercial activities independently, often with flexible hours based on personal requirements and without formal qualifications. Such activities include selling craft goods (e.g. through Etsy or eBay) and providing a service such as transportation (e.g. Uber) or food delivery (e.g. Deliveroo). Buyers are able to gauge the trustworthiness of a given seller through customer ratings and other reputation mechanisms.

1.3.1. Sources of benefits and their measurement

The gains from ICTs and their applications for inclusiveness arise from a set of characteristics that are particularly helpful for inclusion. Many of the inequalities in wealth, income and well-being lie in the fact that disadvantaged and excluded groups have more difficulties participating in markets. Most importantly, lower-income groups do not have the necessary purchasing power to enjoy high standards of well-being, including health and education. This includes individuals living in remote areas where markets and public services are underdeveloped. Digital technologies alleviate these difficulties in the following three ways.

First, *ICTs help to lower information asymmetries.* That is to say, these technologies provide useful means to survey up-to-date conditions on supply and demand in many markets. The volume of information on line is extremely vast and typically available for free or at a very low fixed cost. Search engines continue to grow increasingly efficient in directing users to the information they seek. Individuals have increasingly equal access to the Internet, particularly allowing disadvantaged and excluded groups to benefit from a wider range of services in ways that were not possible before. A straightforward example is access to knowledge and education services offered on line for free. In addition, retail platforms such as Amazon allow people from remote areas to buy products that are not locally available. Greater access to information can also increase the volume of activity markets, including those that are low income. This is because buyers and sellers can use digital innovations and communicate at practically no cost to engage in exchanges.

Second, *reduced information asymmetries lower transaction costs in ways that are relevant to consumers* (see Ciborra, 1993). Transaction costs refer to the resources (such as time and money) that are required for a market exchange to take place. Digital technologies have impacts on three types of transaction costs:

- *Search costs* capture resources necessary to identify the presence of a good/service in a given market and determine where the lowest price is available. ICTs increase the amount of information and the speed at which it is collected and processed, making it easier to find goods and services (for instance through online retail platforms). However, too much information can at times be overwhelming. For this reason, some web services provide consumer advice, filter available offers and rank products in terms of price (and other attributes including quality and value for money). These services support consumers in identifying the lowest priced goods, leading to more competition among suppliers and increasing what consumers can afford to purchase.

- *Negotiation costs* reflect costs necessary to come to an agreement on the terms of exchange (including price). With the aforementioned access to up-to-date conditions on supply and demand, actors have greater negotiation power. Lower-income buyers, for instance, can learn about different vendors and substitute products and services. On the other hand, micro-entrepreneurs can also identify peaks of demand and

raise prices accordingly to draw additional income. Platforms like Uber provide a transparent method to calculate such peaks and adjust prices.

- *Enforcement costs* include resources required to verify and enforce the terms of exchange. ICTs allow economic actors to co-ordinate payment and product/service delivery more easily, while tracking the transaction's progress and monitoring its quality. Often, intermediate retail or service platforms have after-sales services with provisions ensuring that exchanges respect the agreed terms. Moreover, platforms often have reputation mechanisms allowing buyers and sellers to provide feedback on their transactions. Actors (buyers and sellers alike) can use this information to estimate satisfaction of terms in future exchanges. Consumers tend to opt for providers with better reputation and vice versa.

Third, *ICTs enable demand-side economies of scale through network externalities* (see Shapiro and Varian, 1999). Network externalities refer to the value a given user adds to a good or service by using it. Digital innovations often require a critical mass of users to be successful, i.e. they need to acquire enough users so that the value obtained from the innovation is higher than how much it costs to use it. Once such digital networks grow beyond their critical mass, value driven by network effects serves to reduce the price of existing goods and services. For instance, Skype has to a great extent exempted people from incurring costs to make long-distance calls. Wikipedia has replaced traditional encyclopaedias and cloud storage has largely removed the need for physical devices (e.g. CD-ROMs) for transferring data. Generally, individuals at the lower end of income distribution experience higher relative gains from these innovations, since their financial constraints mean they prioritise their income to satisfy basic needs. Lower-income groups thus now have greater access to long-distance calling, curated knowledge and other products than they had in the past because these are available digitally. On the other hand, network externalities give rise to economies of scale as the product becomes more valuable because people use it, attracting even more users. This in turn shapes market structures (i.e. favouring winner-take-all markets) in which digital platforms, web services and data bring about natural monopolies, with one firm becoming dominant. This could have negative implications for social inclusiveness, as mentioned in Section 1.1.

Digitalisation has brought about wide consumer benefits. In broad terms, 2007-11 estimates suggest that the value for consumers of having access to

Internet is equivalent to 5.8% of GDP in the United States (Brynjolfsson and Oh, 2012). Pantea and Martens (2014) calculated comparable estimates for five large European economies, i.e. Germany (6.3% of GDP), the United Kingdom (7.9%), France (4.9%), Italy (4.7%) and Spain (10.7%). Greenwood and Kopecky (2013) estimated that the individual welfare gain from the introduction of personal computers (PCs) was 2-3% of average consumption expenditure using 1997-2004 data. Moreover, consumers with low incomes have benefited from the rapidly decreasing prices of PCs: a typical computer's product cycle lasts 4 months and over this time-period prices fall around 9% (Copeland and Shapiro, 2015). This particularly benefits consumers at the lower end of the income distribution by allowing them to gain easier access to new computers soon after they arrive on markets.

However, measuring these consumer benefits remains difficult. The main reason is that consumers do not pay for the cost of the product and in many cases even receive it for free. Financing comes from third parties, notably advertising. Moreover, other digital innovations accessible at no cost have created markets that did not exist before, e.g. social networks such as Facebook, Twitter and LinkedIn. The challenge then consists in identifying the contribution of entirely new products. Box 1.3 discusses the difficulties in and possible approaches to valuing access to the Internet and digital innovations in general. Digitalisation has increased the wedge between metrics of production and welfare, reinforcing the need to complement GDP with other indicators such as consumer surplus (Ahmad and Schreyer, 2016). In particular, while the production value of free digital products is captured by the underlying financing sources bearing their costs (e.g. advertising and big data), this production value does not reflect the consumer value (or welfare) generated by these products.

Box 1.3. Measuring consumer surplus derived from digital innovations

Different approaches have been adopted to assess the welfare effects of digital innovations. Besides national account data used to calculate GDP, the most common framework used in the quantification of economic costs and benefits is consumer surplus. Consumer surplus measures the difference between the price consumers are willing and able to pay for a product and the actual price they pay. A consumer surplus occurs when the consumer is willing to pay more for a given product than the current market price. It thus aims to capture non-monetary gains, whereas GDP is restricted to monetary transactions. Non-monetary gains are important to ICTs, since many commercial online services are funded by advertising revenues and made available to users for free. Moreover, some important consumer benefits of ICTs are conceptually non-market (Byrne, Fernald and Reinsdorf, 2016), e.g. Wikipedia, open-source software and free web-based services.

When there is no directly measurable price, calculating consumer surplus becomes problematic. Even if price data are available, it is not always easy to control for external factors that could affect both price and consumption. Another caveat is that a user's demand for a technology or service is often a function not only of the benefit derived by the user, but also of how many other users consume it (network externalities) and how other complementary products are being consumed. For example, a single user's surplus from using Facebook will rise with more friends using the service and with more online services marketed via Facebook. As described below, researchers typically rely on surveys and interviews, opportunity cost calculations or other quantitative techniques to track down consumer surplus.

Surveys and interviews. A proxy measure for consumer surplus can be obtained by asking people directly about their willingness to pay for access to a new technology. As an example, McKinsey (2011) asked consumers in six countries what they would pay for 16 Internet services that are now free, since they are largely financed by ads. Consumer surplus was then calculated simply by subtracting the estimated costs (associated with intrusive ads and forgone privacy) from the willingness-to-pay estimates. The obvious concern is that surveys and interviews with hypothetical questions may be unreliable since stated preferences may differ from actual choices. Moreover, this approach assumes that the willingness to pay for a good would be equal to the willingness to accept a payment for renouncing it. This assumption does not seem to hold in reality (Greenstein and McDevitt, 2012).

Opportunity cost. Another way to infer consumer surplus is to translate the number of hours spent on the Internet (or on specific online services) into economic value based on an individual's average hourly wage. This approach relies on the idea of opportunity cost, i.e. that the time spent on line could have been used to earn income. Methods to measure time spent on line vary, from surveys (e.g. Goolsbee and Klenow, 2006; Brynjolfsson and Oh, 2012) to voluntary online consumer panels that track clicked web pages and time spent on each page (e.g. Pantea and Martens, 2014). The aim is to derive quantitative estimates for the monetary benefit of Internet access by comparing wages (or equivalent value of leisure time) to the time spent on line. The main drawbacks of calculating opportunity costs include the unreliability of survey data and the problems stemming from valuing leisure time

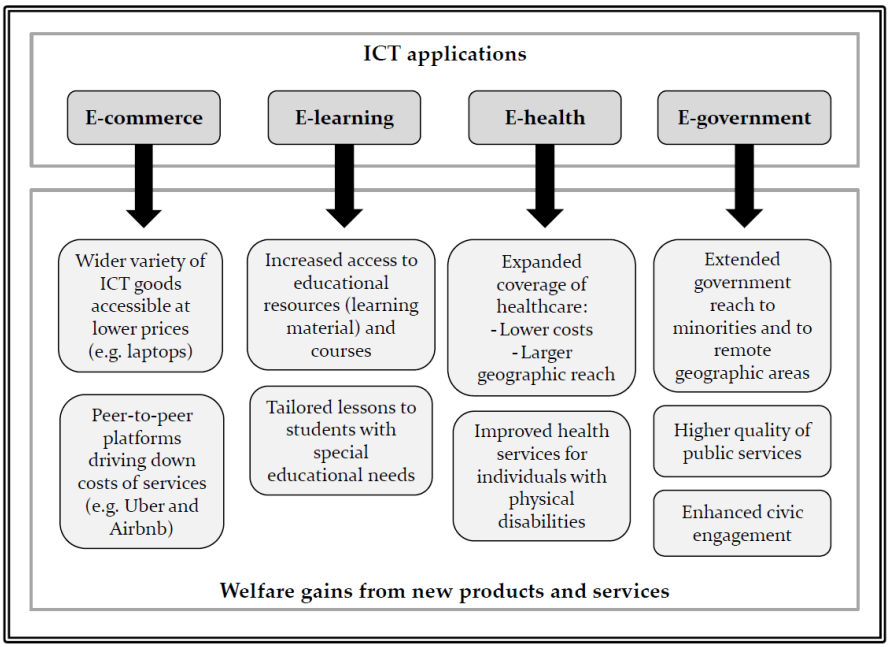
at the wage. If people value their time as less than the wage, welfare gains would be overestimated under this approach. An alternative technique that circumvents these problems calculates the time saved for an activity or goal from using new technology instead of a traditional one. Chen, Jeon and Kim (2014), for instance, compared the use of online search engines to using offline resources, essentially an academic library, to finding information. Specifically, the authors calculate the differences in the probability of finding an answer and the time spent to complete the search. The estimated time savings can then be assigned a value based on average wage, which can then be interpreted as consumer surplus from online search engines.

Quantitative approaches. Researchers also use a wide range of other quantitative techniques (e.g. econometric methods) to estimate consumer surplus. These techniques are very diverse and depend on the exact issue at hand. As an example, Cohen et al. (2016) map out how the demand for Uber changes with varying prices given how, at times of high demand, Uber charges higher fares proportional to the number of ride requests over that of available riders. Quantitative methods have been applied to estimate the consumer surplus of personal computers (Greenwood and Kopecky, 2013), broadband (Greenstein and McDevitt, 2012) and improvements to ICT infrastructures (Cooper, 2012).

1.3.2. Applications and benefits for inclusive growth

Several applications decrease gaps in well-being by leveraging the above contributions of ICTs in private markets and in the public sector. The following subsections will review how digital technologies have contributed to social inclusiveness in key activities, namely commerce, education, health services and government. Figure 1.8 provides an overview of these applications and how new products and services improve the well-being of disadvantaged and excluded groups.

Figure 1.8. Selected ICT applications and associated welfare gains from new products and services



E-commerce

Digital platforms facilitate the exchange of money, goods and services, which is becoming faster, more convenient and less expensive on line. Digital platforms include retail sites where users conduct business with a company (e.g. Amazon, Netflix and iTunes), peer-to-peer platforms where individuals buy and sell products (e.g. eBay, Uber and Airbnb) and financial platforms that provide banking services such as money transfer (e.g. Visa, MasterCard, PayPal and bitcoin). Evidence suggests that e-commerce benefits consumers, as it allows goods and services to be purchased at lower prices. Indeed, with more opportunities to compare prices, many sellers have seen their monopoly power and profit margins decrease. As the offer on line is larger than that of a given physical store, consumers also benefit from choosing from a larger variety of products. Internet-based services allow consumers not only to negotiate better prices for products but also to identify products of better quality or more suited to personal

taste (see e.g. Brynjolfsson, Dick and Smith, 2010; Clay, Krishnan and Wolff, 2001; Brown and Goolsbee, 2002; Sengupta and Wiggins, 2014).

As in the offline world, e-commerce has also been victim of fraud in various ways, but solutions have been found. Potential problems in e-commerce relate to criminals stealing personal information to access the victim's bank accounts as well as transaction fraud, such as not delivering an item ordered after receiving payment. The threat of theft of credit card information has led to the development of alternative payment methods (e.g. PayPal) and the creation of verification solutions that ask users to validate payments and confirm their identity, for instance through their mobile phones. These solutions allow online payments to be conducted securely while providing reassurance and trust that a corresponding exchange will take place.

New market opportunities provided by peer-to-peer platforms facilitate sharing, renting or service provision through underused assets. This includes cars and housing but also car parking spaces, bicycles, photographic kits, musical instruments, garden equipment, outdoor gear and kitchen appliances. Several businesses providing such services are based on this type of platforms, in what is often referred to as the sharing economy or collaborative consumption. Box 1.4 includes examples of these platforms. Typical characteristics include reliance on computing platforms and mobile applications, matching the needs of clients with the offers of service providers, utilising reputation mechanisms (e.g. peer-to-peer rating and ranking systems), reduced middle man roles between clients and providers, and creation or expansion of a particular market even at the cost of closing down another market in the process. Platform-based businesses present opportunities for finding temporary employment, generating extra income and accessing resources or customers not otherwise attainable (Dillahunt and Malone, 2015).

Box 1.4. Examples of peer-to-peer platforms for collaborative consumption in transportation, housing and food services

Uber and Lyft are examples of apps that compete with traditional taxi services. These allow smartphone users to submit a trip request that is then routed to dedicated drivers who use their own cars. Uber is available in over 60 countries and 500 cities worldwide. Lyft mainly operates in the United States – currently in over 200 cities – although it also runs in some Asian cities such as Singapore, Bangkok and Hanoi.

Zipcar and GetAround provide alternatives to traditional car rentals by allowing car owners to directly rent for an arranged number of hours or days. Through smartphone applications, prospective renters can locate available cars that are close by and place requests.

JustPark is a London-based platform that matches drivers looking for parking spots with owners of available places through a website and a mobile application.

Airbnb is a California-based platform for people to list, find and rent lodging, including privately owned apartments. Currently Airbnb has listings in over 34 000 cities from 191 countries, rivalling traditional hotels and guesthouses.

Deliveroo, foodora and JustEat are examples of food delivery apps. Through smartphones, users are able to browse nearby restaurants and place orders. Progress can be tracked as the order is prepared and then delivered by motorcycle couriers who work as independent contractors.

VizEat, Grub Club and EatWith are mobile phone apps that arrange remunerated dinner parties at private homes. Such initiatives aim to allow amateur chefs to provide food services at their homes.

The collaborative economy provides mixed impacts upon inclusiveness. On the demand-side, it brings welfare gains to consumers from disadvantaged and excluded groups by decreasing the prices of certain services. The operational costs of platforms based on collaborative consumption are generally lower from those relying on traditional business models. In particular, a commercial firm that runs a given platform does not need to own the physical assets that are traded by member users. This translates into low marginal costs and low prices that generate welfare benefits. For instance, an estimate indicates that each US dollar spent by consumers on Uber results in USD 1.60 worth of consumer surplus (Cohen et al., 2016). Prices that are lower than those of traditional services (e.g. taxis and hotels) attract large consumer segments, bringing welfare gains to everyone but particularly to lower-income groups. Evidence suggests that the US peer-to-peer

car rental service GetAround brought larger benefits to users at the lower end of the income distribution during 2012-14 (Fraiberger and Sundararajan, 2015). In this case, the gains for wealthier groups have been found to be lower, given that higher incomes allow them to rely on more expensive, traditional taxi services or to own and drive a car.

While consumers benefit from peer-to-peer platforms by using owners' assets or relying on others' labour, micro-entrepreneurs are also able to earn income by renting assets they own or selling services. The benefits from participating in collaborative consumption as micro-entrepreneurs can be substantial for many low-income individuals. Peer-to-peer businesses offer opportunities for generating extra income, often with flexible hours based on personal needs and without formal qualifications. Lower-income groups that are geographically concentrated are often disconnected from outside communities (DeFilippis, 2001) or otherwise have few opportunities to foster connections for employment (Dillahunt, 2014). This supports employment generated through peer-to-peer platforms as a path towards social inclusion.

Impacts from the supply-side are less bright, particularly with regards to labour demand. While businesses built around collaborative consumption have generated new jobs for lower-income groups, opportunities for generating rents from assets (e.g. cars and housing) apply to wealthier individuals who can afford to own these assets. Moreover, jobs created by peer-to-peer platforms are typically on-demand temporary jobs in which workers are considered to be independent contractors. Challenges remain regarding the legal liability, taxation, insurance and other regulations of work generated by the collaborative economy (see OECD, 2016d). For instance, individuals working via peer-to-peer platforms often do not benefit from social security schemes and safety nets associated to standard forms of employment, such as rights to unemployment benefits, paid sick and maternity leave, as well as health insurance and pension schemes. Also, these workers are likely to face precarious conditions (compared to full-time employment), particularly those relying on platforms to sustain their living. Carrying out multiple jobs in different markets may involve longer working hours and lower hourly wages. In the United States, when employees are taken as contractors, the employer is not responsible for paying social security taxes and does not have to withhold income taxes. Employers are also not liable for compensating workers who get hurt in accidents, and independent contractors do not have the right to unionise (see Baker, 2016). While the shares of hours worked and revenues generated in markets from the collaborative economy are still small, they are

likely to become significant if these platforms keep growing at the current rate (OECD, 2016d).

E-learning

Besides promoting better access to information and knowledge, ICTs have introduced new educational resources for teaching, learning and assessing students remotely that enhance traditional classwork (OECD, 2016e). Unlike classroom-based education, online learning is accessible from any location with an Internet connection and at lower costs, often for free. Learning platforms not only reach peripheral locations but also allow flexibility to accommodate individual needs in terms of study schedules (e.g. given concurrent work obligations) and approaches to learning. Learning management systems allow students to consume course materials, post assignments and engage with their virtual classrooms.

The benefits of online education for disadvantaged and excluded groups are considerable. Lower costs in accessing online education can benefit those who cannot afford physical education of similar standards (Zhenghao et al., 2015). ICTs used in teaching can offer "built-in" tools for disabled students, including closed-captioning and descriptive narration as well as compatibility with commercial adaptive technology (e.g. voice dictation or specific magnifying screen readers for those with eye conditions). Related examples include dedicated virtual learning platforms (e.g. Moodle).

Massive Open Online Courses (MOOCs) provide key opportunities for online learning. MOOCs are structured online lectures aiming to offer mass participation with open (often free) access via the web. Providers of MOOCs may be for-profit (e.g. Coursera, Udacity and Futurelearn) or non-profit organisations (e.g. Khan Academy, edX and P2PU). Coursera, Udacity and edX alone had a total of 1.5 million students registered for courses in 2012 (The Economist, 2014). Course materials and classes are also provided for free by universities, for instance through Stanford Online and MIT OpenCourseWare. In 2015, MIT decided to make some of its free online courses eligible for credit with a fee of roughly USD 1 500 and an exam (Bergstein, 2015). Students can work their way into the university by having their first term on line. Evidence suggests that online courses expand access to higher education for students who would not otherwise enrol, increasing the number of students participating in higher education (Goodman, Melkers and Pallais, 2016).

Several challenges remain to be addressed before e-learning develops its full potential. For instance, online instructors have so far offered less feedback and conversation than they would in a face-to-face setting (Haynie, 2014). In terms of inclusiveness, financially disadvantaged learners may face additional difficulties in accessing and using certain technologies that online courses require (Friedman, 2014). In addition, students from disadvantaged and excluded groups may have a lower level of self-directed learning skills and thus have lower tendencies to harness the opportunities offered by online education. Also, in spite of proved benefits from computing (Fairlie and London, 2012), the frequent use of computers among students may crowd out homework time and lead to a decline in test scores (Vigdor, Ladd and Martinez, 2014). The specific uses assigned to computers modulate education-related gains (Belo et al., 2013).

E-health

Information technology has been increasingly used in healthcare (OECD, 2015f). "E-health", that is health services delivered or enhanced through the Internet and related digital technologies (Eysenbach, 2001), enable better access, higher quality, more personalised and lower cost than health services to date. These technologies improve the productivity of healthcare by making diagnostics, treatments and related service provision less expensive. For instance, in a particular healthcare trial, patients with congestive heart failure were outfitted with sensors that provided continuous monitoring (Chui, Löffler and Roberts, 2010). Traditionally, patients with this condition are typically monitored only during periodic physician visits to medical facilities. In the trial, the sensors placed on the patient monitored most of these signs remotely and without interruption, giving practitioners an early warning of conditions that would otherwise lead to unplanned hospitalisations and expensive emergency care.

Several other devices, including wearable biomedical sensors and ingestible medical capsules, also provide promising applications (Chen et al., 2011). Researchers can in addition use the large volumes of data captured from sensors to see which treatments are more effective for specific conditions, and identify side effects of medication. For instance, the Age Friendly City Initiative in China has led to the installation of sensors in homes to monitor as many as 100 000 people for healthcare purposes (Markoff, 2015). Digitalisation is thus leading not only to higher efficiencies but also more effective health services, in ways that reduce the burden of healthcare systems.

Information technology benefits those suffering from chronic diseases and disabilities, groups in society that are often threatened by exclusion. A critical source of welfare gains comes from progressively making treatment more personalised. For instance, diabetic patients can more easily assess their need for insulin through personal devices. Practitioners can more quickly detect urgent maladies as a result of the analytical capabilities embedded in medical equipment. Several new digital technologies, including the Internet of Things and artificial intelligence, promise additional gains as they are further deployed.

E-government

E-government (or digital government) refers to the use of digital technologies by public administration, including for delivery of public services (OECD, forthcoming). Digitalisation has already contributed to social inclusiveness by increasing public service quality, efficiency and reach. The opportunities to file taxes and apply to services on line has made application procedures more convenient, benefitting in particular individuals located in remote areas as well as those from lower-income and excluded groups, as they rely more on allocations and subsidies. The Internet has also made it easier to provide more information on public services to citizens across regions, for instance through websites, email newsletters and social media. Information targeted at specific groups also can now be more easily shared. Fifty-two percent of individuals used the Internet to interact with public authorities in 2015 across OECD countries (OECD, 2017). There is slightly less take-up in lower-income households, at 41%.

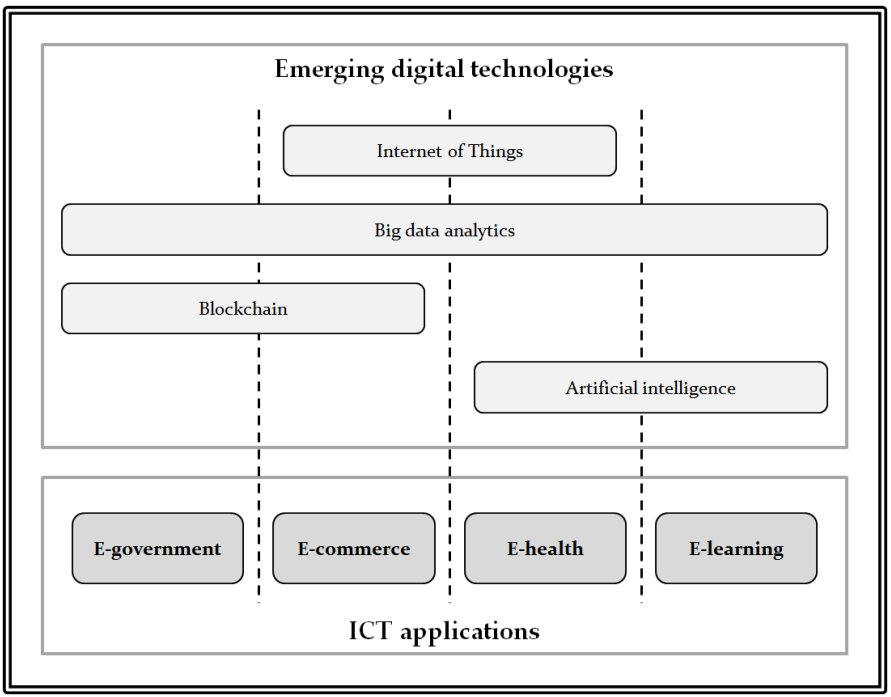
Several digital services favour civic engagement. These include sending filled-in forms to government agencies or public authorities, filing petitions on line, taking part in online consultations or voting to define civic or political issues (Eurostat, 2015). Civic engagement allows minorities, individuals at the lower end of the income distribution and the less educated to engage more, as they have higher abstention rates and lower tendencies to participate in democratic processes (McElwee, 2014). Open Government Data (OGD) refers to information produced or commissioned by public bodies that can be freely used and distributed by anyone, only subject to (at the most) the requirement that users attribute the data and that they make their work available to be shared as well (see Ubaldi, 2013). Applications built on OGD help people make informed decisions *vis-à-vis* government and public sectors (e.g. monitoring government spending, finding optimal routes for public transportation and ascertaining the safest consumer products and vehicles). This way, they promote transparency, accountability and value creation by making government data available to all. However, civic

engagement requires further efforts beyond what digital services can offer to ensure participation of lower-income and excluded groups (Priestley et al., 2016).

1.3.3. Key emerging digital technologies and their potential contributions for disadvantaged and excluded groups

Several digital technologies – and in particular, the Internet of Things (IoT), big data analytics, artificial intelligence and Blockchain [4] -- promise further contributions to social inclusiveness. Figure 1.9 shows how these emerging digital technologies contribute to novel applications for social inclusiveness in the four domains described above.

Figure 1.9. Emerging digital technologies and their applications for social inclusiveness



1.3.3.1. The Internet of Things (IoT)

The Internet of Things (IoT) will lead to further better quality and lower-cost products. The IoT comprises devices and objects whose state can be altered via the Internet. Sensors and actuators are becoming cheaper and their price is expected to decline further, offering opportunities for wider application (Morgan Stanley, 2014).

The IoT promises to fuel the development of e-health. Through Internet-connected medical tools and devices, healthcare providers such as hospitals will be able to collect, record and analyse data more comprehensively, faster, and more accurately. Traditionally, patients are monitored only during periodic physician office visits. Sensors allow the constant and remote monitoring (outside of medical facilities) of a patient's condition (symptoms), location and relevant environmental factors in real time and at increasingly reduced costs. For instance, wearable devices can be connected to inner and outer bodily sensors that can be used by personal health-monitoring software and professional healthcare systems. These devices can give practitioners an early warning of conditions that would otherwise lead to health risks, unplanned hospitalisations and expensive emergency care. Some devices could also administer medication directly by monitoring the appropriate time and bodily conditions in order to provide more accurate and personalised treatments. Diabetic patients could benefit from implants that can continuously monitor blood glucose levels and regulate insulin delivery. Many such applications are expected in the near future (Chen et al., 2011). In general, these devices have the potential to reduce costs of hospitalisation and consequently render services more widely available, including to those not covered by social security who cannot afford the costs.

1.3.3.2. Big data analytics

Big data analytics can also bring products, services and better-tailored policies for individuals in disadvantaged and excluded groups. Big data analytics refers to techniques and tools used to process and interpret large volumes of data generated by the increasing digitisation of different types of content, greater monitoring of human activities, and the spread of the IoT. As people and firms become increasingly connected around the world and use the Internet for a growing number of purposes, they leave vast records of data ranging from consumption preferences to firms' production processes. This information can be challenging to analyse with conventional analytical tools given its size and the fact that it is often unstructured. The OECD report "Data-driven innovation: Big data

for growth and well-being" provides evidence based on the role of big data for promoting growth and well-being, and policy guidance on how to maximise the benefits and overcome challenges (OECD, 2015f). Big data analytics offers the necessary means to process information to overcome this challenge in ways that benefit social inclusiveness. In particular:

- Big data analytics allows searching, filtering and analysing large volumes of data, with key applications arising in e-commerce and e-health. A wide range of applications helps companies extract the value of information regarding customer needs and satisfaction. For instance, Procter & Gamble uses analytical tools to decide which products to launch on markets. Particularly relevant to social inclusiveness are applications in e-health that analyse large data repositories and provide doctors with tools to diagnose and treat patients. Modernizing Medicine is a web-based repository of medical information powered by big data analytics and artificial intelligence, gathering information from more than 14 million patient visits that includes symptoms, diagnoses and treatments provided (Hernandez, 2014). The service allows doctors to obtain advice on clinically challenging situations by checking for cases in the vast amounts of past medical records. As the penetration of MOOCs and online learning platforms continues, big data could also have applications that lead to more effective courses and learning programmes.
- *These tools can fight against poverty and other forms of social exclusion if integrated in policy.* They have the potential to identify individuals in disadvantaged conditions and narrow down target groups for policy instruments. Furthermore, they provide opportunities for policy makers to understand well-being indicators, their fluctuations, and possible determinant factors. For example, the Flowminder Foundation combines census data and household surveys with satellite and mobile phone data to provide up-to-date proxies on poverty levels, mobility and access to healthcare. Several relevant policy initiatives using big data analytics are found in Box 1.5. Efforts leveraging big data analytics could be particularly fruitful when quality national statistics covering disadvantaged segments of the population are not of high quality.

Box 1.5. Policies using big data to support socio-economic development

Online signals for risk factors of non-communicable diseases (NCDS) explores how risk factors (e.g. tobacco, alcohol, diet and physical activity) of maladies such as cancer, diabetes and depression could be measured and analysed from big data sources such as social media and online Internet searches. The project aims to test whether social media could provide faster and cheaper information on risks on an ongoing basis.

Improving transport planning through real-time data analytics gathers real-time bus location data in Jakarta (Indonesia) to monitor service demand data and traffic information. The aim of this project is to enhance transport planning and operational decision making within the Jakarta Government.

Measuring poverty with machine roof counting uses satellite imagery in Uganda and develops image-processing software to count the roofs and identify the type of material they are constructed from. This methodology aims to complement existing statistical tools that use surveys and primary data collection to assess poverty levels.

Unemployment through the lens of social media investigates how social media and online user-generated content can be used to enrich understanding of the changing job conditions in the United States and Ireland. It analyses the moods and topics present in unemployment-related conversations from the open social web and relates them to official unemployment statistics.

Source: United Nations Global Pulse, http://www.unglobalpulse.org/projects.

1.3.3.3. Artificial intelligence

Artificial intelligence (AI) heralds the coming of inclusive innovations, particularly in the domains of e-learning and e-health. AI is the ability of machines and systems to acquire and apply knowledge and to carry out intelligent behaviour. This means performing a broad variety of cognitive tasks, e.g. observing and recognising objects, processing oral language, reasoning, learning, making decisions and demonstrating the ability to move and manipulate tools accordingly.[5] Machine-learning processes that benefit disadvantaged and excluded groups can be embedded in the delivery of healthcare and in education services, making them more efficient and adaptive to particular needs.

AI can support clinical decision making, lead to intelligent devices and instruments, and bring computational intelligence into information systems. On the one hand, applications can track and analyse health trends in populations. For instance, HealthMap uses an AI to scan news stories in multiple languages to

detect outbreaks of infectious diseases. Using articles from Kenyan and Guinean sites, it identified a burst of Ebola more than seven days before this was locally determined. Moreover, medical diagnostics are likely to become more accurate and accessible with AI-enabled analyses of medical databases. IBM aims to train AI software to accurately diagnose cancer and heart disease (McMillan and Dwoskin, 2015). An image-analysis algorithm of the California HealthCare Foundation examines retinal scans of diabetic patients to identify retinal damage with 85% accuracy and faster than traditional human analysis. Such AI-powered systems could be eventually built into medical equipment (e.g. MRI and computer tomography systems), increasing efficiencies in healthcare. Tools already diagnose learning disorders, for instance to distinguish language impairments from dyslexia, autism and other conditions in children (see e.g. Arthi and Tamilarasi, 2008; Kohli and Prasad, 2010). These techniques have led to mainly positive clinical results and gained support from medical practitioners and specialised educators. Other technologies with promising prospects aim to accurately diagnose ADHD (Anuradha et al., 2010) and different types of learning impairments (Jain et al., 2009).

AI can assist teachers in numerous ways, including adapting coursework to students with special educational needs (SEN). Based on its Watson cognitive computing engine, IBM's Teacher Advisor personalises math lessons to primary school students. The software combines targets for skill development and student data to tailor instructional material to varying skill levels and make lesson plans more effective. IBM has set to make Teacher Advisor available for free by the end of 2016 and plans to expand the number of subject areas it can work with (Harris, 2016). In another application, Microsoft developed a machine-learning model to analyse student data (e.g. demographics and academic performance) to predict which students were at risk of dropping out, prompting educators to take preventive measures. A pilot test of the tool in a Washington State school district showed positive results, as graduation rates increased from 55% in 2010 to 78% in 2014 (Microsoft, 2015). Besides diagnosing special needs for education, AI applications can provide necessary learning techniques such as adaptive spelling training systems (Baschera and Gross, 2010). The Russell robot engages with autistic children and stimulates their ability to imitate social behaviour (NSF, 2013). Evidence suggests that the effective application of AI-based techniques has improved the quality of life and educational outcomes of SEN learners (Drigas and Ionnidou, 2013).

Many AI applications promise benefits specific to individuals with physical impairments. The Automatic Sign Language Translator uses AI to help people

understand sign language by interpreting it and converting expressions into text. To make its social network more accessible for blind users, Facebook is implementing computer-vision algorithms that generate descriptive captions for images that are read through text-to-speech software. One Llama Labs developed a smartphone application recognising danger-indicating sounds (e.g. sirens) to warn users with hearing impairments. Moreover, the AI powering self-driving vehicles will eventually help individuals facing physical disabilities (particularly barriers to mobility and transportation). Persons with mobility restrictions can face several forms of social exclusion, such as a lack access to goods, services, social connections, education or employment (US NCD, 2015). While the technology behind self-driving cars is developing at a fast pace, several regulatory and legislative concerns remain. This includes legal responsibility (who should be held accountable in the event of an accident), protection against malicious hacking, how data are recorded and how vehicles are programmed to address conflict dilemmas on the road.

1.3.3.4. Blockchain

Blockchain promises to further reduce transaction costs by enabling value exchanges exclusively through digital means. A blockchain is a distributed database that acts as an open, shared and trusted public ledger that nobody can tamper with and that everyone can inspect.[6] This technology aims to remove the necessity for trustworthy intermediaries to conduct sufficiently secure value transfers (e.g. bitcoin[7]). In particular, Blockchain applications could offer an inclusive "fast track" for greater access to financial services. This technology could help boost financial services where related institutions are less developed and trusted. For instance, international money transfers have traditionally represented high transaction costs in proportion to the remittance amount. BitPesa and Rebit provide opportunities for cross-border remittance payments using Blockchain to Kenya and the Phillipines, respectively. Some applications of this kind do not require users to have bank accounts. Traditional banks are also exploring the use of Blockchain for international payments (Dunkley, 2016). The technology could also offer opportunities for financial inclusion by substituting traditional banking services and facilitating small-scale global commerce (Scott, 2016).

Blockchain can improve the penetration of public registry services in socially excluded groups. Given that the distributed ledger provides a robust, transparent and easily accessible historical record, it can be used for storing any kind of data, including asset ownership. Governments in countries with poor

cadastral records, like Ghana and Georgia, are piloting projects for the use of Blockchain as a springboard towards the full registration of asset ownership. Disadvantaged groups in society are particularly affected by the lack of legal titles proving their control of an asset, which is cause for market exclusion as these assets cannot be used as capital (e.g. to access credit). Aside from contributing to the resolution of this issue, Blockchain's prospective advantages over traditional notary services are threefold: it ensures data records cannot be corrupted, facilitates auditing, and streamlines processes by reducing the friction and the cost of property right registration (Shun, 2016). Blockchain could also be applied to registration of intellectual property (IP) rights in developed countries, thus decreasing costs and increasing the efficiency and transparency of IP systems that are already well established.

"Smart contract" applications may favour collaborative consumption, leading to further opportunities for micro-entrepreneurs. As Blockchain offers the opportunity to append additional data to value transactions, this information could specify that certain rules are required to be met before the transfer takes place. In this way, a transaction would work as an invoice that would be cleared automatically upon fulfilment of certain conditions. The conditions specified in the transfer as programming code could express the provision of a given service, including those from collaborative consumption, removing the need for intermediaries such as Airbnb and Uber and allowing micro-entrepreneurs to access other markets with reduced commissions.

1.4. Challenges and policy options to facilitate inclusive growth opportunities from digital innovations

1.4.1. Policy options to address impacts of digital innovation on markets and inclusive growth

Two factors are critical to considering policy implications. First, rents are needed for innovation, and, innovation is necessary to growth: hence policies should avoid targeting innovation-based rents (and rents that facilitate innovation), but instead focus on the rents that do not come from innovation (e.g. leveraging market power based on regulatory monopolies, anti-competitive practices, barriers to trade etc.). Second, many policies shaping innovation were designed for an economy in which tangible activities were dominant, hence innovation-based rents lower. They need reviewing to assess whether the balance between market rents for innovation and opportunities for innovation by new entrants is adequate.

What does this mean for policies? Tax policy, the instrument of choice for dealing with income inequalities, has important drawbacks as it does not make the distinction between competitive and excess market rents: it may therefore have detrimental effects on the incentives to innovate. Instead of attempting to redistribute (ex post) rents, it might be more effective to eliminate them (ex ante) in the first place by strengthening market competition. Policy instruments which may be mobilized and adapted to this purpose include IPR (ensuring that they favor access to knowledge); standards; rules of access to and ownership of data; competition policy; support to innovation (favoring new, small players) and entrepreneurship (including training).

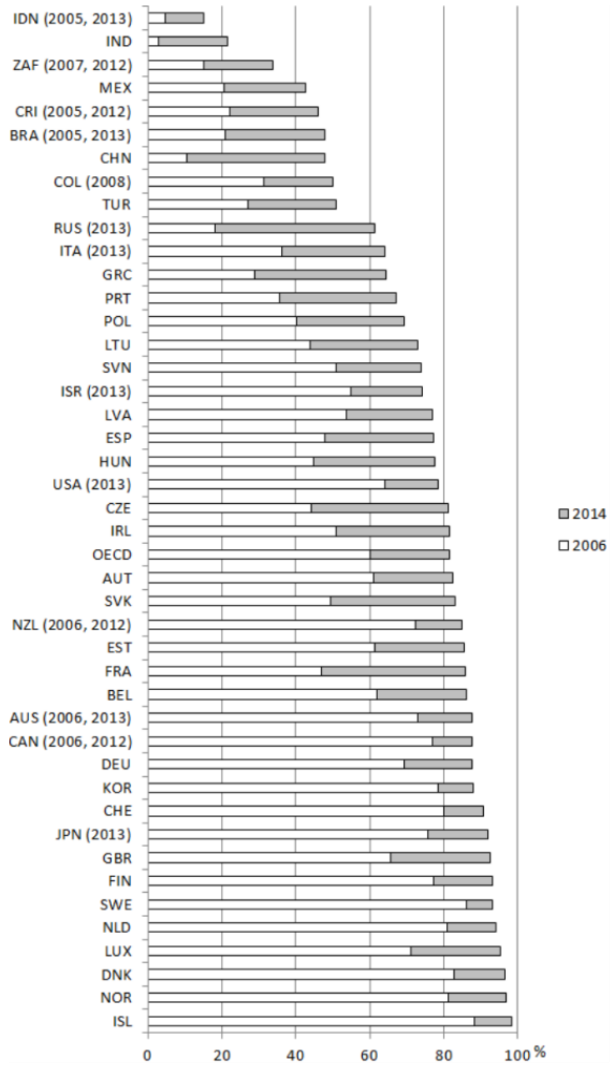
1.4.2. Policy options to leverage the potential of digital innovation

1.4.2.1. Disparities in access to ICTs

The aforementioned welfare benefits to disadvantaged and excluded groups hinge on the wide diffusion and innovative use of ICTs. Access to ICTs has been expanding rapidly. In average across OECD countries, . In the OECD area, the proportion of total Internet users has increased from 60% in 2006 to 82% in 2014 (Figure 1.10). In the United States, 84% of households reported computer ownership in 2013 (US Census Bureau, 2013). At the same time, access to computers is not equitable across the board. Evidence indicates that households with low incomes use computers and the Internet less intensively, especially in lower-income OECD countries (OECD, 2015e). Often, lower levels of access are correlated with peripheral location and low levels of educational attainment. Other characteristics such as education, race and ethnicity also matter, while the disabled also tend to use the Internet less than others (Rust, 2015).

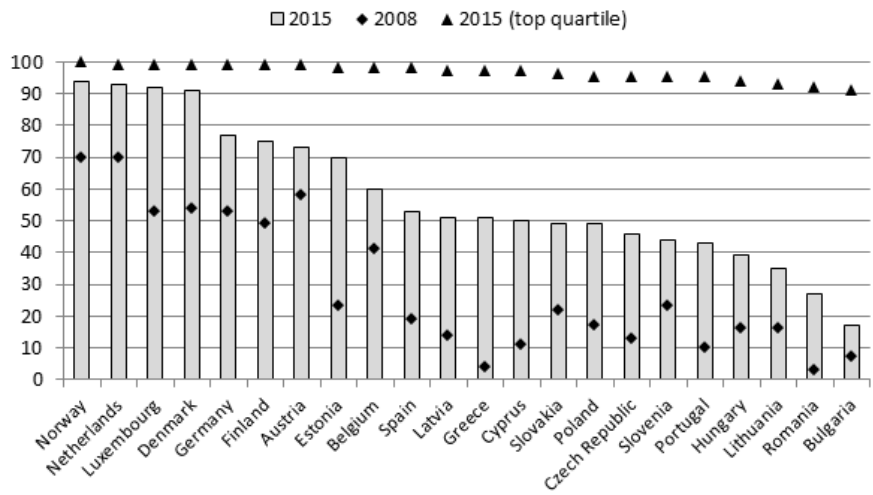
Despite remaining inequalities, lower-income populations are gaining access to Internet at a fast pace. Figure 1.11 describes the share of households with Internet access in 2008 and 2015 for the bottom income quartile in several European countries. It also includes the top quartile for 2015, showing how high-income population segments in these countries have access rates higher than 90%. In low-income households, rates have surpassed 90% in Norway, the Netherlands, Luxembourg and Denmark. While countries such as Bulgaria, Romania, Lithuania and Hungary have also experienced growth, their shares did not reach 40% in 2015. Existing gaps are likely to further narrow in the near future, in light of the rapidly decreasing costs of broadband access (OECD, 2015e).

Figure 1.10. Total Internet users, 2014 and 2006.



Source: OECD, 2015g.

Figure 1.11. Percentage of low-income households with Internet access by country, 2008 and 2015



Source: Eurostat, 2016.

Skills related to ICTs are essential for individuals to reap the benefits from regional innovation. Digital inequality (or the "digital divide") refers not only to disparities in access to physical devices and the Internet but also to disparities in the cultural and cognitive resources required to make good use of ICTs. Workers across a growing range of occupations need a variety of generic skills to use these technologies effectively in their daily work. These include skills specific to ICTs such as the ability to gather information on line but also complementary skills like the capacity to process complex information, communicate with colleagues and stakeholders, and adjust quickly to changing environments (OECD, 2016f). Building these skills requires early exposure to digital technologies. On average across OECD countries, only 23% of students in low-income (quartile) households had started using computers at the age of 6 or earlier, as compared to 43% of those from high-income households OECD (2015h). Also, whether individuals use the Internet for personal development or for leisure is correlated with their socio-economic background (van Deursen and van Dijk, 2014; OECD, 2016g). Schools play an important role in ensuring that all students have access to ICT resources and learn to use them, regardless of socio-economic status. The Internet hosts all sorts of information, correct or not, tested or not, etc. Checking or ensuring the

reliability of available information is therefore important, and this is partly to be done by users themselves: education has to also teach the cognitive skills associated with critical approaches to information.

At the same time, digital products and services are progressively delivered in ways that alleviate complexities requiring advanced ICT skills. Smartphone and web applications increasingly provide user-friendly interfaces that gather, package and deliver valuable information without requiring training on the part of the user. For instance, Rainbow Agri provides a host of services for farmers in India to communicate (e.g. on meetings, diseases, vaccinations, weather) and trade goods without the need for a middleman. Digital platforms aimed at micro-entrepreneurs like Etsy and Uber provide simple interfaces aiming to obviate the need for background ICT skills. Squarespace is an online service allowing individuals to build and maintain websites without any knowledge in web design or programming. In the future, artificial intelligence could help users perform more complicated tasks. As discussed below, some services already provide assistance to help individuals with disabilities.

1.4.2.2. Other challenges for wider contributions of digital technologies to lower-income and excluded groups

Several technical challenges, specific to the IoT, remain to be solved before the potential for inclusiveness can be realised. Multiple devices need to communicate effectively and securely among each other for interoperability, which is difficult as they often operate under different standards. The challenge is to create and establish communication standards or pathways through which connected objects can exchange information and interact with each other. In addition, as IoT products regularly transmit data to their parent company describing how they are being used, consumers are sensitive to privacy protection and cyber-security issues. Attacks by hackers and misuse of data in companies could make people turn away from the IoT.

AI-driven innovations favouring social inclusiveness require access to large volumes of unbiased data. Machine-learning applications require training with large volumes of data before reaching commercial grade. As with big data analytics, forms of social exclusion may be built into and reinforced by computer programs, as systems form a view of the world based on training data (Crawford, 2016). For instance, Google's initial efforts to automatically label images had problems identifying non-whites, as the application was mostly trained with photos of people with lighter skin tones. AI informing United States judges of a

defendant's risk of criminal recurrence was found to have a strong racial bias (Angwin et al., 2016). AI needs to be correctly designed and trained to avoid self-fulfilling prophecies leading to further marginalisation of social groups. In particular, it is essential for training data to be sufficiently diverse and unbiased to achieve accurate predictions that do not replicate the current forms of social exclusion.

Some applications of big data could lead to social exclusion. Data analytics can result in greater efficiencies, but may also limit an individual's ability to modify path-dependent trajectories and escape socio-economic lock-ins (OECD, 2016c). Moreover, data and analytical programmes could serve to manipulate people, distort their perception of reality and influence their choices (Helbing, 2015; Piniewski, Codagnone and Osimo, 2011). In the private sector, data profiling techniques could lead to increased marginalisation of disadvantaged social groups in housing, credit, employment and education. For instance, banks and credit rating agencies are starting to gather and process data from social media and other online trail records to determine the credit rating of prospective clients. The way individuals use the Internet is starting to be used to predict socio-economic factors and character traits to determine creditworthiness (Alloway, 2015). This type of data profiling could result in self-fulfilling predictions that make disadvantaged groups further excluded from loans, jobs and other opportunities. This practice is aggravated by how scores based on big data algorithms are often undisclosed – thus the presence of discriminatory impacts is hard to detect.

Blockchain applications for social inclusion have yet to demonstrate their potential. Applications in finance and public services are only in early stages of development. With regards to collaborative consumption and peer-to-peer platforms, it is uncertain to what extent complex services can be sufficiently programmed into rules. In order for Blockchain networks to run completely on their own (i.e. without a firm backing the service), instructions embedded in transfers should provide an exhaustive definition of the service. While this is likely possible for a great amount of routine services (e.g. computing), it is questionable whether it could be achieved with more complicated applications in human-oriented marketplaces. These marketplaces often require mechanisms of dispute resolution that are difficult to codify and delimit, and an intermediating institution that both parties can trust.

1.4.2.3. Policy options to leverage digital innovation for inclusive growth

Policies could incentivise IoT, big data and AI applications in healthcare and/or education that benefit disadvantaged and excluded groups, possibly through R&D support and public procurement. Many of the prospective applications will be led by the public sector. For instance, in the IoT this includes not only the development of connected equipment in public hospitals but also the underlying digital infrastructures. While consumer-oriented products are likely to be developed by the private sector, these also promise to contribute towards more accessible health services. Public investments could also help to explore the potential of AI to improve health and education services. Potential efficiency gains in healthcare also motivate consideration of IoT and AI technologies in R&D and innovation funding schemes. Especially with regard to the IoT, such investments would need to consider the interoperability challenge and promote the development of standards allowing devices and systems to communicate with each other effectively and securely.

Big data and AI could inform policy design and implementation to improve policies for inclusive growth. Initial experiences are demonstrating the potential for these tools to gather information about target groups in disadvantaged conditions, for better tracking factors leading to social exclusion and monitoring the implementation of policies. For instance, a recent study explored the potential of using the network of international postal flows to approximate socio-economic indicators such as the Human Development Index typically used to benchmark national well-being (Hristova et al., 2016). Such initiatives demonstrate the room for public sector innovation using big data; for governments to be able to harness these opportunities, they will need to bring their tools into policy-making processes and training personnel with the necessary skills to use them.

Continued efforts are needed to reduce the digital divide (i.e. narrowing inequalities in access to ICT and disparities in the skills necessary to effectively use these technologies). With regards to access to Internet, countries can extend broadband coverage and promote its affordability through several mechanisms. Governments should first encourage investment and competition in the private sector with an appropriate regulatory framework that, for instance, lowers administrative barriers to deployment and provides regulatory certainty for investors (OECD, 2016h). For cases where markets fail to provide access, public authorities can resort to other mechanisms, including subsidies for rural deployment or direct funding through public-private partnerships (see ITU, 2014). Governments can also introduce inclusion measures for people with disabilities,

including accessibility provisions in product market regulations and the promotion of accessibility software addressing the needs of individuals facing physical impairments. Furthermore, public education plays a major role in providing early exposure across society and providing equal opportunities for all individuals to build the skills necessary to effectively use ICTs, as follows.

Skills remain critical to fully leverage opportunities of ICTs for inclusiveness. For instance, at a basic level, individuals seeking to benefit from e-commerce need to be at ease using computers and smartphones, and know how find reliable information online. The promotion of digital literacy often falls on national education ministries, which determine to what extent ICT skills are included in curricula (OECD, 2016f). Nevertheless, as digital products and services mature and interfaces become more user-friendly, the requirements for specialised skills to reap their benefits may be reduced.

Caveats to inclusive growth need addressing. Particularly with regards to big data analytics and AI, this includes appropriate regulation and oversight mechanisms to prevent further marginalisation of social groups via algorithms. Initial applications in e-commerce indicate that stereotypes and discrimination biases are ingrained within data and analytic tools, and AI at times fails to filter these biases out. Companies are using these tools to evaluate creditworthiness and filter housing and job applications.

While this chapter has focused on demand-side impacts of ICTs, policy makers should note the overall pervasive nature of supply-side impacts. Policies should consider the impacts of ICTs when it comes to market structures and competition. Policies can work in unison with measures aimed at firms to support innovation and experimentation at the frontier and its diffusion throughout the economy, in areas related to skills, labour, competition, product market regulation, financial regulation, innovation and regulations related to the corporate sector. The details of policy packages that deliver stronger and broader-based productivity growth and reduce inequality will depend on each country's specific circumstances, governance and institutional settings. Given the global nature of these challenges, deepening international collaboration and co-ordination will be required in a number of areas, including tax and innovation policies (OECD, 2016b).

Notes

1 . The section is based on Paunov and Guellec (2017), Innovation and the Distribution of Income, unpublished mimeo.

2 . IT-related services include the following 2-digit SIC industries: Business Services (73), Communication (48) and Engineering, Accounting, Research, and Management Services (87). Innovation-intensive manufacturing includes Chemicals and Allied Products (28) and Measuring, Photographic, Medical, & Optical Goods, & Clocks (38).

3. Consumer surplus is the difference between the price consumers are willing and able to pay for a product and the actual price they pay. The more one is willing to pay and the lower the price, the more one benefits from the good. Consumer surplus is generally viewed as a useful measure of economic well-being because it measures the total benefit to buyers from participating in a market where new technology is sold.

4. Blockchain is a distributed database that enables value transactions without the necessity of a central institution or third party.

5. AI deals with the design, development and use of algorithms that allow computer programmes to "learn" as they perform the task, i.e. by analysing data and fine-tuning their operations. While both AI and big data analytics employ algorithms to carry out tasks, they differ in that the former adapts the underlying algorithm to changing conditions, seeking to optimise performance (i.e. learning).

6. Protocols built on Blockchain (e.g. bitcoin) specify how participants in a network can maintain and update the ledger using cryptography and through general consensus. The combination of transparency, strict rules and constant oversight that can potentially characterise a Blockchain-based network provides sufficient conditions for its users to trust the transactions conducted within, without the necessity of a central institution (see UK GOS, 2016).

7. Bitcoin is a digital currency that is not regulated nor backed by any central bank. Instead, the technology aims to be trustworthy by itself (i.e. it makes a trusted third party unnecessary) by preventing double-spending and constantly keeping track of currency ownership and transactions (see OECD, 2015i).

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CHAPTER 2. INNOVATION AND TERRITORIAL INCLUSIVENESS: RECENT REGIONAL TRENDS AND POLICY OPTIONS

In the knowledge economy, regional performance plays a role in a region's innovation capacity and long-run productivity growth. Yet, the bulk of R&D spending and other investments in innovation, such as spending in human capital, are geographically concentrated, generally more so than economic activity. Countries are seeking strategies to promote "territorial inclusiveness" - the extent to which the capacities to participate in innovation activities are evenly distributed across regions within a country - through greater innovation capacity in all regions, but are they succeeding? This chapter first considers the theoretic frameworks for thinking about territorial inclusiveness and innovation, through the lens of agglomeration, productivity and growth. It then explores regional trends in several knowledge economy indicators that underpin innovation capacity. Interregional disparities and their changes over the last 15-plus years are assessed using indicators of concentration (e.g. the share of R&D in the top regions) and intensity (e.g. R&D as a share of GDP) as well as changes in regions' rank position. It also considers the relationships between regional concentration and national performance when it comes to factors such as R&D, patenting and productivity. Policy instruments to support territorial inclusiveness with respect to innovation are then reviewed to offer strategies for countries seeking to reduce interregional disparities.

Introduction

Investments in knowledge economy factors are critical components of innovation, but have all regions been keeping up? "Knowledge-based economies" rely to a greater extent on knowledge, information and high skill levels than other economies, and thus knowledge economy factors such as a highly educated workforce, investments in research and development, etc. are more important for economic growth.[1] It is a well-established view that innovation is the predominant driver of long-term productivity and economic growth (e.g. Romer, 1986; Aghion and Howitt, 1992; Krugman, 1994). Investments in innovation and other knowledge economy factors have increased within OECD countries over the past two decades. While these investments facilitate the development of new technologies and other advances that can lead to innovation – hence productivity growth – not all elements of this relationship are straightforward or linear in all regions. Strong differences exist in the regional intensity of knowledge economy

inputs. And on average in OECD countries, the regional productivity gap has been widening over the past 20 years, as some regions at the frontier outpace the vast majority (OECD, 2016a). National policies in many countries, as well as certain EU-level policies, seek to mitigate these disparities. Understanding the dynamics of regional innovation disparities over time is paramount to designing better policies *by* and *for* regions, to boost their performance in terms of innovation and productivity.

Innovation policy makers tend to be most concerned about national averages, but less about the distribution of that performance across different cities and regions, and this has implications for "territorial inclusiveness". Innovation policy goals and the instruments used are not typically conceived with an explicit place-based dimension; however, they have significant place-based consequences. Government research spending will generally go to the locations with public laboratories. Public support to R&D in universities is also conditioned on the location of these institutions, which in some cases have been in existence for centuries. Programmes targeting firms in a particular sector or technology will end up funding places with a higher concentration of those firms.

More evidence is needed on cross-regional trends to address a number of critical questions facing national and regional policy makers. The first concerns how best to address significant regional economic imbalances in a country. It is neither feasible nor advisable to seek to remove all interregional differences; the question is the degree to which those differences exist and how to reduce the gap, in part, over time. The acceptable degree of concentration and inequality is a political question, but it is also an economic one, as lagging performance in some regions holds back aggregate national performance. A second question concerns how to (better) manage regional innovation strategies (RIS) that seek to guide investments in knowledge and innovation in a region, and their translation into tangible results – e.g. "smart specialisation" strategies in Europe. A third question concerns how innovation contributes to productivity growth in different types of regions. The end goal is not innovation for its own sake but rather how it leads to higher standards of living and jobs in different regions. There may be a need to reconsider how well the policy mix meets these goals since not all regions can be at the top in all areas, or strive to be.

To address these questions, the chapter is structured as follows. It first considers the academic literature on innovation, regions and growth. There are possible tensions between agglomeration phenomena and reducing interregional gaps. Furthermore, the relationship among regions, innovation, productivity and

growth is not the same in all regional contexts. The chapter then assesses actual changes in interregional gaps over time on knowledge economy indicators for OECD regions with data, considering regional concentration of knowledge economy resources, the level of interregional gaps in the intensity of such factors, and the changes in rank order of regions over time. It then explores whether within-country concentration is associated with better country performance, and whether increasing or reducing gaps in knowledge economy indicators has any clear relationship with productivity gap trends. In other words, would territorial inclusiveness come at the cost of lower performance at the national level? Finally, in light of the results, it considers what policy can and should do regarding interregional gaps in knowledge economy performance, bearing in mind that innovation is a means to an end.

2.1. What do we know about innovation, regions and growth?

2.1.1. Place matters for innovation

Most factors associated with the knowledge economy are more spatially concentrated than people or economic activity. For example, between 20% and 65% of total R&D activities take place in the top 20% of large (TL2)[2] regions, depending on the country. Around one-third of tertiary-educated workers are concentrated in the top 20% of OECD regions. In a number of countries, patents are twice as concentrated as GDP. This is true for both low patenting-intensive countries of the OECD, such as Mexico or Chile, as well as higher patenting-intensive countries such as Germany, the Netherlands and Japan. A map of patenting trends among small (TL3) regions illustrates the stark contrasts across places in the same country (Figure 2.1). At an OECD area-wide scale, around half of patents are applied for by the top 20% OECD regions.

There are also significant differences in the intensity of knowledge economy indicators between the top and bottom regions – more so within many countries than across them. Comparing that ratio for the share of the labour force with tertiary education, total R&D expenditures (as a share of GDP) and GDP per worker, for some countries top and bottom regions are relatively close in terms of the intensity of indicators. However, wide differences are noticeable in some countries for some indicators. For example, the top 20% regions can have a total R&D intensity of four to five times greater than the bottom 20% (such as in Denmark, Poland and the United States) (Figure 2.2). In general, the range in the ratio between the top and bottom 20% regions is typically between 1.1 to 2.4 for the share of the workforce with tertiary education; 1.1 to 3.2 for GDP/worker; and

between 1.1 and 5.1 for total R&D. These ratios of within-country differences can be higher than across OECD countries. In fact, for patenting that difference is over 40% more within than across countries, up from 15% in 1992. For business R&D, the difference is about 10% or more, down from 20% more in 2000.[3]

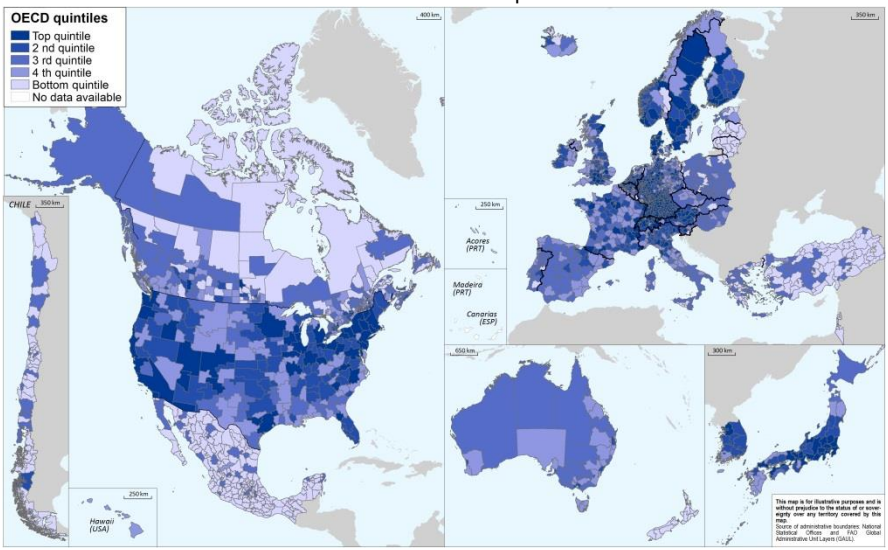
There is considerable evidence that geographic proximity plays a role in certain forms of innovation. Economies of agglomeration, also known as Marshallian externalities, enable sharing of facilities or inputs to the production process; increase the size of labour markets, resulting in better matching of workers to jobs; and foster technology or knowledge spill-overs (Duranton and Puga, 2004). These are the benefits associated with the clustering of firms and knowledge institutions (universities, research labs, start-ups, etc.) In addition, cities tend to have more diversified economic structures and institutions, leading to what are known in the literature as Jacobian diversification externalities which are different from Marshallian externalities (Beaudry and Schiffauerova, 2009). These benefits derive from the complementarity of the knowledge created in one particular sector that is then applied to another. Positive dynamics can therefore reinforce each other when technological, scientific, and entrepreneurial capacities are brought together in a place, which contributes to what has been termed a regional innovation system.[4]

Knowledge spill-overs and "neighbourhood effects" also highlight the importance of geographic proximity. In other words, the benefits of proximity can be measured in terms of distance. Such benefits are generally assessed examining i) sectoral concentration of firms; ii) human capital characteristics; iii) R&D activities; and iv) patents and patent citations (OECD, 2013a).[5] The degree to which proximity matters varies by the sector and nature of the activity, from less than a kilometre for networking in the advertising field in Manhattan (Arzaghi and Henderson, 2008) to generally two or three hours' driving distance for patent citations. A distance of around 200 kilometres is also found to be the radius for GDP growth benefits of R&D investments by neighbouring regions (Rodríguez-Pose and Crescenzi, 2008). Analysis of this neighbourhood effect nevertheless requires that the analyses discern true spill-over effects from spatial auto-correlation related to either unobserved characteristics or common context factors (Manski, 1993).

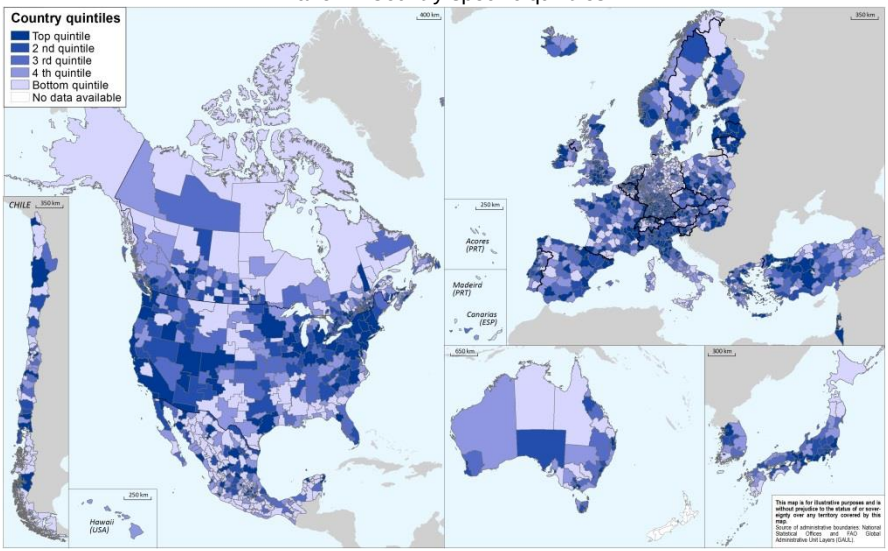
Figure 2.1. Patenting intensity varies considerably across regions in a country

Patents per million inhabitants, TL3 regions

Panel A: OECD-wide quintiles

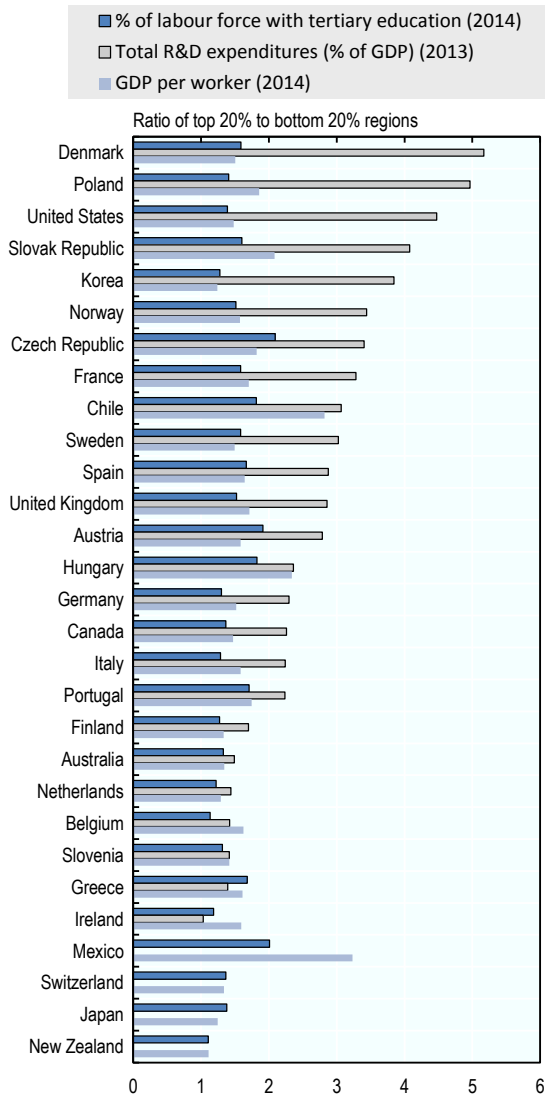


Panel B: Country-specific quintiles



Source: Calculations based on OECD (2016b), *OECD Regional Statistics* (database).

Figure 2.2. Interregional gaps: R&D, tertiary-educated workers and productivity



Source: Calculations based on OECD (2016b), *OECD Regional Statistics* (database).

2.1.2. Growth dynamics are not the same across all types of regions

In line with endogenous growth theory,[6] many studies seek to assess the role of investments in innovation-related indicators that result in productivity increases contributing to economic growth. The assumption is that investments in innovation (often investment in R&D is used as a proxy) would lead to innovation in firms (often patenting is used as a proxy), which would then increase productivity and thus improve overall income levels (GDP per capita is used as a proxy). Human capital (proxied by the share of the workforce with a tertiary education) is another key input for growth.

The challenge with the proxies of R&D investment and patenting is that they tend to be more representative of science and technology-related innovations in particular sectors or in frontier firms. The leading firms continue to experience strong productivity growth, but the remaining firms do not (Andrews, Criscuolo and Gal, 2015). A similar trend is found among regions (OECD, 2016a). Science and technology-intensive indicators generally capture the activities of high-tech industries and hide the fact that innovation can also take place outside these sectors, and play a similarly important role in driving regional competitiveness (Schibany and Streicher, 2008). Firms that may not be R&D- or patent-intensive can contribute to regional growth through productivity increases.

Human capital has been found to have strong direct and indirect impacts on regional growth in numerous studies. The indirect effect is observed through its influence on patenting (OECD, 2009a). Carlino and Hunt (2009) suggest that by far the most important indicators in explaining inventive activity (in cities) is the accumulation of human capital, even when controlling for R&D expenditures. The authors also find that more patents obtained by local inventors are associated with more local job growth and hence foster local economic growth.

Having a large share of highly educated workers is not enough, as the share without significant education and skill mismatches can also be bottlenecks to growth. Much of the literature on human capital for growth focuses on the share of the labour force with a certain degree of education (typically tertiary education). In some countries, however, skill mismatches among the highly skilled are notable. For example, Italy and Spain both have one-third of their workforce in tertiary education, but nevertheless suffer from significant skill mismatches (McGowan and Andrews, 2015). Furthermore, a greater bottleneck for growth generally across regions is not the lack of highly skilled workers per se but having a larger share of unskilled workers (i.e. without secondary education) (OECD, 2012).

R&D intensity and patents matter for GDP per capita growth, particularly among the regions economically strongest in a country. Many studies note the importance of R&D and patents for regional growth, albeit these are typically based on pre-crisis data (see for example OECD [2009a] for OECD regions or Rodriguez-Pose and Crescenzi [2008] and Paas and Vahi [2012] for EU regions). The benefits for growth may take several years to appear (OECD, 2009a). Among the regions with a GDP per capita above the country average, those that were growing at a faster rate than the country growth rate had on average R&D as a share of GDP almost 50% higher and almost double the value of patents per inhabitants as compared to those high-income regions that were growing below the national average. These relationships did not hold for regions with a GDP per capita below the national average, suggesting that a wider range of factors beyond science and technology-based innovation indicators are behind the relative growth levels of these lower-income regions (OECD, 2012). Sterlacchini (2008) finds that for European regions, returns to R&D investments are generally higher in more advanced places, creating a virtuous cycle for those regions.

One of the reasons for this differential role of R&D for regional growth has been described as "absorption capacity" or a "social filter". Measures of such capacity tend to be proxied by indicators considering human capital and/or prior investments in R&D itself. The knowledge-based economy depends in large part on the education and skills of its workforce, which helps determine a region's ability to generate or benefit from new knowledge. Increasing investments in R&D do not have the same growth impacts where there is insufficient "absorption capacity" as proxied by the level of human capital (Ahlin, Drnovšek and Hisrich, 2014). Local socio-economic conditions for the birth and assimilation of innovation and its transformation into economic growth across regions are critical. The "social filter" therefore refers to education levels as well as local labour force conditions and the demographic structure (Rodríguez-Pose and Crescenzi, 2008). The quality of governance has also been highlighted as contributing to both GDP per capita growth and returns to public investment among EU regions (Rodríguez-Pose and Garcilazo, 2013). Access to broadband and other structural capital are also factors that could influence the both absorption capacity and the productivity of R&D investments.

The supply of venture capital can have a positive and sizeable impact on innovation and economic growth (OECD, 2013c). A study in the United States suggests that geographically concentrated venture capital plays an important role in fostering entrepreneurial communities and innovation in the regions where the VC firms are located (Lerner, 2010). OECD member countries have increasingly

sought to encourage the availability of venture capital (OECD, 2011a). Creating a favourable regional environment for entrepreneurship minimises obstacles for new start-up markets and helps promote venture capital investments outside established industry clusters (Chen et al., 2009).

2.1.3. Agglomeration, innovation and productivity: Dynamics for and against territorial inclusiveness

Co-location can influence the ability of R&D to generate knowledge-intensive employment and other localised economic benefits. For example, agglomeration is found to have an impact on market-oriented research, while for more science-driven research it is interregional networking on a global scale that helps translate R&D into high-skill jobs (Varga, Pontikakis and Chorafakis, 2012). Other research finds that innovation networks are often organised within institutional boundaries, such as private firms or universities, where collaboration in the innovation process is increasingly important to handle the burden of specialised knowledge that drives innovation. The geographic proximity of these institutions supports collaboration processes, but innovators' social networks were found to be the most critical component in this process according to a recent study by Crescenzi, Nathan and Rodríguez-Pose (2016).[7] Storper et al. (2015) also note that networks of people and leaders, as well as capacities for organisational change in firms, help explain metropolitan economy success over the long term.

There exists a tension between the importance of agglomeration for innovation and the goal of reducing knowledge economy disparities across regions. For many sectors, including science-based and knowledge-intensive business services, agglomeration benefits are critical. However, strong performance does not necessarily require a large metropolitan area. Some regions with medium-sized cities have proved successful in their country contexts in achieving productivity levels and growth despite the lack of a large city (e.g. the Basque Country in Spain).

The degree of spatial concentration of economic activity and its positive link to regional productivity is widely documented, so is there a trade-off? A doubling of employment density in a county results in an increase in average labour productivity of about 6% (Ciccone and Hall, 1996). A doubling of the population size of a city is associated with an increase in productivity of between 2% and 5%.[8] Many other studies document this density-productivity relationship (for example, Glaeser, 2008; Florida, 2009). However, policies to reduce regional inequalities may be inefficient at a national scale, producing a trade-off between

national growth in productivity and equality (Kuznets, 1955; Williamson, 1965; Okun, 1975). Empirical evidence suggests that both sides of the argument can be valid (Martin, 2010). For example, knowledge spill-overs that reach lagging regions in the form of a trade in ideas rather than trade in goods benefit lagging regions without compromising growth in leading regions (Baldwin et al., 2003). A key issue remaining in the trade-off discussion is how spatial concentration and indicators investigated are measured and included in an appropriate growth model (Gardiner, Martin and Tyler, 2010; Martin, 2010).

The disparities in knowledge economy factors across regions are more serious if innovation diffusion mechanisms are not working. The physical place in which innovation takes place would be irrelevant if the diffusion of technology were instantaneous. However, knowledge is "sticky": the innovative region therefore has an advantage over others, and the extent of this advantage depends on the easiness of diffusion (Fratesi, 2003). Within EU countries, some industries have become more geographically concentrated, particularly those in R&D-intensive sectors (Midelfart-Knarvik et al., 2000). Evidence on productivity at the firm and regional levels highlights that these diffusion mechanisms are indeed not working as hoped (OECD, 2015a; OECD 2016a).

While it is important to consider R&D trends, there are many reasons to look beyond R&D for understanding regional growth and productivity. An analysis of interregional productivity gaps within countries has noted that levels of R&D investment in lesser-performing regions is not, on average, a distinguishing characteristic for those that are catching up to a national frontier relative to those that are not are not (OECD, 2016a). Traditional analyses based on linear innovation models are rooted in the assumption that increasing R&D investment in any given territory will lead to greater innovation, and this in turn will result in greater economic growth. More recent works identify rather complex relationships between innovation and spill-overs that positively affect regional growth and ultimately facilitate the catching-up of lagging regions *vis-à-vis* the leading ones. Knowing regional innovation dynamics helps to understand the types of innovation policies that more directly influence productivity growth, and in which types of regions.

2.2. How have interregional disparities changed over time?

The indicators included in this analysis are those in the OECD Regional Database (Table 2.1). Patenting data is one indicator considered, given that most significant technology-based innovations are patented.[9] Different forms of R&D

expenditure are also considered: total, business and public (i.e. the sum of R&D performed by higher education and government institutions).[10] However, it should be noted that firms increasingly invest in knowledge-based capital other than R&D, such as software, organisational capital and training (OECD, 2015b). Human capital indicators used include the tertiary-educated labour force and R&D personnel. To characterise the knowledge and technological intensity of the industrial structure, two indicators are considered: the labour force working in high-technology manufacturing, and the share of the labour force in knowledge-intensive services.[11] These are the indicators available for a substantial number of OECD countries at the TL2 level (large regions). Due to limited availability, regional data on venture capital is presented for only a few countries.

Table 2.1. Knowledge economy indicators assessed

Values measured at the regional level

Variable	Measures	Comments
Gross domestic expenditure on R&D (GERD)	- As a % of GDP	The overall level and intensity of research and development expenditure in a regional economy by different public, private and non-profit actors; headline indicator used by many regions.
Business enterprise expenditure on R&D (BERD)	- As a % of GDP	R&D performed by firms; more likely to lead to an innovation than R&D expenditure by other types of actors. Note that not all innovations are the result of R&D expenditure.
Public R&D expenditure as share of GDP	- As a % of GDP	Measures the intensity of research and development expenditures by the higher education (HERD) and government (GOVERD) sectors combined.
Labour force with tertiary education (ISCED 5-8)	- Number of workers - As a % of the total labour force	Measures the relative share of highly educated workers in the labour force and is often used as an indicator of a region's "absorption capacity"; doesn't measure the relevance of those skills for the regional economy.
Patent Co-operation Treaty (PCT) patent applications	- Number of patents (3-year moving average) - Per million inhabitants (3-year moving average)	Measures invention, particularly that which is technology-intensive, and is strongly influenced by sectoral composition. Patent counts by priority date and by inventor (as opposed to applicant) are used to reflect more accurately the timing and location of the inventive activity. The economic benefits to patent owners may accrue to another region

		(domestic or foreign) depending on where the owner (as opposed to the inventor if not the same) is located. The average over a 3-year period is used to smooth out annual data fluctuations.
R&D personnel	- Number of R&D personnel - R&D personnel per 1 000 workers	Indicates the relative importance of R&D personnel in the regional workforce; includes R&D managers, administrators, technicians and clerical staff.
Workers in knowledge-intensive services (KIS)[a]	- Number of workers in knowledge-intensive services - Workers in knowledge-intensive services as a % of the total labour force	Describes the degree to which the local economy includes employees in knowledge-intensive service jobs, which are more likely to generate value added for the region than other types of services. There are also documented positive spill-overs between knowledge-intensive service activities and other sectors of the economy for innovation.
Workers in high-technology manufacturing (HTM)[b]	- Number of workers in high-and medium-high technology manufacturing - Workers in high- and medium-high technology manufacturing as a % of total labour force	Higher-technology manufacturing activities tend to contribute a greater value added to the economy than lower-technology sectors. Such sectors are also more likely to show higher levels of R&D investment and patenting activity. High-technology activities may occur in low-technology manufacturing sectors, and vice versa.
Venture capital (VC)[c]	- As a % of GDP	Venture capital consists of private capital provided by specialised firms acting as intermediaries between primary sources of finance (insurance, pension funds, banks, etc.) and private start-up and high-growth companies whose shares are not freely traded on any stock market; important financing source particularly for young firms with growth and innovation potential.
Broadband access	- As a % of households with Internet broadband access	Broadband access is an enabling infrastructure that facilities firm-level productivity.

Notes:

a. For a detailed overview of sectors within the KIS category, see definition by EUROSTAT: http://ec.europa.eu/eurostat/cache/metadata/Annexes/htec_esms_an3.pdf.

b. For a detailed overview of sectors that constitute the HTM category, see definition by EUROSTAT: http://ec.europa.eu/eurostat/cache/metadata/Annexes/htec_esms_an3.pdf.

c. Venture capital is a subset of private equity (i.e. equity capital provided to enterprises not quoted on a stock market) and refers to equity investments made to support the pre-launch, launch and early stage development phases of a business.

For further detail on these variables, see OECD, 2016b and OECD, 2016c.

Unfortunately, the OECD does not have variables at the regional level that address innovation directly. The most common indicator used in other analyses is the share of firms in a region that are innovating; this is used in the Regional Innovation Scoreboard of the EU. Innovation surveys typically contain a richer set of questions regarding the development, type and impact of an innovation, such as the sales associated with new products.

For innovation activity, a small region/metropolitan area may be more appropriate for understanding the dynamics of innovation clustering. However, for all but patents, the only spatial scale available for these variables is that of the large regions (TL2) (see Table 2.A1.1 for availability by country by year). The scale of the analysis calls for consideration of potential biases due to the modifiable area unit problem (i.e. changing the spatial scale changes the results). A test using small regions (TL3) for patents does not appear to change conclusions about interregional dynamics over time in most countries, but the smaller-scale unit does result in greater values for interregional disparities (Figure 2.A1.1).[12]

A range of measures is used to assess interregional disparities. The first is the degree of regional concentration within countries and across the OECD area, using multiple measures, as well as the change in the degree of concentration over time. Another type of measure considers the ratio of the intensity of innovation performance in top and bottom regions and the changes in that value over time. A population-weighted calculation for top and bottom 20% regions is used to facilitate greater cross-country comparisons and reduce the potential differences when considering variables at a small spatial scale. A final measure to assess regional ranking change considers the share of regions that move out of the top or bottom quintile over time (Box 2.1).

Box 2.1. Choice of indicators to measure interregional dynamics on knowledge economy variables

The analysis provided here focuses on the indicators of relative regional performance over time.

Concentration measures – Two measures of concentration are used for within-country comparisons. The first is the share of the volume of a resource in a country that is in the top 20% of regions (see definition of top/bottom 20% below). This concentration indicator focuses on the top of the distribution, as there is often a skewed distribution of innovation activity, with few regions showing high values and many more with lower values. The second within-country concentration metric used is the normalised Herfindahl-Hirschman Index (HHI) that takes into account all the regions in a country, including the

middle of the distribution – not just the top 20%. The HHI ranges from 0 (homogeneous distribution) to 1 (concentrated in one region). Cross-country comparisons of the index are to be interpreted with care since the value of the index is sensitive to the number of regions, despite the normalisation. The analysis therefore focuses on the change in the indicator in a given country, not the cross-country comparisons of levels on a given indicator. For OECD area-wide measures, where the number of observations allows, additional measures of concentration are considered, notably the Theil Index and the Gini Coefficient.

Intensity measure – Many regions and countries have particular targets regarding R&D intensity (R&D as a share of GDP) or the knowledge capacity of the labour force (share of the labour force with tertiary education). The metric considered is the ratio between the top and bottom 20% performing regions and its evolution over time. Top 20% was chosen to avoid skewed results from considering simply the difference or ratio between the top and bottom regions only.

Population weighting – To make these measures more comparable across countries, the top and bottom regions are defined taking into account population. Often the measures used in different analyses consider each region as having the same weight, irrespective of its share in the economy or national population. However, if there are significantly fewer people in the poor-performing regions, the low values on indicators in those regions have less overall impact on national performance. In addition, an unweighted approach limits the interpretation of cross-country comparisons. A population-weighted figure helps to mitigate the effects of different spatial unit sizes on the magnitude of the difference when considering the variable at a smaller spatial scale. To address these problems, the top and bottom 20% are based on the regions ranked in order until 20% of the national population is reached. For example, if there are 50 regions in a country, 20% would normally be 10 regions. However, if those 10 regions are home to 70% of the national population, fewer than 10 regions would be included. The value of the indicator is then recalculated based on the top/bottom 20% regions. For example, if the indicator is R&D as a share of GDP, the sum of R&D expenditure over the sum of GDP for the selected regions is then used to calculate the overall figure for the top 20% (or bottom 20%).

When compared with quintiles (which give each region an equal weight), the results are not the same. For measures of intensity, the weighted method shows a less positive picture in terms of the closing of interregional gaps than if the top and bottom quintile regions (unweighted) are used. The top 20% figures are typically based on a smaller number of regions with the highest values, since these top regions are often those with large cities. For concentration measures, this tends to result in a smaller value of concentration in the top 20% than if regions were taken regardless of population share, as again the more populous regions are found in the top 20% and therefore would represent a larger relative share of the population. Some of the lesser-performing regions in the bottom 20% of a country are often rural, and therefore a larger number of regions need to be included to reach 20% of the population than if simply the bottom quintile of regions is used.

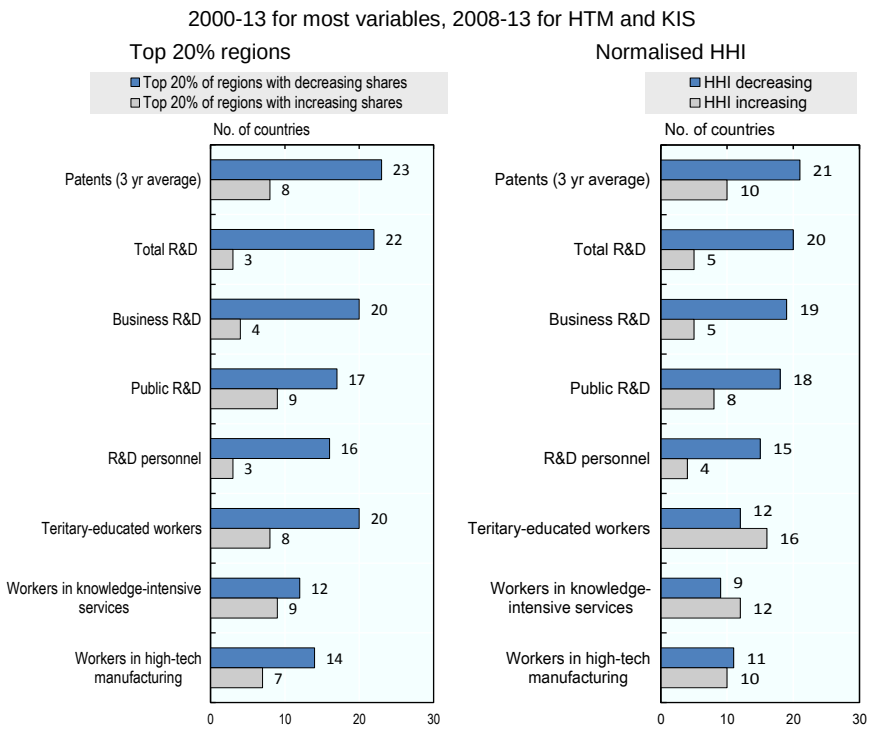
Regional ranking changes – For these analyses, the quintile measure of regions has been preserved. This is the case, for example, in analyses considering the share of regions that have moved out of the bottom or top quintile. Otherwise, the probability of staying or leaving the quintile would be unequal across variables and years, and therefore less comparable an indicator.

2.2.1. Spatial concentration of knowledge economy factors has been on the decline in most countries

The concentration of resources in the top 20% regions has typically declined in more countries than it has increased (Figure 2.3). Total, business and public R&D expenditures saw shares in the top 20% of regions decline in the majority of countries, although for public R&D this decline was less striking (9 out of 17 countries showed an increase in that factor's concentration in the top 20% regions). Patenting and human capital variables also showed a clear trend of decreasing concentration. The top 20% share of workers in knowledge-intensive services and high-tech manufacturing shows more mixed results, with shares in concentration increasing in around the same number of countries as those decreasing. The time frame observed for these last two is, however, only 5 years in the post-crisis period compared to 13 years for the other variables considered.

The trend of a decline in spatial concentration within countries is confirmed using a second measure that considers all regions, not just the top 20%, with an exception for tertiary-educated workers (Figure 2.3). Using the normalised Herfindahl-Hirschman Index, the concentration of tertiary-educated workers has increased in 16 out of 28 countries, as compared to an increase in concentration in the top 20% in only 8 out of the 28. While there has been an improvement across the board in OECD regions in terms of the share of the labour force with tertiary education, and a reduction in concentration in the top 20%, these highly skilled workers are nevertheless somewhat more concentrated overall today than fifteen years ago in more than half of the countries with data.

Figure 2.3. Changes in interregional concentration of knowledge economy variables: Country counts

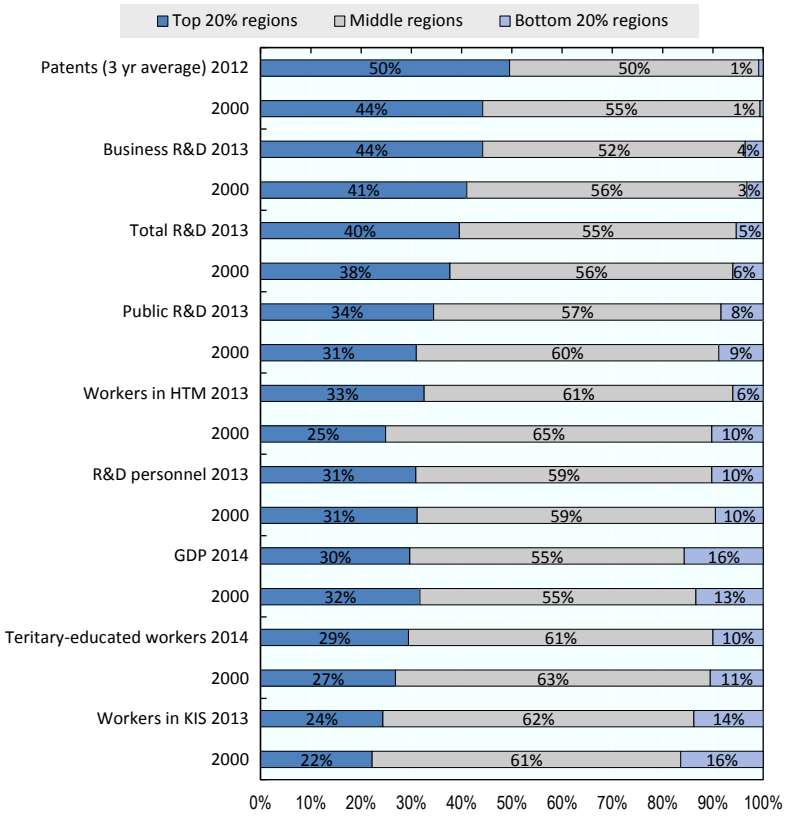


Notes: Regions are at Territorial Level 2. The year ranges are: Patents (2000-12), based on a three-year average for the first and last year; Total, Business, Higher Education and Government R&D expenditures (2000-13); R&D personnel (2000-12); Tertiary-educated workers (2000-14). Countries included are as follows. For Total and Public R&D expenditures and R&D personnel (except Australia, France, Greece, Sweden, United Kingdom, United States):, Australia, France, Greece, Sweden, United Kingdom, United States): Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Korea, Netherlands, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, United Kingdom, United States. Business R&D expenditures also include Switzerland. Patent data also includes Iceland, Israel, Mexico, Switzerland and Turkey. Tertiary-educated labour force also includes Israel and New Zealand. Estonia and Luxembourg are excluded for all variables, as both have only one TL2 region.

Source: Calculations using the OECD Regional Database.

On an OECD area-wide basis, the top 20% regions have shown an increase in their share of concentration over the assessed time period, albeit other concentration indicators show less clear-cut increases (Figure 2.4). The only exception in this trend is R&D personnel, which remained constant. In comparison, the share of GDP in the top 20% regions declined by 2 percentage points. Most pronounced was the share increase for workers in high-technology manufacturing, 8 percentage points. When looking at the entire period for which country data are available, in some cases over 20 years, the data show that the increase in concentration in top 20% of regions had been even more pronounced than what has been observed since 2000. For example, the top 20% of regions increased their share of patents from 39% to 50% from 1990 to 2012 (3-year averages): 11 percentage points. Other indicators considering all regions show that changes in concentration on an OECD area-wide basis show some gap reductions (Figure 2.5). The normalised Herfindahl-Hirschman Index shows a regional convergence trend over time across almost all indicators (tertiary-educated workers). This trend is commensurate with that found for the Gini Coefficient, while overall the Theil Index shows more mixed results between greater and lesser concentration, depending on the variable.[13]

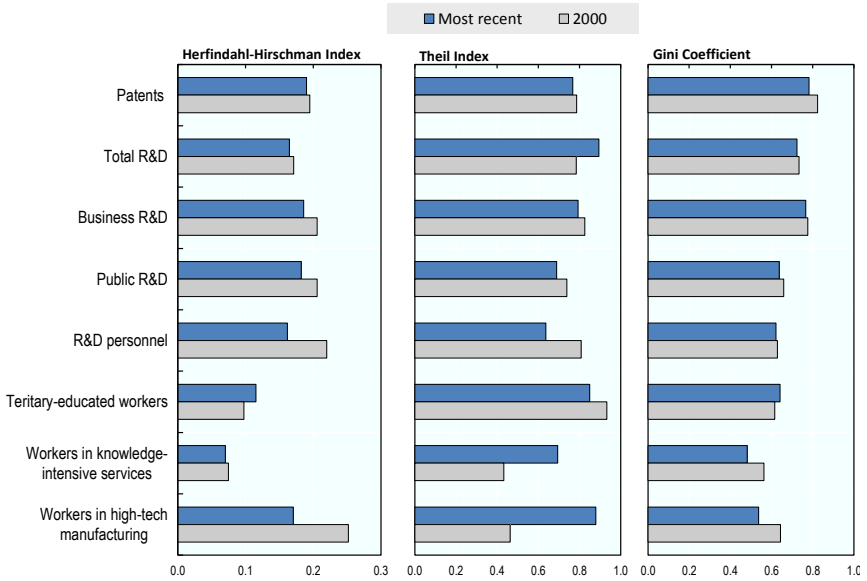
Figure 2.4. Changes in the share of knowledge economy resources concentrated across OECD regions



Note: HTM = high-tech manufacturing and KIS = knowledge-intensive services.

Source: Calculations based on OECD (2016b), *OECD Regional Statistics* (database).

Figure 2.5. Multiple measures of regional concentration at an OECD-wide scale

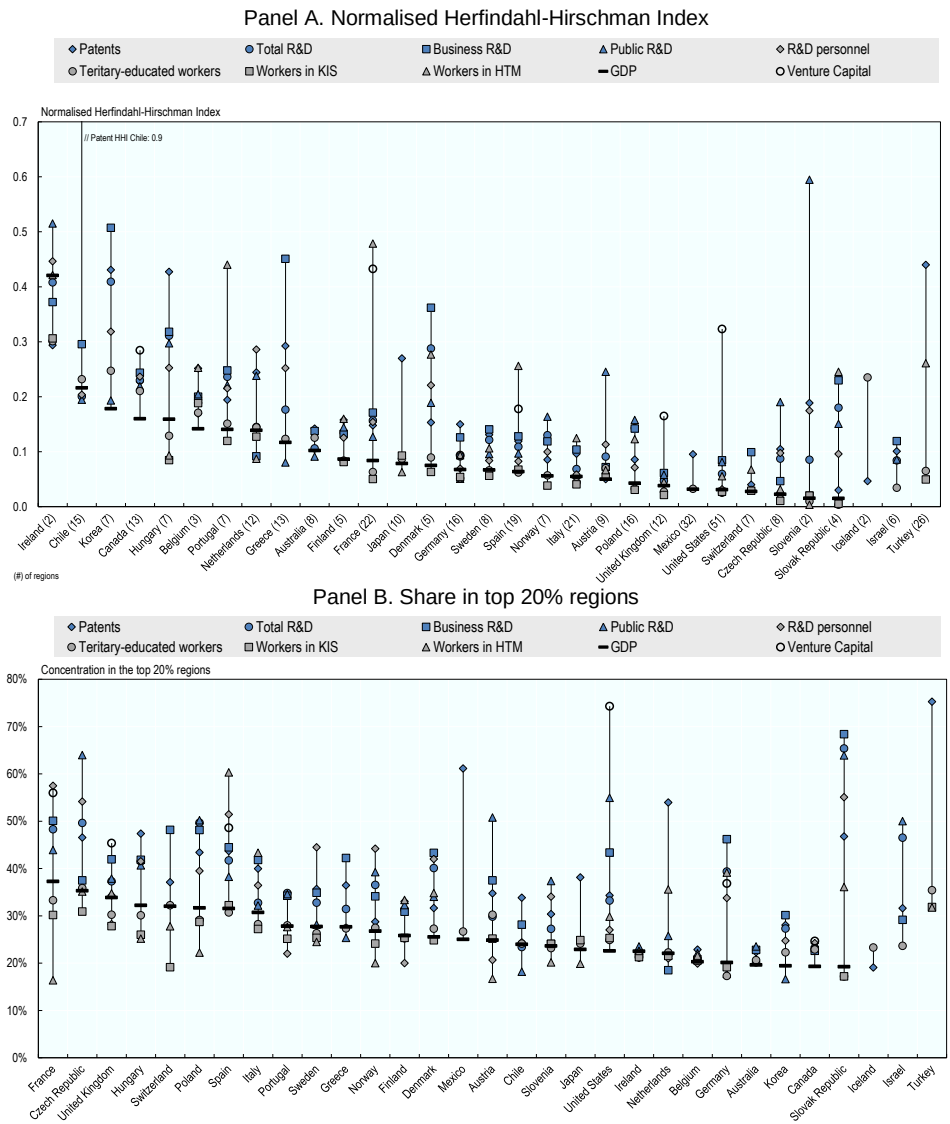


Note: Most recent year is 2012 for Patents; 2013 for Total, Business and Public R&D as well as R&D personnel and workers in HTM and KIS; and 2014 for tertiary-educated workers.

Source: Calculations based on OECD (2016b), *OECD Regional Statistics* (database).

Regardless of the measure, there is a notable differential in terms of the spatial concentration of variables in the same country (Figure 2.6). Venture capital (VC)[14] is the most concentrated variable among the six countries with data, with the exception of France where VC is just below the concentration of high-tech manufacturing. Patents tend to be relatively more concentrated in space than other indicators, followed by business R&D. Knowledge-intensive services tend to be the least concentrated, likely given the presence of many non-tradeable services throughout a country whereas tradeable activities are more concentrated in space. The share of the tertiary-educated labour force is also typically less concentrated than GDP. Within public R&D expenditures, government R&D tends to be more concentrated than higher education R&D expenditures, likely given the fewer number of public laboratories relative to universities in many countries. Public policy in several countries has actively sought to fill gaps in regions that lack public universities by creating them. There are some differences in the relative ranking of spatial concentration depending on whether the top 20% or HHI is measure is used (Figure 2.6).

Figure 2.6. Relative concentration of knowledge economy variables by country, 2013



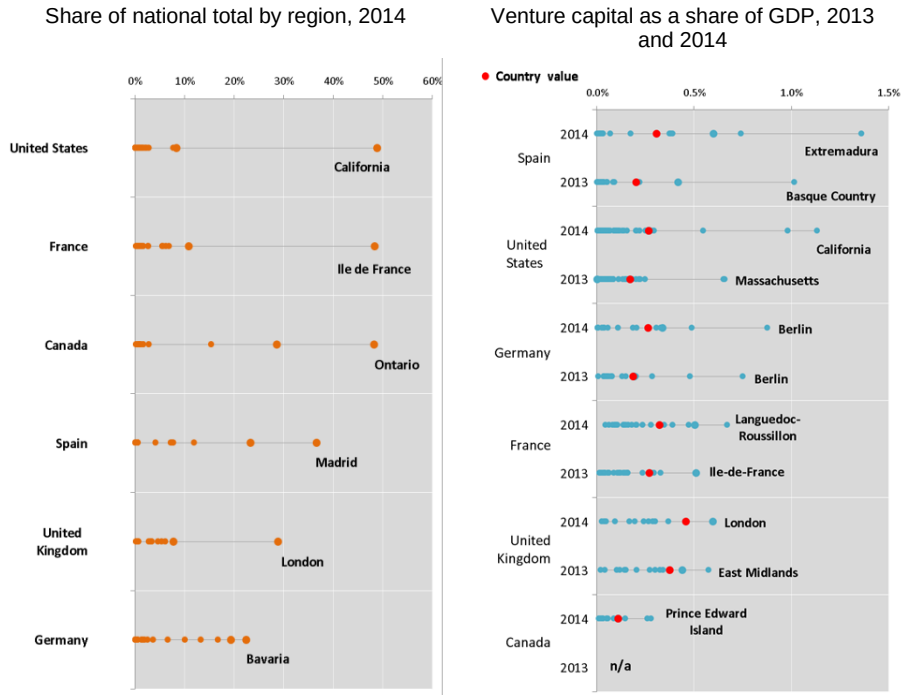
Notes: Regions are at Territorial Level 2. Numbers in parenthesis indicate the number of regions in the country.
Source: Calculations based on OECD (2016b), *OECD Regional Statistics* (database).

2.2.2. Venture capital is among the most spatially concentrated variables

Venture capital (VC) signals the availability of high-risk, high-potential innovation investments. With the exception of Germany, where VC is less concentrated than in other countries with data, the regional concentration of venture capital shows a marked concentration in the leading regions (Figure 2.7). The top 20% regions (based on national population shares) for the countries considered apart from Germany – Canada, France, Spain, the United Kingdom and the United States – were responsible for over 70% of all VC invested in 2014. The same regions represent only between 41% (United States) and 55% (Spain) of their respective national GDP, indicating significant concentration in both volume and intensity in the economy of the leading VC regions. The remaining share of VC is distributed across the remaining regions, which tend to be far from the value in the top region.

VC as a share of GDP also shows pronounced interregional differences. The top region is not always the same as the region that has the highest national share (Figure 2.7). In some cases though, high regional values (as a share of GDP) are due to irregular investments in a location with a low level of regional GDP, such as in the case of Extremadura (Spain) in 2013 or the Canadian province of Prince Edward Island in 2014. These data also show how volatile the indicator can be from year to year, regarding both the value in terms of GDP and the region that is at the top.

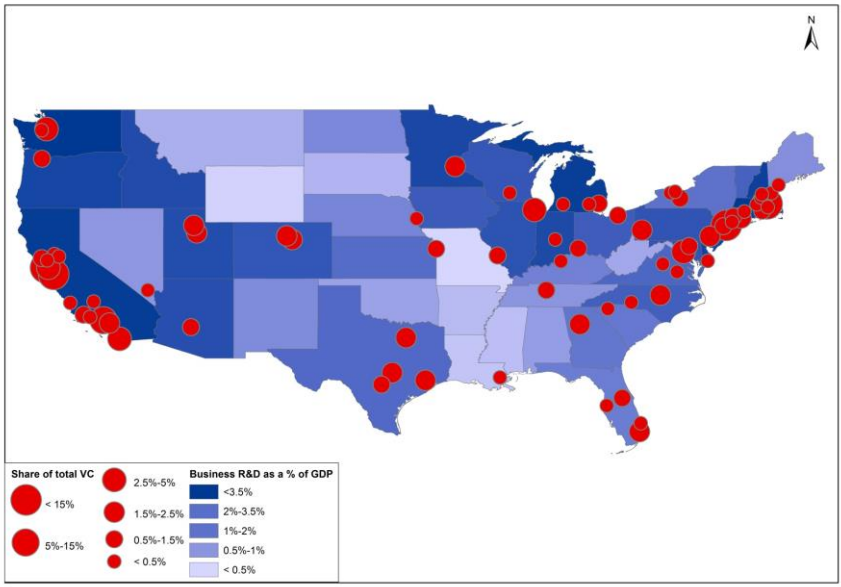
Figure 2.7. Venture capital: Regional concentration and intensity



Source: OECD (2016c) using data from country-specific sources.

Venture capital may be an exception to the trend of declining within-country concentration, signalling that certain innovation system factors require significant critical mass. The example of the United States is revealing. The share of VC in that country in the top 20% (out of the PWC-defined 20 US regional groupings) – Silicon Valley, NY Metro, New England and LA/Orange County – increased from 51% in 1995 to 76% in 2014 (PWC, 2015), largely driven by the dominance of a few metropolitan areas. Many of these same metro areas are found in states with a high rate of business R&D intensity (R&D share in GDP) (Figure 2.8).

Figure 2.8. Concentration of venture capital in US metropolitan areas



Notes: Metropolitan areas in this figure refer to the U.S.-defined metropolitan statistical areas; for a detailed definition consult the US Office of Budget and Management. Data refer to 2014 for venture capital (VC) and 2013 for business R&D as a % of GDP. The top metropolitan areas and their share of total VC in the United States are: San Francisco (32%), San Jose (14%), Boston (9%), New York (9%) and Los Angeles (4%). The states of Alaska and Hawaii are not shown for ease of visual display.

Source: OECD (2016c) using data from the U.S. National Venture Capital Association (NVCA); Business R&D expenditures from OECD (2016b), *OECD Regional Statistics* (database).

2.2.3. Interregional gaps in intensity also narrowing, but in fewer countries than for concentration

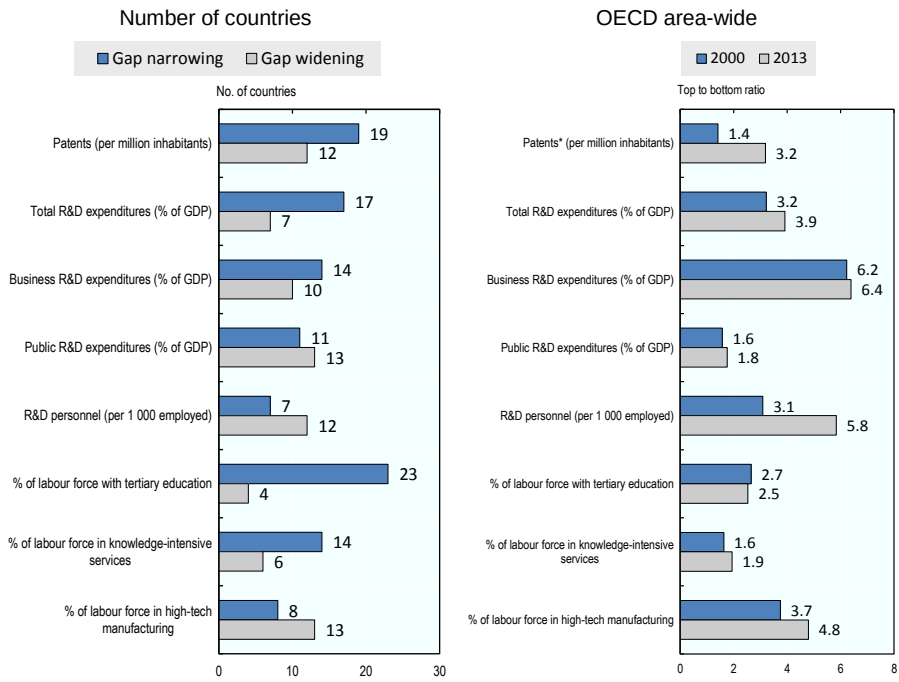
There has been a general reduction in the gap in intensity between top and bottom 20% performing regions in each country for the majority of assessed variables (Figure 2.9). Comparing the ratio of the performance of the top 20% over the bottom 20% of regions (weighted by population), gaps have narrowed in more than half of the countries for most variables. However, gaps for R&D personnel per 1 000 workers appears to be growing. The ratio for the share of the labour force with tertiary education has declined in the vast majority of countries

(25 out of 32 countries with data), the exceptions being Austria, Belgium, Canada and the United Kingdom. For total and business R&D intensity (R&D as a share of GDP), the gap has declined for both indicators in 17 out of 25 countries with data, albeit in only 14 out of 25 for intensity of public R&D (see also Figure 2.10). The latter is particularly interesting, given that public R&D is strongly influenced by public policy, and yet gaps are increasing. Patenting intensity (patents per million inhabitants) shows more mixed results, as only a little over half of the countries showed a reduction in the gap (19 out of 31); a likely reason is that more technology-intensive requirements are specific to certain industries and their spatial concentration. The regional gap in the access of households to broadband declined in two-thirds of the countries (14 out of 21) (Figure 2.10).

On an OECD area-wide basis, however, the gaps widened as measured by the ratio between the top 20% and bottom 20% of regions. The only exception where the ratio declined was for the share of the labour force with tertiary education. Most pronounced was the increase for patents per million inhabitants; here, the gap between the top 20% and bottom 20% of regions rose from 1.4 to 3.2. Despite following the overall trend of widening disparities, business R&D (as a share of GDP) remained basically stable, declining by just 0.2 to a ratio of 6.2 between the top 20% and bottom 20% regions. This is nevertheless the variable with the highest ratio value, and thus the highest magnitude of difference between the top and bottom 20% regions.

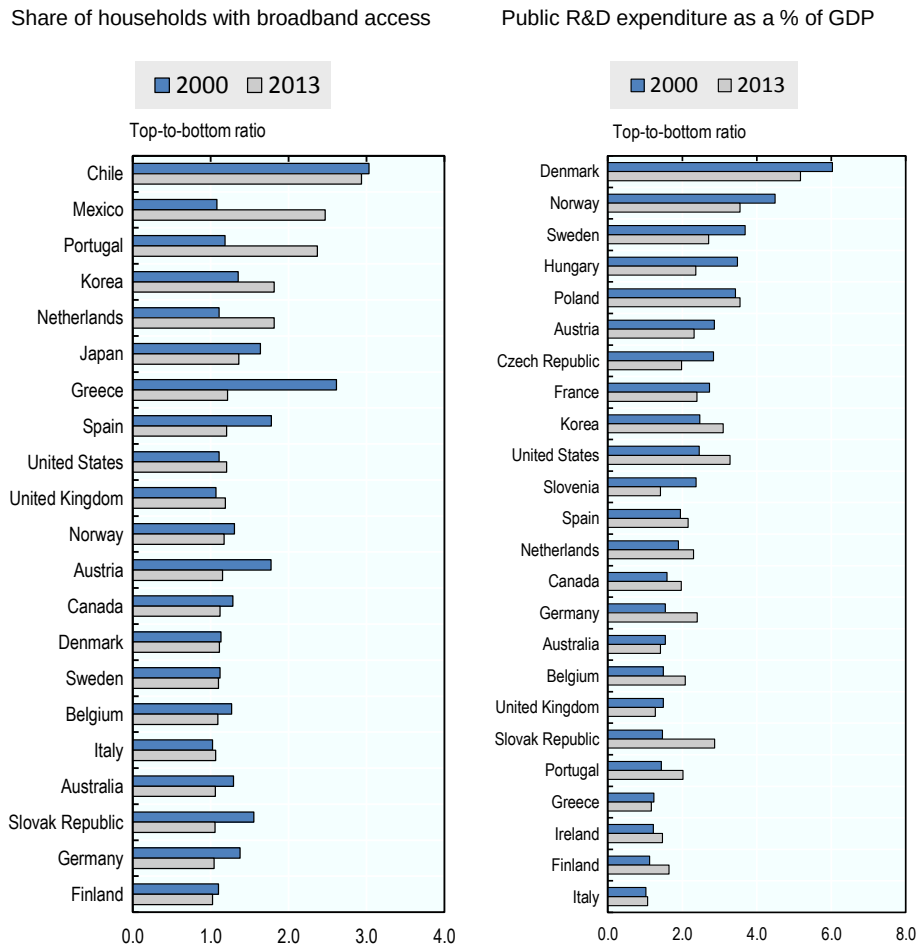
Figure 2.9. Degree of interregional intensity gaps: Top and bottom 20%

2000-13 (HTM and KIS 2008-13)



Note: Based on the population-weighted calculations of top and bottom 20%. * For visibility with respect to other knowledge economy factors displayed, patents are divided by a factor of 10.
Source: Calculations based on OECD (2016b), *OECD Regional Statistics* (database).

Figure 2.10. Country-level values for top to bottom 20% regions: Broadband access and public R&D



Note: Public R&D includes R&D performed by the higher education and government sectors.

Source: Calculations based on OECD (2016b), *OECD Regional Statistics* (database).

2.2.4. Dynamics of regional convergence appear to occur through the "catching-up" of bottom regions

Convergence can happen for "good" or "bad" reasons depending on the performance of both the top and the bottom regions. For example, the ratio in the concentration of the top 20% over bottom 20% regions indicates a convergence when the ratio declines over time, or a divergence if the ratio increases. There are six possible trends that drive interregional dynamics towards declining or increasing disparities (Table 2.2). For example, if interregional disparities decline due to "good" reasons, it means that both leading and lagging regions increased their shares, but the bottom did so at a faster rate. This dynamic is what can be termed "catching-up".

Table 2.2. Regional dynamics leading to convergence or divergence

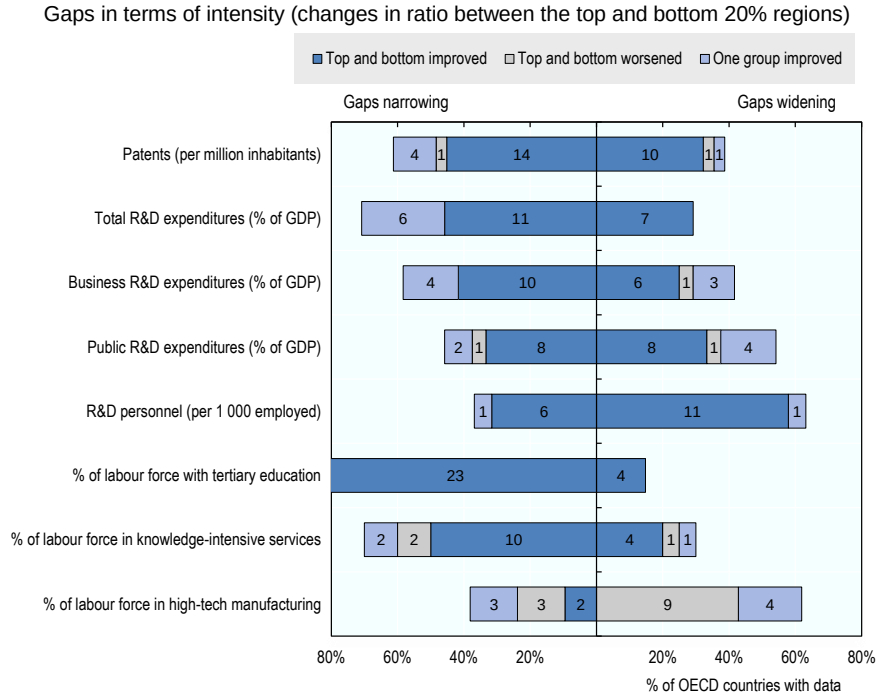
Trend	Scenario	Top region	Bottom region
Convergence	1	Increase (slower than bottom)	Increase (faster than top)
	2	Decrease	Increase
	3	Decrease (faster than bottom)	Decrease (slower than top)
Divergence	4	Decrease (slower than bottom)	Decrease (faster than top)
	5	Increase	Decrease
	6	Increase (faster than bottom)	Increase (slower than top)

The dynamics of convergence and divergence in terms of concentration (e.g. the national share of R&D in the region) are a zero-sum game. In terms of spatial concentration, as these are shares of a national total, an increase in one set of regions means a decrease in another by definition. Spatial concentration gaps typically declined due to a drop in the top regions, accompanied by an increase in the share in the bottom 20% (albeit smaller in absolute terms than the decline in the top, since the middle 60% benefited as well). Where disparities increased, this was the result of both a decline in the concentrations in bottom regions as well as a concurrent increase in the leading regions, in other words both top and bottom regions were contributing to the divergence.

In terms of intensity (e.g. R&D as a share of GDP), convergence was overwhelmingly due to a catching-up effect with relatively faster improvements in the lagging regions (Figure 2.11).[15] Its reverse, convergence due to a drop in values in the leading regions, would not be desirable from a national perspective.

The left-hand side of the graph indicates that disparities were reduced while at the same time there were improvements in both leading and lagging regions. Only in a few countries did both top and bottom regions decline between the beginning and the end of the period. Where interregional gaps increased, this also happened while both top and bottom 20% regions improved; top regions simply improved more. For business R&D expenditures, convergence was driven in part by a decline in the leading regions, generally with a simultaneous increase in values in the bottom regions. Where divergence between top and bottom 20% regions occurred, this was generally driven by the greater increase in the top regions *vis-à-vis* the bottom ones, or the decrease in bottom regions while top regions performed better.

Figure 2.11. Interregional convergence and divergence dynamics for knowledge economy factors

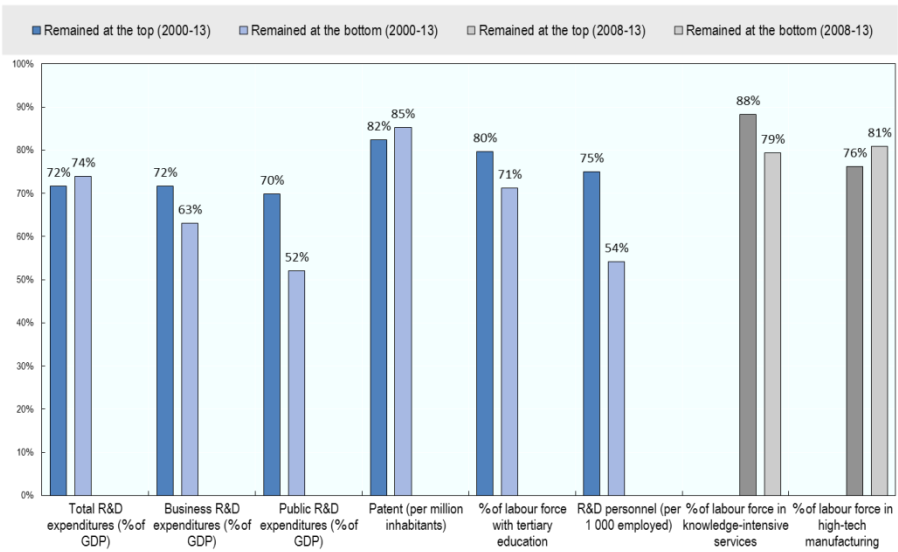


Source: Calculations based on OECD (2016b), *OECD Regional Statistics* (database).

2.2.5. The rank order of regions is generally stable within countries, but more dynamic OECD area-wide

At the country level, the rank order of regions does not change considerably. Across the assessed indicators this picture remains stable; changes in within-country regional ranks occur to a limited extent in southern but mainly in eastern European countries. While changes in ranks are also found in most other countries, for the most part these changes reflect only fluctuations at the margin.

Figure 2.12. Share of OECD regions that moved out of the top and bottom quintiles (2000-2013)



Notes: Regions are at Territorial Level 2. The year ranges are: Patents (2000-11), based on a three-year average for the first and last year; Total, Business and Public (which includes Higher Education and Government) R&D expenditures (2000-11); R&D personnel (2000-12); Tertiary-educated labour force (2000-13). Countries include the following. For Total and Public R&D expenditures and R&D personnel (except Australia, France, Greece, Sweden, United Kingdom, United States): Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Korea, Netherlands, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, United Kingdom, United States. Business R&D expenditures also include Switzerland. Patent data also include Iceland, Israel, Mexico, Switzerland, and Turkey; Tertiary educated labour force also includes Israel and New Zealand. Estonia and Luxembourg are excluded, as both have only one TL2 region.

Source: Calculations based on OECD (2016b), *OECD Regional Statistics* (database).

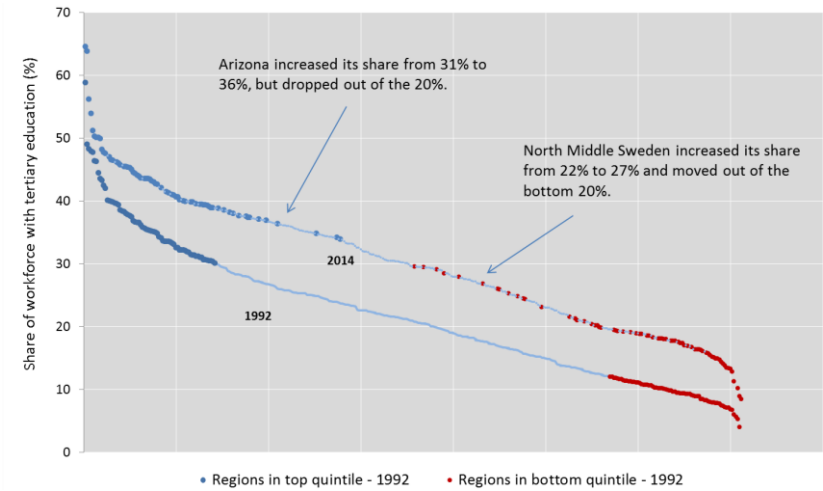
On an OECD area-wide scale, there is notably more movement among regions than within countries, particularly in bottom regions more so than in top regions. The evidence shows more persistence in the top quintile over the decade 2000-13 than the bottom (Figure 2.12). The share of regions remaining in the top quintile of regions (unweighted for population)[16] ranges from 70% for public R&D expenditure as a share of GDP to 88% for the share of the labour force in knowledge-intensive services. For regions in the bottom quintile, the share that remains at the bottom ranges between 54% for R&D personnel per 1 000 workers to 85% for patent applications per million inhabitants.

The change in ranks that some regions managed *vis-à-vis* other regions over time illustrates a clear improvement for bottom regions. For example, looking at the regional movements that have occurred for the labour force with tertiary education between 1995 and 2014 (Figure 2.13), there was a substantial increase in the share of tertiary-educated labour across all regions, as seen in the upward shift of the curve. (Only five regions across the entire OECD area had lower shares at the end of the period compared to the beginning.) At the same time, a substantial number of regions managed to move out of the bottom quintile into the middle range of regions. Some regions dropped out of the top quintile as other regions managed to increase the share of tertiary-educated labour at a faster rate. Regions leaving the bottom quintile came predominantly from eastern Europe, while those remaining were mainly also from eastern Europe but from Spain and Italy as well.

Over the period 1995 to 2013, business R&D intensity (R&D as a share of GDP) improved noticeably across all OECD regions (Figure 2.14). While this upward shift is less pronounced in the top 20% and bottom 20% of regions, it is particularly visible for the middle 60% of regions. Nevertheless, a number of bottom 20% regions managed to improve their business R&D intensity enough to join the middle 60% regions. A handful of regions in the top 20%, whose business R&D intensity remained flat over the assessed time period, were replaced by faster growing middle 60% regions.

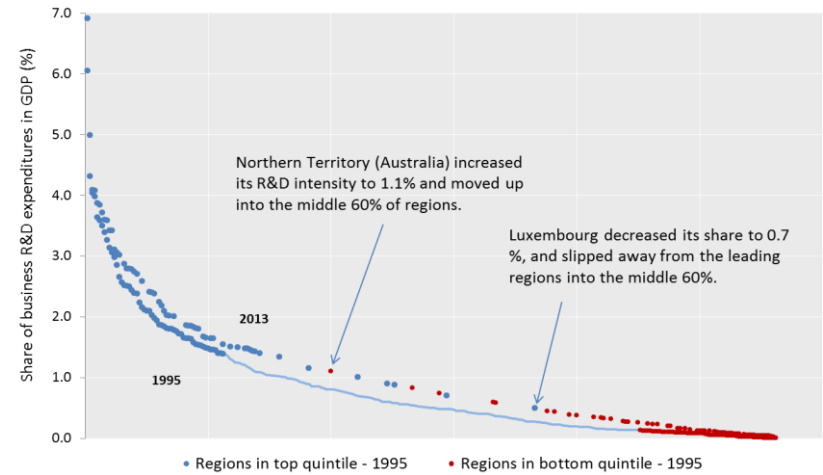
Considering total R&D intensity (R&D as a share of GDP), a clear upward shift can also be observed between 1995 and 2013 (Figure 2.15). Sixteen bottom quintile regions managed to improve sufficiently to move into the middle 60% of regions. However, 57 regions saw their R&D intensity decrease over the period, and 12 regions slipped out of the top quintile. Among those regions that experienced lower relative performance, no clear country pattern could be observed.

Figure 2.13. Change in regional rankings: Share of workforce with tertiary education (1992-2014)



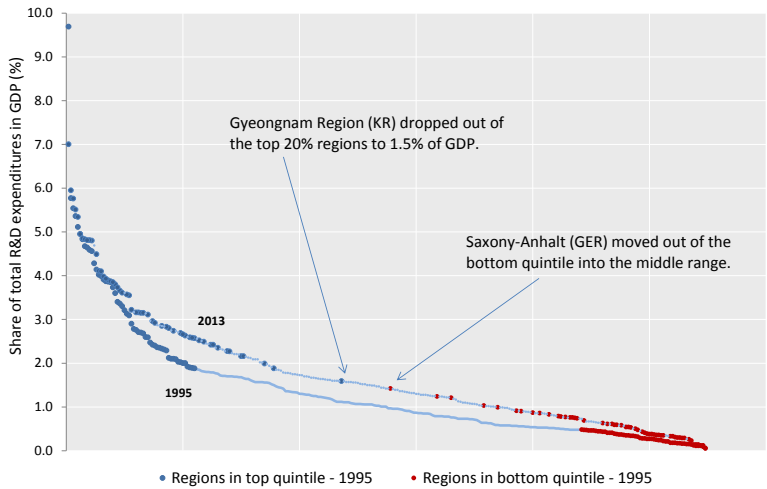
Source: Calculations based on OECD (2016b), *OECD Regional Statistics* (database).

Figure 2.14. Change in regional rankings: Business R&D expenditures (1995-2013)



Note: In the OECD territorial classification, the country of Luxembourg is considered one TL2 region.
Source: Calculations based on OECD (2016b), *OECD Regional Statistics* (database).

Figure 2.15. Change in regional rankings: Total R&D expenditures (1995-2013)



Source: Calculations based on OECD (2016b), *OECD Regional Statistics* (database).

2.3. Is there a relationship between regional concentration, disparities, and national/regional performance?

Concentration of knowledge economy factors within a country does not appear to be related to higher levels of national values for those factors. Neither concentration in the top 20% regions nor the normalised HHI measure was able to explain much of the cross-country variation ($R^2 < 0.05$); typically, the relationship appeared slightly negative. The following combinations were tested at country level:[17] total R&D concentration in 2000 and national R&D growth 2000-13; patent concentration and national patenting growth; and business R&D expenditure concentration and growth in GDP per worker.

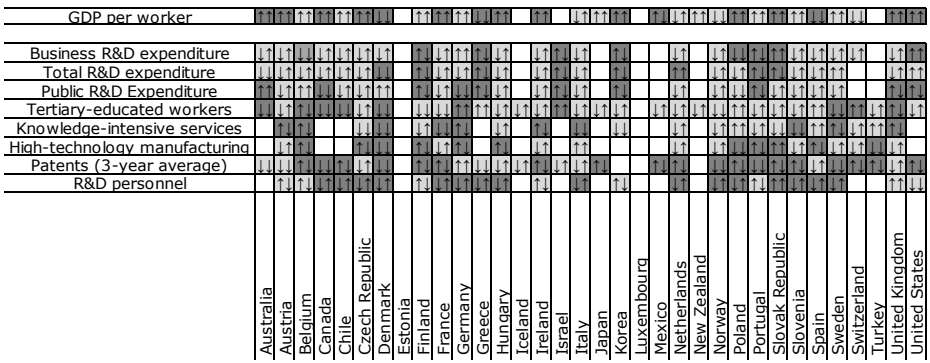
There are important place-based implications associated with poor diffusion mechanisms. The aforementioned spatial decay of knowledge spill-overs highlights the role of geographic proximity in this diffusion process. There are many possible explanations for this breakdown, and these are being explored (OECD, 2015a). With respect to multinational enterprises (MNEs), for example, business R&D investments have the largest impact on a region if they occur in proximity to local firms operating in the same sector but not operating

internationally and hence, are not competing with the investing MNE (Crescenzi, Gagliardi and Iammarino, 2016). The role a region plays within a value chain; the location factors that attract specific MNE investments with positive externalities for a region is therefore an area for further study.

The data do not show any noticeable patterns in terms of reducing gaps on certain knowledge economy indicators or gaps in terms of labour productivity. Figures 2.16 and 2.17 show within-country convergence (lighter) or divergence (darker), and the details of interregional dynamics. The first arrow indicates a growing (↑) or decreasing (↓) trend in the top 20% of regions, and a second arrow indicates the dynamics in the bottom 20% of regions. When assessed on a country-by-country basis, the trends across indicators do not show convergence or divergence across all indicators – the picture is more mixed. Nor does the trend in interregional disparities for GDP per worker show a uniform pattern with respect to the interregional dynamics in knowledge economy factors.

Figure 2.16. Interregional disparities in terms of concentration: Country trends

2000-13 (HTM and KIS 2008-13)

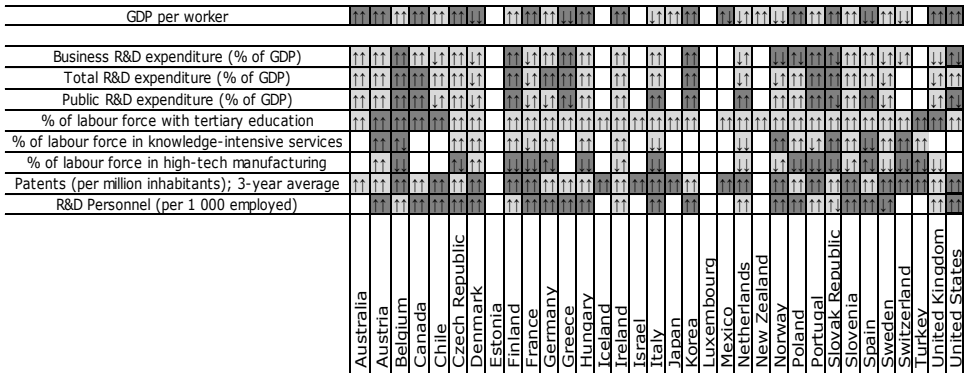


Note: The left arrow refers to the trend in top 20% regions, the right arrow in bottom 20% regions. The lighter colour shows countries with interregional convergence in terms of the concentration of these indicators, and the darker colour shows divergence.

Source: Calculations based on OECD (2016b), *OECD Regional Statistics* (database).

Figure 2.17. Interregional disparities in terms of intensity: Country trends

2000-13 (HTM and KIS 2008-13)



Note: The left arrow refers to trend in top 20% regions, the right arrow the bottom 20% regions. The lighter colour shows countries with interregional convergence in terms of the concentration of these indicators, and the darker colour shows divergence.

Source: Calculations based on OECD (2016b), *OECD Regional Statistics* (database).

2.4. What can and should policy do to support territorial inclusiveness in light of these trends?

2.4.1. Policy can help by going beyond traditional S&T approaches and setting realistic expectations

Some policies are likely contributing to the general within-country convergence trends for knowledge economy indicators. Many of the traditional S&T policies continue to favour the leading regions de facto if not by design. However, over the past 15 to 20 years, regional development policy has increasingly placed the emphasis on innovation through policies designed to increase the R&D efforts of firms, cluster policies, etc., with the aim of improving productivity. It is also noted in evaluations of regional policy in the EU that the quality of interventions has improved in recent years (Bachtler et al., 2013). The improving R&D figures and the catching-up dynamics on these measures indicate that policy is quite possibly having some impact. The same is true of the massive increases over the past two decades in the share of the labour force with tertiary education. The distribution of public R&D across regions is also a direct policy decision, even if place is not the main selection criteria for allocation; nevertheless

convergence on this measure in OECD countries has proved less strong than for several other knowledge economy factors.

The pace or magnitude of change may be slower than hoped by some policy makers. Again, in part this may be a question of resources flows. It is also an issue of the time frame for payoff on economic development programmes – particularly in fields such as innovation, where the benefits are not known *ex ante* and there is a certain element of risk. There is also no counterfactual to know whether the gap would have grown even more in the absence of the intensified regional development focus on innovation.

While there is movement in regional rankings at the OECD level, radical movements in these rankings on headline indicators within countries are unlikely. Indicators at a regional level are the accumulation of effects stemming from many different public and private factors. Other than a massive change in policy or investments or firm locations, with a differential impact by region, these within-country rankings are not likely to radically change for the next a decade or two. The story is different when focusing on a specific technology, where more interregional movements are observed over a twenty- to thirty-year period (Ajmone Marsan and Primi, 2012).

The trends observed call for moderated expectations of policy's ability to significantly reduce the gaps across regions on these knowledge economy indicators, and for an even greater focus on the drivers of innovation diffusion. While policies can seek to build a minimum capacity in all regions, changing the relative positioning is a challenge and not necessarily desirable. Policy action to support territorial inclusiveness needs to consider both performance of the top ("frontier") regions and the degree to which diffusion from those top locations reaches other regions. Given the so-called "breakdown of the diffusion machine", territorial inclusiveness is all the more doubtful and warrants policy interventions that will ultimately support the region's capacity to translate advances found within the region – but more importantly, outside it – into productivity improvements.

2.4.2. Targeted actions to support territorial inclusiveness should seek to avoid common pitfalls

There is increasing policy interest in the role of place in the innovation process, as observed with the innovation focus in regional development policy and the role of regions in innovation policy (OECD, 2011b). The OECD Innovation Strategy notes the efforts of science and technology policy, as well as policies at regional and local level, to cultivate this place-innovation link (OECD, 2010a, 2015d). Regional development policy efforts have also placed innovation at the core of policy approaches in many countries and regions. For example, 27 out of 30 OECD countries report business development and 24 clusters/centres of expertise as policy instruments in their regional policy approaches (OECD, 2016a).

Most countries have therefore been seeking to promote territorial inclusiveness through regional development programmes, and some national STI programmes have also targeted lagging regions. While some programmes may be directed at specific targets, others de facto target such places because they are seeking to address the needs of specific categories of people or firms that are spatially concentrated in these lagging places – be they regions, cities or neighbourhoods. In the EU, for example, Cohesion Policy (a policy with the goal of supporting territorial inclusiveness) accounts for a substantial share of EU spending on research and innovation. Over the seven-year period 2014-20, approximately EUR 40 billion is expected to be spent on the thematic objective "strengthening research, technological development and innovation". In comparison, the EU Horizon 2020 programme for research and innovation has a budget of almost EUR 80 billion (EC, 2014). An overview of the types of programmes, the common modalities in their application, the potential design challenges for these policy instruments and strategies to overcome them are found in Table 2.3.

Table 2.3. Innovation instruments to promote territorial inclusiveness

Type of policy	Common approaches	Policy design challenges to address	Strategies to overcome design challenges
Basic business development and innovation support to firms	– Targeting firms in specific locations – Targeting firms led by particular population groups	– Supply-driven approaches (provider promotes service, not what firm needs) – Restricting innovation support to S&T only	– Diagnosis of need from a neutral provider – Ensuring the mix of business support programmes covers a wide range of innovation needs beyond technology support
Clusters and centres of expertise	– Same programme for all regions (so lagging regions included) – 2nd-track policy for non-frontier regions (possibly from a different policy stream, such as regional development) – Firm-focus versus research-driven	– "Wishful thinking" clusters and resources spent to create what doesn't already exist – Locking in existing industrial structures, preventing "creative destruction" – Sectoral focus only preventing cross-sectoral combinations	– Allocate funds based on documented existing capacities and potential in the region – Avoid permanent aid to specific clusters – Promote cross-cluster linkages
Capacity building for the public sector	– Regional innovation strategy development support – Networks of professionals across regions	– Copying strategies from one region to next – Developing strategies with insufficient interaction among innovation system actors – Disconnect with industry and skills considerations	– Require strategies based on region-specific diagnoses – Ensure that the strategy process is facilitated, not dominated, by the public sector – Require that strategies include a link to skills policies
Capacity building for innovation actors	– Focus on public/quasi-public actors – Co-applicants/co-sponsor to include lagging regions	– "Check the box" involvement of lagging regions in projects – Insufficient outreach to harder-to-reach actors	– Require sufficient co-financing to reduce check-the-box risks – Ensure a policy mix that supports both excellence and outreach
Targeted R&D funding (sectors and places)	– Focus on specific sectors (e.g. agriculture) – Focus on challenges for specific region types (e.g. remote rural)	– Miss new cross-sectoral opportunities – Lack of absorption capacity of a region (particularly with large funds)	– Avoid permanent aid to specific sectors – Prioritise building the pipeline of qualified projects over funds absorption

University engagement in regions	– Educational programmes relevant for regional firms – Supporting collaborative R&D – Involvement in regional economic and social development strategies	– Spreading university resources too thin by trying to offer all subjects in all places – Supply- instead of demand-driven approach to supporting firms – Rent-seeking behaviour in regional strategies and programmes	– Promote relevant specialisation in disciplines within some universities – Prioritise collaborative research with firms over brokerage of knowledge to unknown users – Balance participation in strategy development across types of system actors
Science and industrial parks	– University based – Industrial focus	– Moving from physical infrastructure to innovation systems – Missing entrepreneurs	– Develop parks based on potential linkages with other innovation system actors – Ensure accompanying entrepreneurship programme support
Venture capital funds	– Public funds – Public co-financing with private support	– Providing to firms that are not deal-ready – Public sector often has unclear exit strategies and low risk tolerance – Neglecting the other elements of the entrepreneurial environment	– Use private sector expertise in judging applications – Diagnose the needs of the entrepreneurial environment for complementary measures

Note: S&T stands for Science and Technology.

Some traditional STI programmes may simply adapt certain programme rules in a way that enables lagging regions to participate more fully, such as modified co-financing and eligibility criteria. One option is to reduce the level of matching fund requirements for lagging regions. For example, in some European programmes the co-financing rate varies by the type of region, based on its degree of development. Another strategy is to somewhat relax eligibility requirements for participating in the programme if the participant comes from a lagging region. For example, in the context of Australia's Entrepreneurs' Programme, for two of the four support strands (Business Management and Innovation Connections) there is a lower annual turnover or operating expenditure requirement for an applicant from "remote" Australia. Yet another consideration is to have somewhat lower "excellence-based" criteria for applicants to programmes from less-advantaged regions. Such a change would nevertheless require a minimum degree of quality, even if certain projects were not ranked as high in excellence as those in a more leading region to be eligible for funding.

Innovation and business support programmes

Countries generally have business support programmes that are accessible in all regions, and therefore do not target less developed regions per se. Such programmes may have some adaptations to less developed regions, such as modified programme requirements (see preceding paragraph). Some EU countries use Cohesion Policy funds for such programmes and therefore target lesser-performing regions, or do so with higher funding levels. The place-based element may also be introduced when policies target business owners/entrepreneurs that belong to specific populations that may be more present in some regions than in others (e.g., an indigenous/aboriginal population, such as in Canada and New Zealand). Some countries have a place-based approach to support firms outside the main metropolitan area(s), such as the AusIndustry Regional Manager Network in Australia, or Iceland's multiple programmes to support entrepreneurs and firms with innovative ideas in locations outside of the capital. In Portugal, some of the firm R&D, entrepreneurship and innovation voucher programmes have special calls for firms in low-density areas. In a similar spirit, Austria has programmes that specifically target mountainous regions. Some countries may also be explicitly targeting business support to firms in a particular sector that is strongly place-based, such as the Canadian Initiative for the Economic Diversification of Communities Reliant on Chrysotile. China's S&T Envoy programme, begun in 2002, sends S&T specialists to rural areas nationwide to encourage rural entrepreneurship using S&T. The programme has also been important for the expansion and adoption of S&T methods in agriculture.

The challenges for these programmes are those common to innovation/business support more generally. A potential pitfall – one that becomes more prominent in regions with a reduced offer of service providers – is the ability to ensure access to the requisite innovation support. Some programmes have also shown that while collaboration with the same partner may not continue after the voucher, awareness was raised about the need for innovation and types of possible partners (OECD, 2011b). A conflict of interest may occur when the service provider doing the diagnostic has an incentive to recommend a business/innovation support service that it provides and it receives public funding for that recommendation. Innovation vouchers and other tools can help overcome this problem of separating diagnosis from the service, although in some cases a certification or labelling of service providers may be needed to help firms choose quality providers where they may use such vouchers. Ensuring a mix of business support programmes that covers a wide range of innovation needs beyond technology support is another strategy.

Clusters and centres of expertise

Among the most commonly reported tools for supporting lagging regions are clusters and centres of expertise (Box 2.2) (OECD, 2015c). In many countries these programmes are open to all regions, but their ability to be tailored to local conditions/needs allows them to serve lagging regions. The Industrial Cluster programme in Japan, now in its third phase, is one example. In a country's programme, there may be two tracks, with the second for those less developed clusters that are important to lagging regions. For example, the French Competitiveness Poles programme has a tiered labelling system; those clusters labelled as regionally important were selected in part to help regions that did not have clusters labelled by the government as world class. A country may have two sets of cluster programmes, one for less developed clusters and one for those more developed, although they may not be exclusively targeting lagging locations (OECD, 2007a). Finland has a specific policy instrument to support smaller-scale clusters that can then develop linkages with stronger clusters in the Innovative Cities Programme. Many national competence centre/collaborative research centre programmes that are available in all or many regions are therefore able to support lagging regions – such as certain UK Catapult centres or Australia's Collaborative Research Centres (Box 2.2).

In some cases, the typical challenges these programmes face are even bigger in lagging regions. The so-called "wishful thinking" clusters are more wishful in places with even fewer local assets. The ability to promote new cross-sectoral combinations for innovation, and to avoid a purely sectoral approach to clusters that locks in existing sectors (e.g., automotive), can be more difficult to achieve in lagging regions with less economic diversity. To overcome these challenges, policy makers can be more stringent and allocate funds based on documented existing capacities and potential in the region. Cluster policies should avoid permanent ongoing cluster support and promote cross-cluster linkages to reduce the potential for locking in certain sectors of the regional economy that prevent diversification to related and new fields.

Box 2.2. Clusters and centres of expertise: Country examples

- **Australia –** The Cooperative Research Centres programme supports industry-driven, multi-year research collaborations to conduct and commercialise leading-edge research and solve industry problems. In 2015-16 there were 34 centres in diverse areas including hearing, healthcare, and bushfire and natural hazards management.

- **Chile** – The country has a Regional Program of Scientific and Technological Research (CONICYT) that includes lagging regions.

- **Denmark** – In 2013, a new cluster strategy was launched to improve framework conditions for innovation and knowledge sharing. It includes the establishment of a forum to increase collaboration in cluster development at local, regional and national levels, and the strengthening of international activities of clusters.

- **Estonia** – A grant scheme to establish and develop regional competence centres based on region-specific resources and know-how is part of the country's Cohesion Policy programming. Competence centres are the product of a joint effort of regional R&D and educational institutions, public administrations and enterprises. The goal is for the centres to become innovation nests of the regions and administrators of know-how. The regional competence centres are generally founded alongside regional colleges or universities.**Finland** – For smaller regions there is a specific instrument for creating clusters at a smaller scale, and encouraging their linkages with the Innovative Cities Programme.

- **France** – *Pôles de compétitivités* have a tiered label system, with some designated as world class while others are labelled as having a more regional cluster focus. Another long-standing programme is that supporting local productive systems (*grappes d'entreprises*) to encourage partnerships and innovation for less technologically intense SMEs, or those that are far from the competitiveness poles.

- **Iceland** – Innovation Centre Iceland has supported clusters outside innovation hubs, through both counselling and direct funding. Clusters have also been funded through regional growth funds.

- **Japan** – The Japanese Industrial Cluster Policy has been in place since 2001, and is now in its third phase. It aims to enhance the competitiveness of Japan through industrial clusters formed by local small- and medium-sized companies and venture businesses, utilising seeds from universities and other research institutions.

- **United Kingdom** – The Catapult programme comprises a network of world-leading centres designed to transform the country's capability for innovation in specific areas and help drive future economic growth. In some cases they are located in lesser-performing regions and can contribute to regional economic performance.

Source: OECD, 2015c.

Capacity building for the public sector

With respect to promoting innovation capacity in the public sector, many countries have supported either networks for knowledge sharing or strategy development capacities (Box 2.3). Sweden has for many years had an active regional network for dialogue on innovation and development, co-ordinated by the Ministry of Enterprise and Innovation and Sweden's innovation agency. Previously in the United Kingdom, a network of innovation programme professionals in the English regional development agencies served as a knowledge-sharing platform for public sector capacity building. Many countries have been supporting strategy development. In Chile for instance, the Partnership Project Programme supports the design and implementation of regional innovation strategies (RIS) in 11 out of 15 regional governments. France also ran a similar programme for supporting RIS development in its regions. The role of the European Commission in support of smart specialisation, including through a dedicated research and exchange platform for regions to learn from their peers, is an example of both types of capacity-building efforts on a massive scale.

While capacity-building efforts can help improve the quality of regional interventions, there are nevertheless some lessons to be learned from these and other country examples. For example, in one country, the challenge was that this support to regions resulted in several regions hiring the same consulting firm to develop the strategy – thus many regions had strategies more or less copied from one region to the next. The strategies lacked a tailored approach to the specific needs in the region, and being totally outsourced they did not contribute to the capacity building of public sector officials. Another challenge with these capacity-building approaches for regional strategy development is that they do not focus enough on the role of the public sector in mobilising the expertise of the private sector and other innovation system actors. This networking role is relatively new for most regions, and even harder for those with little regional networking experience (OECD, 2011b). Such purely public sector-driven strategies run the risk of being more of a paperwork exercise than a tool to garner support from regional innovation system actors towards shared goals. Finally, given the often high-tech orientation of such strategies, their application in less developed regions may be even more disconnected from the regional industry and skill profile than in leading regions. Requiring that regional strategies be based on region-specific diagnoses in terms of skills in addition to scientific, industrial and technical competencies can ground efforts in the region's needs. It should be facilitated, not dominated, by the public sector and not be entirely outsourced to external providers, which diminishes the capacity-building element.

Box 2.3. Capacity building for the public sector: Country examples

- **European Commission Smart Specialisation Platform –** Smart specialisation is an *ex ante* condition for accessing European Structural and Investment Funds. However, to develop these smart specialisation strategies, the European Commission's Joint Research Centre developed a platform to support regional efforts (http://s3platform.jrc.ec.europa.eu/).

- **European Commission Horizon 2020 –** Within Horizon 2020, the Policy Support Facility aims to improve the design, implementation and evaluation of national/regional research and innovation policies, by offering expert advice to public authorities at national or regional level on a voluntary basis (https://ec.europa.eu/programmes/horizon2020/en/h2020-section/spreading-excellence-and-widening-participation).

- **New Zealand –** The cross-government Regional Growth Programme identifies and responds to economic growth opportunities in regions that face persistent economic challenges but have strong growth potential. The programme also has a particular focus on developing the Maori economy in each of these regions. It involves identifying the economic strengths and opportunities in the four regions, including their sector specialisations, investment opportunities and cross-cutting enablers of growth (e.g. skills, transport). A strong collaborative approach is being taken among local authorities, business and central government.

- **Poland** – The country provides regions with technical assistance through its Regional Operational Programmes.

- **Switzerland** – Capacity building is one of three pillars of Switzerland's New Regional Policy (NRP). The federal government dedicated CHF 11 million of its CHF 405.5 million 2008-11 budget to the capacity development pillar. CHF 9.6 million was set aside for Regiosuisse, a network of three private companies launched in 2008 to provide assistance to cantons and regional agencies. It offers an Internet portal, a telephone hotline, education and training opportunities, communities of practice, media information, and a research network to enhance linkages between research and practice.

- **Turkey –** A network of regional development agencies provides financial and technical support for regional clusters. Development agencies assess and classify clusters in their regions, and design and implement programmes according to needs of regional clusters.

Source: OECD, 2015c and the listed websites.

Capacity building for innovation actors

Another set of programmes used in some countries target capacity building in individual innovation system actors beyond the public administration. Often these approaches are used to help research actors in a region to reach the level of being able to compete effectively for access to innovation-related funds allocated based on excellence. For example, in the United States, the Experimental Program to Stimulate Competitive Research works with research centres in regions that tend to underperform in competitive calls by the National Science Foundation. The European Commission's Horizon 2020 has specific programmes with the goals of spreading excellence and widening participation. Other countries have programmes that support research parks or centres, in particular outside the core cities, such as Iceland's Fab Labs or Portugal's efforts to develop research centres in universities located in the interior medium-sized cities.

Some common challenges have been observed in these types of programmes. The first, for those requiring the involvement of both leading and lagging region innovation actors, is that this collaboration becomes more of a "check the box" type of exercise. In other words, actors work opportunistically to capture the funds and simply divide the pot without a real transfer of knowledge to the actor in the lesser-performing region. Another challenge is that these exercises may simply be "cherry-picking", so the best actors are involved, those that could have done so without the programme, while the harder-to-reach innovation system actors do not have opportunities to improve their capacity.

Box 2.4. Capacity building for innovation system actors: Country examples

- **European Commission Horizon 2020 programme** – The EU Framework Programme for Research and Innovation offers research funds based on a competitive basis. This programme has specific measures for spreading excellence and widening participation that are targeted at low-performing Member States in terms of research and innovation. Such actions include "teaming" (associating advanced research institutions with other institutions, agencies or regions for the creation or upgrade of existing centres of excellence); "twinning" actions (linking a knowledge institution with at least two internationally leading counterparts in Europe); the ERA Chairs scheme (support for universities and other research institutions to attract and maintain high-quality human resources and implement the structural changes necessary to achieve excellence on a sustainable basis); and the COST programme (to support access to international networks for excellent researchers and innovators who lack sufficient involvement in European and international networks) (https://ec.europa.eu/programmes/horizon2020/en/h2020-section/spreading-excellence-and-widening-participation).

- **Iceland** – Innovation Center Iceland runs Fab Labs, digital fabrication labs in six locations in Iceland, all but one located in regions outside of national innovation hubs in order to increase innovation in these regions. All Fab Labs are run in close co-operation with schools in the regions to promote STEM and vocational education through creativity.

- **Italy** – With respect to the National Operational Programme for "Research and Competitiveness" 2007-13, Directorial Decree No. 254/Ric. of 18 May 2011 by the Italian Ministry of Education, University and Research has invited universities, public research bodies and other research organisations to submit projects for structural improvement, such as those aimed at developing new laboratories, purchasing scientific and technological equipment, carrying out construction work and structural modernisation, and providing training courses.

- **Japan** – Among the 40 regional innovation strategy promotion areas are 15 "regions for enhancement of international competitiveness" (i.e. leading regions) 21 "regions for enhancement of research functions and industrial clusters", and 4 "assistance for reconstruction from the Great East Japan Earthquake". Initially started in 2011 and expanded since then, this programme involves multiple ministries covering education, economy and agriculture, among others. They have selected regions that have proactive and prominent initiatives formulated through collaboration among local governments; research institutions, including universities; industries; and financial institutions. These "regional innovation strategy promotion areas," have built a system to support them by employing policies of relevant ministries to implement continuous development, from the research phase to commercialisation.

- **New Zealand** – The government is investigating possibilities for establishing regional

research institutes located outside Auckland, Wellington and Christchurch. The government will work with regional stakeholders to identify the best location opportunities, and has set aside NZD 25 million over three years to support the best proposals.

- **Portugal** – A recent initiative is designed to develop research centres in universities located in the interior medium-size cities (Vila Real, Covilhã and Évora).

- **United States** – The EPSCoR (Experimental Program to Stimulate Competitive Research) programme seeks to advance excellence in science and engineering research and education. The ultimate objective is to achieve sustainable increases in research, education, and training capacity and competitiveness that will enable EPSCoR jurisdictions to have increased engagement in areas supported by the National Science Foundation. The goals of EPSCoR are: a) to provide strategic programmes and opportunities for EPSCoR participants that stimulate sustainable improvements in their R&D capacity and competitiveness; b) to advance science and engineering capabilities in EPSCoR jurisdictions for discovery, innovation and overall knowledge-based prosperity.

Source: OECD, 2015c.

Engagement of universities in regional development

Universities perform multiple functions to support regions, through their primary function of educating future workers; their research role; and their engagement in a "third mission" of local/regional engagement (OECD, 2007b). Some programmes are seeking to ensure that the universities are providing education that is relevant for local industry, such as Japan's COC+ project with regional universities. More common are instruments to support university engagement through collaborative research with industry, such as with programmes in Australia, the United Kingdom and Turkey. Chile has programmes that mobilise regional universities in a holistic strategy to support regional development – including the third mission – such as through strategic links between the regional governments and regional universities. A number of programmes are also meant to improve the quality of universities across regions more generally – such as in Mexico, and in the United States the EPSCOR programme (see Box 2.4 and Box 2.5).

Box 2.5. University engagement in regions: Country examples

- **Australia –** Collaborative Research Networks (CRNs) are intended to effect structural adjustment in the research and research training capacity of smaller, regional and less research-intensive universities in the higher education system. The first two rounds have involved 15 CRNs for a total of around AUD 81.1 million.

- **Chile** – Through the national and regional governments, the Regional State Universities Program implements two projects to support engagement with regions. The first is the National Research Project and its components of a) regional economies, b) socio-cultural development with the environment, and c) scholarships for undergraduate and postgraduate research relevant to regional development. The second is the installation of a strategic link between four regional governments and regional state universities in their regions, for the integral development of the region.

- **Japan** – The Program for Promoting Regional Revitalization by Universities as a Center of Community（the COC+） The COC+ is a government project to subsidise regional universities. The project aims to encourage universities to create new job opportunities appealing to graduates in the local area, and to improve their education programmes in order to cultivate the human resources expected in the local area, in co-operation with local governments and companies.

- **Mexico –** The Support Program for Higher Education aims to promote strategic projects aimed at strengthening the quality of higher education, to support the professionalisation of academic staff of higher education institutions; to promote comprehensive education, strengthen the diversification of educational opportunities, the relevance of higher education and links with the productive and social sectors; to promote the dissemination and extension of culture; and to encourage the internationalisation of higher education, among others (www.ses.sep.gob.mx/programa-de-apoyo-al-desarrollo-de-la-educacion-superior-2015).

- **Turkey** – A very recent initiative launched by Higher Education Council aims at developing a framework to monitor, assess and steer the role of universities specifically in regional development. The Scientific and Technological Research Council of Turkey (TÜBİTAK) implements what is called the Project Markets Support Programme, as well as the University-Industry Collaboration Support Programme.

- **United Kingdom** – Universities have benefited from City and Growth Deal funding, Regional Growth Fund support, and money from the Higher Education Funding Council for England (HEFEC) (www.gov.uk/government/speeches/contribution-of-uk-universities-to-national-and-local-economic-growth; http://www.hefce.ac.uk/).

Source: OECD, 2015c.

There are several common challenges in promoting the local engagement of universities. For example, in some counties the creation of regional universities has raised questions about the ability to maintain quality across all disciplines in all places, and yet universities can be hesitant to specialise (OECD, 2010b). Perhaps the most common challenge observed is the expectation that the supply of university knowledge can easily be transmitted to regional firms, instead of developing research more directly linked to the demand of regional firms from the start. This brokerage role of communicating university research to potentially interested firms is costly and not easily supported by university budgets or expertise (OECD, 2011b). Universities can also engage in rent-seeking behaviour in some regions with respect to regional strategies for innovation and the associated support programmes (OECD, 2008).

Sectoral or place-based targeted R&D funding

Another common tool found in virtually all countries is targeted R&D focused on sectors with specific challenges or that tend to be located in lesser-performing regions. Sectoral ministries such as those for agriculture frequently use this strategy, even if not all farming land is in a poor-performing region. In Austria, local sectors are subject to support in non-hub regions if of vital interest to the development of the particular region. Norway has an innovative approach through Innovation Norway. As this is a jointly owned agency (around half by subnational governments and just over half by the national level), the priorities for R&D projects are designed to meet the development needs of the regional co-owners. One of the Cooperative Research Centres in Australia is focused on Remote Economic Participation, and partners with over 50 stakeholders to deliver solutions to the economic challenges that affect "remote" Australia.

In other cases, the target may be to simply ensure that R&D is taking place in lagging regions such as in special economic zones, or similar efforts. One example is the Large Companies' R&D Centres in Israel's Periphery programme which supports the relocation of large firms with R&D to more peripheral locations. Among the challenges in the programme was the lack of skilled labour available in the designated periphery regions and the long-term process of firm relocation. Strategies put in place to address such challenges included longer time frames for the grants and closer collaboration with local universities to identify talented students.[18] Many programmes internationally for special economic zones are focused on providing better physical infrastructure and a reduced administrative burden for firms, such as the new programme to create three special economic zones in less developed parts of Mexico, or free economic zones to

promote more territorially balanced development in Korea. Among the classic challenges when supporting firms and their R&D efforts in such locations is the firms' willingness to stay once the advantages are reduced. Cultivating to the extent possible a regional innovation system around these zones serves to embed the firms above and beyond the fiscal and regulatory incentives.

2.5. Conclusion

Overall, recent trends generally show a reduction in concentration and in interregional gaps in the intensity of knowledge economy indicators – in other words, greater territorial inclusiveness. The assessment shows that within countries, disparities between the top and bottom 20% have converged somewhat. In terms of intensity, this is due to a catching-up process whereby the bottom 20% grew at a faster rate than the top. However, on an OECD area-wide basis the picture is somewhat different, with generally increasing concentration of resources in the top 20% regions as well as divergence between the top and the bottom 20% regions in terms of the intensity of the assessed indicators. The analysis has also shown that overall, more movement in rank positions occurred on an OECD area-wide basis as compared to within a given country, where relative regional positions are very stable and changes are often at the margin. Furthermore, the degree of concentration of certain knowledge economy factors in a country does not appear to be directly related to national performance (on the indicators in question or on GDP per worker growth).

These trends suggest a need to design innovation instruments more carefully in order to avoid common pitfalls, and to refocus policy instruments beyond classic R&D support towards a wider array of strategies that boost productivity. While many traditional policies promoting science and technology de facto favour leading regions, some convergence on knowledge economy indicators is likely attributable to policy efforts focused on increasing the presence of knowledge economy factors in lagging regions, including regional development policies with an innovation focus. The policy mix for regions could be somewhat refocused on productivity drivers, given the lack of a direct relationship between reducing interregional disparities on the knowledge economy factors considered and trends in the interregional productivity gap. Not all factors can be equally present in all regions. Future research will need to further unpack the productivity puzzle, and in particular its place-based dimension. If diffusion mechanisms are not working, then the degree of concentration in top regions may amplify interregional disparities in the long term even if more recent trends showed slight convergence. More systematic evaluations of the policy instruments to boost performance in

lagging regions will provide lessons on how best to structure these instruments, to avoid the common pitfalls associated that diminish the return of public investment in lesser-performing regions to boost their innovation capacity.

Notes

1. As defined by the OECD/EUROSTAT (2005) Oslo Manual.

2. The OECD classifies regions into one of two territorial levels (TLs) that reflect the administrative organisation of countries. Large regions (TL2) represent the first administrative tier of subnational government, such as the Ontario region in Canada. Small regions (TL3) are contained within a TL2 region in most countries. For more information, see OECD, 2011c.

3. Based on differences in the value of Theil Index to measure inequality for regional differences within countries and country differences.

4. The concept is derived from that of national innovation systems, and popularised at the regional level by Cooke, such as in Cooke, Gomez Uranga and Etxebarria, 1997.

5. See Box 1.1 in OECD (2013a) for a literature review.

6. Endogenous growth theory sees economic growth as being driven by internal factors (i.e. endogenous) instead of external factors. Such models highlight the importance of investment in human capital, innovation and knowledge as core elements for economic growth (see Arrow, 1962; Romer, 1986; and Aghion and Howitt, 1992, to name a few).

7. Using co-patenting data from the past three decades, the authors find that organisational proximity is a key feature of co-patenting teams as well as cultural and ethnic diversity.

8. See Ahrend et al., 2014 for a study of five countries (Germany, Mexico, Spain, the United Kingdom and the United States). The same range is typically found in the agglomeration literature, as noted in the review by Combes, Duranton and Gobillon (2011).

9. Patents here refers to those registered under the Patent Cooperation Treaty, and the geography is based on the address of the inventors – as opposed to the applicants – on patent applications. Patenting rates are highly sector dependent, since patenting rates are considerably higher in some sectors than in others. Many patents never lead to an innovation. However, most important

technological advances are patented. For further information on interpreting patent data, please refer to OECD, 2009b.

10. Some countries have chosen to channel public research funds through universities and others through a separate public research system. That distinction is not considered for purposes of this analysis, as it would confound regional performance and country-level public innovation system choices.

11. This classification is based on the industry level overall and not the technology level of different activities within the industry, as there can be high-technology activities in industries classified as low technology, and vice versa.

12. At the metropolitan scale (which can be smaller than a TL3), using the OECD Metropolitan Database for which patenting data are available for the period 2000-08, a slight decrease in the concentration of patents is observed.

13. The Theil Index measures inequality of a given indicator, expressed as its distribution across different spatial units against an expected distribution based on that of the population within these same units.

14. Venture capital data were available for six countries: Canada, France, Germany, Italy, the United Kingdom, and the United States).

15. The year-by-year ratio per variable and per country is calculated in the country pages of the working paper; it establishes that these are general trends in each country and not due to the choice of the first and last year.

16. As previously mentioned in this chapter, the choice to use unweighted figures was made to remove an unequal probability of moving out of the top or bottom regions, which would be the case if the calculation used the top 20% of regions weighted by population.

17. These tests were conducted by the authors for this chapter.

18. As reported in a Policy Case for the OECD project, Innovation Policies for Inclusiveness for the 2016 OECD project, Innovation Policies for Inclusiveness.

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Annex A. Data specifications at regional level

Table A.1. Knowledge economy indicators at regional level in OECD Regional Statistics: Availability by country and year

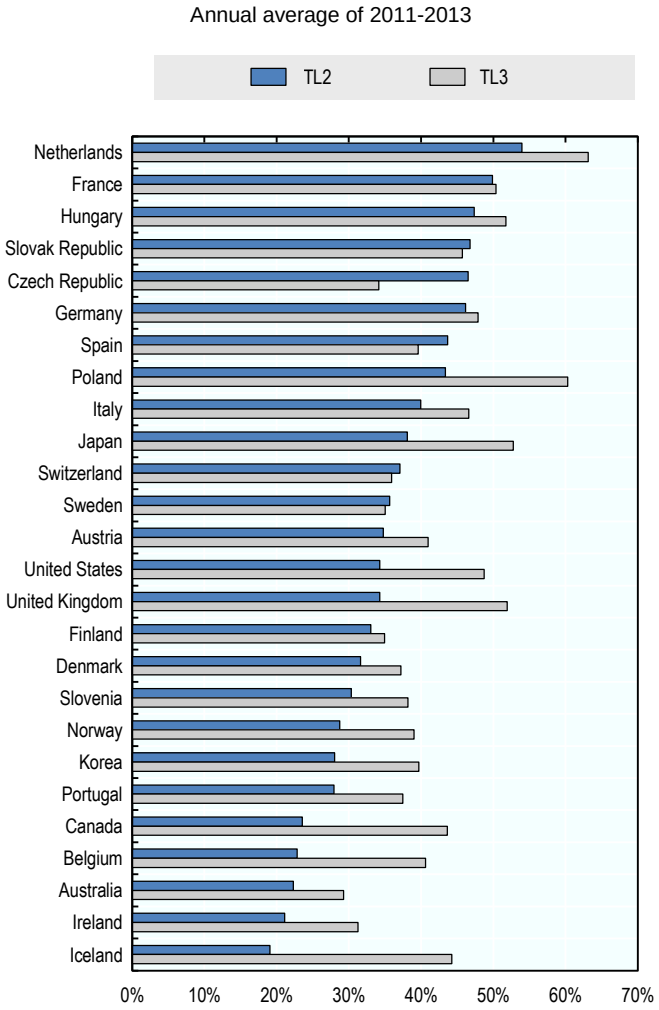
Cou-ntry Code	Country	Tertiary-educated labour force	Employ-ment in HTM	Employment in KIS	Total R&D exp./person	Business R&D exp./person	Public R&D exp./person	R&D personnel	Broadband access	PCT patent applications	
		TL2	TL2	TL2	TL2	TL2	TL2	TL2	TL2	TL2	TL3
AUT	Austria	1999 - 2013	2008 - 2013	2008 - 2013	1993 - 2013	1993 - 2013	1993 - 2013	1998 - 2013	1993 - 2013	1990-2012	1990-2012
BEL	Belgium	1999 - 2013	2008 - 2013	2008 - 2013	2000 - 2013	1991 - 2013	1993 - 2013	2000 - 2013	1993 - 2013	1990-2012	1990-2012
CZE	Czech Republic	1993 - 2013	2008 - 2013	2008 - 2013	2000 - 2013	2000 - 2013	2000 - 2013	2000 - 2013	2000 - 2013	1990-2012	1990-2012
DNK	Denmark	2007 - 2013	2008 - 2013	2008 - 2013	2007 - 2013	2007 - 2013	2007 - 2013	2007 - 2013	2007 - 2013	1990-2012	1990-2012
EST	Estonia	1997 - 2013	2008 - 2013	2008 - 2013	1998 - 2013	1998 - 2013	1993 - 2013	1998 - 2013	1993 - 2013	1990-2012	1990-2012
FIN	Finland	1990 - 2013	2008 - 2013	2008 - 2013	1995 - 2013	1999 - 2013	1995 - 2013	1995 - 2013	1995 - 2013	1990-2012	1990-2012
FRA	France	1999 - 2013	2008 - 2013	2008 - 2013	1991 - 2013	1990 - 2013	1991 - 2013	1991 - 2001	1991 - 2013	1990-2012	1990-2012
DEU	Germany	1999 - 2013	2008 - 2013	2008 - 2013	1991 - 2013	1991 - 2013	1991 - 2013	2000 - 2013	1991 - 2013	1990-2012	1990-2012
GRC	Greece	1999 - 2013	-	-	2011 - 2013	2011 - 2013	2011 - 2013	2005 - 2013	2011 - 2013	1990-2012	1990-2012
HUN	Hungary	1999 - 2013	2008 - 2013	2008 - 2013	1999 - 2013	1999 - 2013	1999 - 2013	1999 - 2013	1999 - 2013	1990-2012	1990-2012
IRL	Ireland	1999 - 2013	2008 - 2013	2008 - 2013	2000 - 2013	2000 - 2013	2000 - 2013	2000 - 2013	2000 - 2013	1990-2012	1990-2012
ITA	Italy	1999 - 2013	2008 - 2013	2008 - 2013	1994 - 2013	1991 - 2013	1991 - 2013	1994 - 2013	1991 - 2013	1990-2012	1990-2012
LVA	Latvia	-	-	-	-	-	-	-	-	-	-
LUX	Luxembourg	1999 - 2013	2008 - 2010	2008 - 2013	2000 - 2013	2000 - 2013	2000 - 2013	2000 - 2013	2000 - 2013	1990-2012	1990-2012
NLD	Netherlands	1999 - 2013	2008 - 2013	2008 - 2013	2000 - 2013	2005 - 2013	2011 - 2013	2005 - 2013	2011 - 2013	1990-2012	1990-2012
POL	Poland	1999 - 2013	2008 - 2013	2008 - 2013	2000 - 2013	2000 - 2013	2000 - 2013	2000 - 2013	2000 - 2013	1990-2012	1990-2012

PRT	Portugal	1998 - 2014	2008 - 2013	2008 - 2013	1990 - 2013	1990 - 2013	1990 - 2013	1990 - 2013	1990 - 2013	1990-2012	1990-2012
SVK	Slovak Republic	1999 - 2013	2008 - 2013	2008 - 2013	2000 - 2013	1999 - 2013	2000 - 2013	2000 - 2013	2000 - 2013	1990-2012	1990-2012
SVN	Slovenia	2001 - 2013	2008 - 2013	2008 - 2013	2000 - 2013	2000 - 2013	2000 - 2013	2000 - 2013	2000 - 2013	1990-2012	1990-2012
ESP	Spain	1999 - 2013	2008 - 2013	2008 - 2013	1990 - 2013	1990 - 2013	1990 - 2013	1990 - 2013	1990 - 2013	1990-2012	1990-2012
SWE	Sweden	1999 - 2013	2008 - 2013	2008 - 2013	2000 - 2013	1996 - 2013	1999 - 2013	1993 - 2013	1999 - 2013	1990-2012	1990-2012
GBR	United Kingdom	1999 - 2013	2008 - 2013	2008 - 2013	1995 - 2013	1995 - 2013	1995 - 2013	2005 - 2013	1995 - 2013	1990-2012	1990-2012
AUS	Australia	2010 - 2014	-	-	1992 - 2013	1992 - 2013	1992 - 2013	-	1992 - 2013	1990-2012	1990-2012
CAN	Canada	1990 - 2013	-	-	1990 - 2013	1990 - 2013	1990 - 2013	2000 - 2013	1990 - 2013	1990-2012	1990-2012
CHL	Chile	2010 - 2014	-	-	2009 - 2013	2009 - 2013	2009 - 2013	2009 - 2013	2009 - 2013	1990-2012	1990-2012
ISL	Iceland	2003 - 2012	-	-	-	-	-	-	-	1990-2012	1990-2012
ISR	Israel	2000 - 2013	-	-	2007 - 2008	2007 - 2008	2007 - 2008	-	2007 - 2008	1990-2012	1990-2012
JPN	Japan	1990 - 2010	2012 - 2012	2012 - 2012	-	-	-	-	1990 - 2013	1990-2012	1990-2012
KOR	Korea	2000 - 2014	-	-	1995 - 2013	1995 - 2013	1995 - 2013	1995 - 2013	1995 - 2013	1990-2012	1990-2012
MEX	Mexico	2000 - 2010	-	-	-	-	-	-	-	1990-2012	1990-2012
NZL	New Zealand	1991 - 2012	-	-	-	-	-	-	-	1990-2012	1990-2012
NOR	Norway	1999 - 2013	2008 - 2013	2008 - 2013	1993 - 2013	1993 - 2013	1993 - 2013	1993 - 2013	1993 - 2013	1990-2012	1990-2012
CHE	Switzerland	2001 - 2013	2008 - 2013	2008 - 2013	-	2003 - 2013	-	-	-	1990-2012	1990-2012
TUR	Turkey	2006 - 2014	2009 - 2013	2009 - 2013	-	-	-	-	-	1990-2012	1990-2012
USA	United States	2000 - 2013	2012 - 2012	2012 - 2012	1991 - 2013	1990 - 2013	1990 - 2013	2008 - 2013	1990 - 2013	1990-2012	1990-2012

Note: Due to breaks in time series, incomplete regional data, or data time frames that are too short, a number of countries have been excluded from the assessment. For some countries, data have been extrapolated for a maximum of three years where data were not available at the beginning or the end of the assessed time frame. For example, if data for 2000 were not available they have been substituted with data from 2001, 2002 or 2003. PCT= Patent Co-operation Treaty.

Source: OECD (2016b), *OECD Regional Statistics* (database).

Figure A.1. Concentration of patents in top 20% regions: Different spatial scales



Note: TL2 are large regions and TL3 are small regions. See OECD, 2016c for a definition of the different spatial scales used to define TL2 and TL3.

Source: Calculations based on OECD (2016b), *OECD Regional Statistics* (database).

CHAPTER 3. INCLUSIVE INNOVATION POLICIES: LESSONS FROM INTERNATIONAL CASE STUDIES

Many countries have begun implementing "inclusive innovation policies", which are policies that aim to remove barriers to the participation of individuals, social groups, firms, sectors and regions underrepresented in innovation activities. Their objective is to offer all segments of society equal opportunities to successfully contribute to and benefit from innovation. This chapter discusses how the unequal distribution of capacities and opportunities to participate in innovation activities hampers inclusive growth. It then analyses the role innovation policies can play in tackling social, industrial and territorial inclusiveness challenges, drawing on 33 detailed policy examples from 15 countries. The chapter discusses why such policies should be a priority in OECD countries, noting specific challenges faced during the implementation of these policies and how they can best be addressed.

Introduction

Innovation policies are central to growth agendas in most countries, but have figured much less prominently in strategies to promote social inclusion. Other policy areas such as education, social and labour market policies, competition and tax policies have traditionally played a stronger role in fostering more inclusive societies. This chapter argues that innovation policies can also play an important complementary role in promoting *inclusive growth*, which is "economic growth that creates opportunity for all segments of the population and distributes the dividends of increased prosperity, both in monetary and non-monetary terms, fairly across society".[1]

This chapter focuses on *inclusive innovation policies* – policies that aim to remove barriers to the participation of individuals, social groups, firms, sectors and regions underrepresented in innovation activities. Their objective is to offer all segments of society equal opportunities to successfully participate in and benefit from innovation. Drawing on 33 detailed policy examples from 15 countries,[2] this chapter discusses the role these innovation policy instruments can play in fostering inclusive growth. Emphasis is placed on identifying the challenges these policies need to address to be successful and solutions that have been identified, based on concrete policy examples.

Inclusive innovation policies are important additions to the policy toolkit against a background of widening inequalities in most OECD countries over the past decade even after tax and social benefits (OECD, 2015e). If successful, they allow excluded groups to participate in the growth process so as to resolve growth that is not inclusive. Inclusive innovation policies are complementary to other policy tools, particularly to education policies that ensure equal access to high-quality education, labour market policies that support opportunities for disadvantaged groups and good quality public services.

The chapter is organised as follows. Section 3.1 discusses how the unequal distribution of capacities and opportunities to participate in innovation activities hampers inclusive growth. Section 3.2 analyses the role innovation policies can play in tackling social, industrial and territorial inclusiveness challenges, while Section 3.3 argues why such policies should be a priority in OECD countries. Section 3.4 looks at specific challenges that could arise during the implementation of these policies and how best to address them.

3.1. The distribution of innovation capacities and opportunities: effects on inclusiveness

Inequalities are one of today's most pressing challenges across OECD countries. Income disparities have risen to unprecedented levels in some countries over the past three decades, with the richest 10% in the OECD area earning almost ten times more than the poorest 10%. Wealth is even more concentrated than income: in 2012, the richest 10% controlled half of all total household wealth, while the poorest 40% held only 3% of the total across 18 OECD countries[3] (OECD, 2015a). Increasing disparities have been driven both by the rise in income of population at the top of the income distribution (particularly at the top 1%) and by the decline at the bottom 40% (OECD, 2015b).

People who are economically disadvantaged often also fall behind in other non-income dimensions of well-being. They generally have lower educational attainment; are more likely to be unemployed or dissatisfied with their jobs; report worse health status; and are more affected by environmental degradation (OECD, 2016a). In addition, certain social groups are persistently underrepresented in the top of the income distribution. This suggests that economic disadvantage frequently intersects with certain social identity dimensions (such as gender, age, ethnic origin, place of residence or disability status) in ways that perpetuate inequality and social exclusion (World Bank, 2013a).

High levels of inequality not only significantly affect the well-being of the most vulnerable segments of the population, but also undermine countries' economic performance. As more disadvantaged segments of society have fewer resources to invest in skills and education, they have fewer opportunities to access more productive and rewarding jobs. Consequently, human resources in the economy are not used to the full potential, which negatively affects productivity growth in the long run. According to estimates for 19 OECD countries, the rise of income inequality between 1985 and 2005 would have knocked 4.7 percentage points off cumulative growth between 1990 and 2010 (OECD, 2015b). In addition, widening income gaps have a negative impact on social cohesion and diminish trust in institutions, which can contribute to social and political instability (Alesina and Perotti, 1996; Keefer and Knack, 2000).

In the current wave of skilled-biased technological change, opportunities arise for those having adequate capacities to participate in innovation, as new jobs require their skills and new entrepreneurial opportunities are emerging. Prospects for many others worsen: routine middle-skilled tasks are increasingly being automated, while jobs at the lower end of the skills distribution are seeing increased demand but are associated with low wages and low levels of job security. This growing polarisation in the labour markets may further exacerbate inequalities (Berger and Frey, 2016; OECD, 2011a).

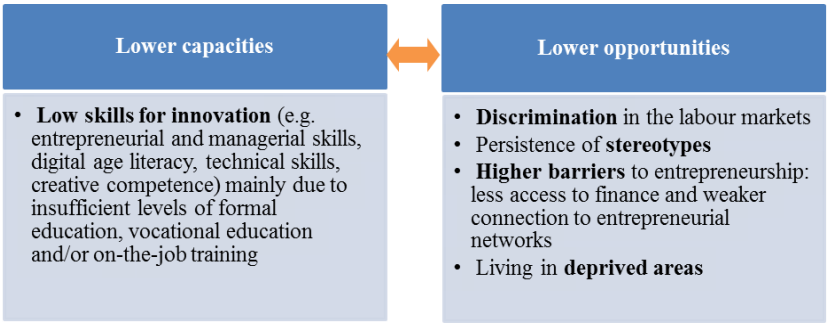
Given these trends, measures to enhance the innovation capacities of disadvantaged groups and facilitate their access to innovation opportunities are crucial to foster inclusive growth. For purposes of this discussion, "social inclusiveness" is defined as the extent to which individuals in a country, independently of their socio-economic background, gender, age, ethnic origin, religion or place of residence, have the capacity and the opportunity to participate in innovation activities.[4]

3.1.1. Evidence and drivers of low social inclusiveness

Participation in innovation activities is not evenly distributed across social groups. Women, ethnic minorities, immigrants and residents in deprived areas, among others, are systematically underrepresented in research, innovation and entrepreneurship activities in most countries. For example, in Japan only 14.7% of total researchers in 2015 were women, and their share was even lower in the fields of science and engineering (Statistics Japan, 2016). In Israel, the Arab minority represented only 5.7% of total employment in the high-tech sector and 2% of employment in the R&D sector in 2015, while they accounted for 21% of the country's population (Innovation Israel, 2016). The low participation of those groups in

innovation activities is frequently due to their lack of adequate capacities and/or their lower access to opportunities (Figure 3.1).

Figure 3.1. Causes of low participation of some groups in innovation activities



Capacities for innovation of disadvantaged and underrepresented groups

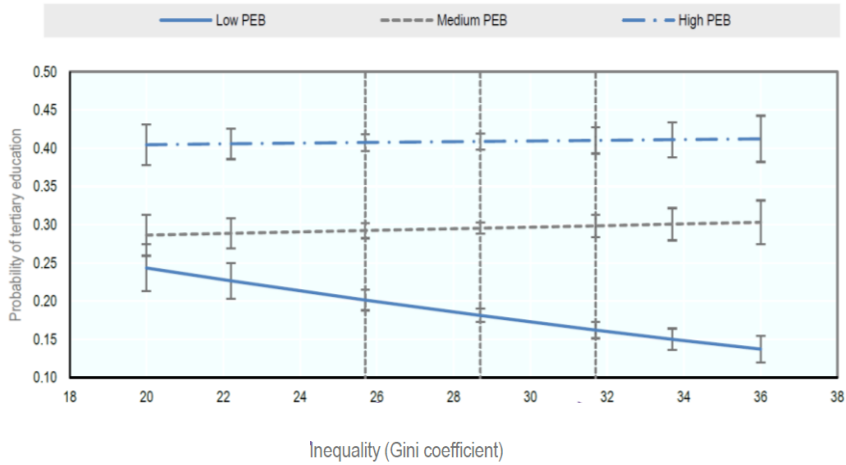
Most disadvantaged segments of the population frequently lack adequate capacities or skills for innovation. These are acquired through formal education, vocational education and on-the-job training, and include notably the ability for problem solving, critical and creative thinking, ability to learn and to manage complexity, ability for team working and communication, having initiative and motivation, being receptive to innovation, and leadership and entrepreneurial skills, among others (OECD, 2010a).

The relative importance of these skills depends on the characteristics of the innovative activity as well as the economic sector in which it takes place (Planes-Satorra, Moriguchi and Paunov, forthcoming). For example, solid scientific training, complex problem-solving ability and good communication skills are critical to engage in academic research or participate in R&D activities in high-technology sectors; vocational education and entrepreneurial skills might be relevant to adopt technologies or organisational methods created elsewhere to improve the productivity of small-sized enterprises (SMEs), or to expand the market outreach of start-ups through the use of new digital platforms.

One of the main factors influencing the capacity of individuals to participate in innovative activities is their level of educational attainment. Highly educated individuals are often more able to generate new ideas, and to recognise the value of knowledge created elsewhere and adapt it to new

areas. They are also more flexible in adapting to and identifying new business opportunities arising through rapid technological change and shifts in consumer preferences. However, low-income families are often unable to afford to keep their children in education an optimal length of time, or to afford high-quality education. Even in countries where quality tertiary-level education is free, low-income groups may not be aware of the benefits of education, and/or may have low incentives to invest in it. This is particularly the case in societies with high levels of inequality, where the probability of tertiary educational attainment of children in lower-income groups is significantly lower than that of children in other income groups (Figure 3.2) (OECD, 2015b).

Figure 3.2. Probability of tertiary educational attainment by parents' educational background (PEB) and inequality



Notes: The figure shows the average predicted probability that individuals from poor, medium and high parental (educational) backgrounds attain tertiary education as a function of the degree of inequality (Gini points) in the country at the time they were around 14 years old. The level of education of parents (high, medium and low) is used in this figure as a proxy for socio-economic status. Low PEB: neither parent has attained upper secondary education; medium PEB: at least one parent has attained secondary and post-secondary, non-tertiary education; high PEB: at least one parent has attained tertiary education. The bars indicate 95% confidence intervals. The vertical dashed lines indicate the 25th, the median and the 75th percentiles of the underlying distribution of inequality.

Source: OECD, 2015b.

Enterpreneurship skills also increase the capacity of individuals to participate in innovation activities. These comprise the combination of technical skills, business management skills and personal skills required for starting up and operating in business and self-employment. They include, for

example, opportunity recognition, team building, negotiation, strategy development, communication, decision making, risk management, financial planning, marketing and the ability to motivate and mentor. These may be developed through vocational education and training outside of formal education (including on-the-job training). Engaging in such training activities may be less costly than tertiary education, which increases the attractiveness for more disadvantaged groups.

Innovation opportunities for disadvantaged and underrepresented groups

Skills critically impact individuals' ability to participate fully in innovative activities. However, other factors might also limit the opportunities they have to do so, independently of their capacities. Obstacles may for example stem from:

- *Discrimination in the labour markets* – Some segments of society may be confronted with discrimination in the labour market on the grounds of gender, age, race, religion, ethnic origin or place of residence – and frequently a combination of those. Such discrimination may reduce these groups' chances of participating in more productive and innovative activities, and so discourage them from investing in any development of their innovation capacities. Different theories explain discrimination based on different arguments. The "taste discrimination" theory argues that employers have a preference bias or aversion to certain groups (Becker, 1957). The "statistical discrimination" theory maintains that discrimination is based on stereotypes: in a context of information asymmetries, employers use an observable identity characteristic of a group (e.g. race or gender) as a signal for an unobservable variable (e.g. skills or productivity) (Phelps, 1972; Arrow, 1973). Others argue that it may be favouritism towards one's own group rather than discrimination against other groups that leads to differences in labour market outcomes – or possibly a combination of both (Goldberg, 1982; Cain, 1986; Feld, Salamanca and Hamermesh, 2016).

- *Persistence of stereotypes* – Stereotyping of gender roles in society and business is still happening today; in fact it is perpetuated in subtle ways at home, in schools and in society in general. From early age, boys and girls perceive different stereotyped notions of what they should excel and enjoy in doing, which shapes their behaviours and may even affect their performance (Hill, Corbett and St. Rose, 2010; OECD, 2012a).

For example, as early as the first year of primary school, girls rate their own ability in mathematics as lower than that of boys, even when their actual performance does not differ (Fredericks and Eccles, 2002; Herbert and Stipek, 2005). As attitudes and aspirations are formed early in life, such stereotypes have a critical role in shaping future academic and professional career choices; they may account in part for the low shares of women undertaking science, technology, engineering and mathematics (STEM) studies, starting their own businesses, or holding leadership positions (Box 3.1). Stereotyping also often affects ethnic minority groups or immigrants, with individuals assigned the expected capacities or behaviours of the group they belong to.

Box 3.1. Women in research and entrepreneurship activities

The low participation of women in research activities is evident in many OECD countries. While in 2013 58% of students that graduated from a higher education institution with a bachelor's degree were women (OECD, 2015d), women are less likely to choose scientific and technological fields of study: only 31% of bachelor's degrees awarded in science and engineering in 2013 went to women. Even when they do choose those fields of study, they are less likely to pursue a science career than men – 43% of female graduates versus 71% of male graduates (OECD, 2012a). They are also less likely to take up careers in research, particularly in STEM fields. In addition, the proportion of female scientists tends to fall as seniority rises (OECD, 2015c). While personal choices play an important role, women may face certain barriers to pursuing research careers, such as the existence of gender stereotypes; insufficient measures to facilitate the work-life balance; inadequate facilities for childcare; and non-transparent nomination and appointment procedures.

Women are also underrepresented in entrepreneurial activities. Between 2009 and 2013, women in the European Union were half as likely as men to be new business owners (1.8% vs. 3.5%) (OECD/EU, 2016). Evidence also shows that more women than men decide to become entrepreneurs out of necessity (e.g. due to difficulties in entering the labour market otherwise). Moreover, female-owned enterprises register on average lower profits, labour productivity and innovation outcomes than male-owned firms – which to a great extent is explained by the sectoral, size and capital-intensity characteristics of their firms. It has also been observed that female entrepreneurs rely less on external finance, but it is unclear whether this is due to personal preferences, discriminatory treatment in capital markets (e.g. in cases where they are charged higher interest rates or asked for more guarantees), or a combination of both (OECD, 2012a). An additional barrier is their lack of previous experience in management positions, as well as lower engagement in entrepreneur associations or networks.

Sources: OECD, 2015c; 2015d; 2012a.

- *Barriers to accessing finance* – While accessing finance is one of the main barriers for business start-ups as well as growing SMEs, entrepreneurs from disadvantaged and underrepresented groups frequently find it even more difficult to access formal external financing, and tend to rely more on informal sources of finance (e.g. family and friends). These individuals often lack collateral assets to offer, have short or nonexistent credit histories and lack successful business track records, and therefore generally face more stringent conditions for accessing credit. Discrimination in credit markets, and attitudes of mistrust by potential investors towards certain social groups, may also limit individuals' capacity to engage in entrepreneurship activities.

- *Weak connection to entrepreneurial networks* – Entrepreneurs from disadvantaged groups tend to have more limited business networks than other entrepreneurs. For instance, women entrepreneurs tend to rely more on networks composed of family and friends than men (Renzulli and Aldrich, 2005), as they have fewer opportunities to connect to new customers and business partners. For ethnic minorities and immigrants, barriers to building rich business networks mainly involve culture and language.

- *Living in deprived areas* – Living in deprived areas can adversely affect individuals' chances throughout their lives, including their opportunities to participate in the most productive and innovative activities. For example, studies show that people living in more deprived areas of the United Kingdom are more likely to have low income and be unemployed, have lower life expectancy, live in poorer housing in more degraded local environments, and receive poorer education and health services. Overall, living in those areas affects people's lives more than their personal characteristics (Cabinet Office & Strategy Unit, 2005).

In some cases, more than one of the above-mentioned drivers can come into play, making it especially difficult for individuals to integrate innovation activities.

Box 3.2. Ethnic minority and immigrant entrepreneurs

In many OECD countries, entrepreneurship is slightly higher among immigrants than natives. Overall, businesses created by immigrants generate substantial economic activity and employment. For example, in the United States, immigrants start 28% of all new businesses in the country. They are also twice as likely to file a patent, and employ one out of every ten employees (Small Business Administration, 2016).

Ethnic minority and immigrant entrepreneurs, however, often face additional barriers to those already faced by many start-ups and SMEs; that may explain why the survival rates of immigrant businesses tend to be lower than those of their native counterparts (OECD, 2010b). For instance, data for Germany show that while around 30% of native start-ups close three years after their establishment, the share rises to 39% for start-ups created by migrants (Metzger, 2016).

Many of the barriers faced by immigrant entrepreneurs are directly related to skill levels, particularly entrepreneurship skills. Research in Ireland found that entrepreneurs from ethnic minority groups have difficulties in building business networks and have low levels of management skills (Cooney and Flynn, 2008). Poor language skills and belonging to a racial or ethnic minority may be additional constraints to obtaining capital in traditional credit markets (Oliveira and Rath, 2008).

Regulatory impediments on market entry and contract enforcement can also be particularly burdensome for immigrants (OECD, 2010b).

Sources: Cooney and Flynn, 2008; OECD, 2010b; Oliveira and Rath, 2008; Small Business Administration, 2016; Metzger, 2016.

3.1.2. Evidence and drivers of low industrial and territorial inclusiveness

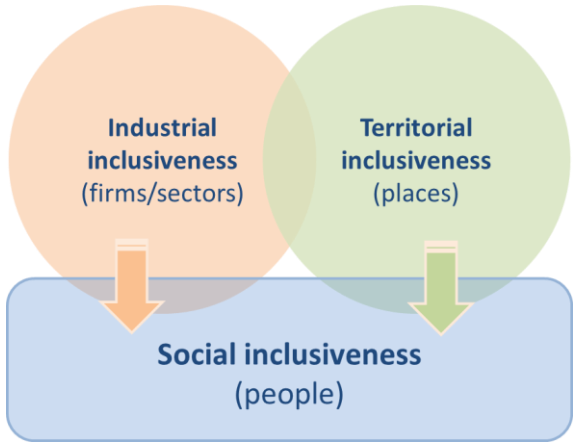
The features of a country's production system play a central role in shaping inclusive growth. The distribution of capacities to participate in innovation activities across firms, sectors and regions may be the most important of these features. Inclusiveness of national productive systems can be defined along two dimensions:

- *Industrial inclusiveness* is the extent to which the capacities to participate in innovation activities are evenly distributed across firms (independently of their size and age) and industry sectors within a county.

- *Territorial inclusiveness* is the extent to which the capacities to participate in innovation activities are evenly distributed across regions within a country.

These two dimensions are closely linked to social inclusiveness (Figure 3.3): when innovation capacities are not widely distributed across sectors and regions, the well-being of some groups in society is negatively affected. This is particularly true for individuals working in less innovative sectors and/or living in less innovative regions that suffer from multiple factors of disadvantage (e.g. low skills, low income), as they are less able to move to more innovative activities.

Figure 3.3. Interactions among social, industrial and territorial inclusiveness

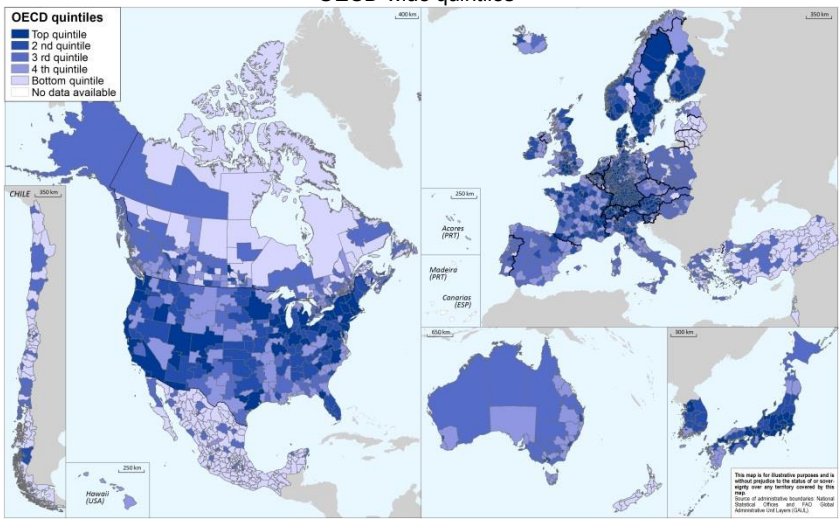


Evidence shows that innovation tends to be concentrated within some firms and sectors, which in turn tend to be concentrated in metropolitan areas. For example, between 20% and 65% of total R&D activities take place in the top 20% regions within countries, depending on the country. These regions also concentrate around 30% of tertiary-educated workers and about half of patent applications of their respective countries (Figure 3.4). (See Chapter 2 for a more detailed analysis of the concentration of factors associated with the knowledge economy).

Figure 3.4. Regional patenting intensity in OECD countries (average 2011-2013)

Patents per million inhabitants, TL3 regions

OECD-wide quintiles



Note: Regions within OECD countries are classified on two territorial levels reflecting the administrative organisation of countries. The OECD large (TL2) regions represent the first administrative tier of subnational government, for example, the Ontario Province in Canada. The OECD small (TL3) regions are contained in a TL2 region.

Source: Calculations based on the OECD Regional Database.

The concentration of most innovative activities would not pose an inclusiveness challenge if the benefits of innovation spread across firms and regions – that is to say, if knowledge and technology produced in the most innovative areas were diffused throughout the economy, with the resulting positive impact on productivity and well-being across all sectors and regions. Weak absorptive capacities of individuals and firms performing non-innovative activities and/or located in lagging areas frequently hinder such diffusion.

Industrial inclusiveness: Less-innovative and traditional sectors

The uneven distribution of innovation capacities across firms has contributed to widening the gap in productivity performance between the most productive and less productive firms. The capacity of less productive firms to learn from leading firms might also have diminished, as the cumulative and frequently tacit and localised nature of knowledge makes it progressively more difficult for laggards to catch up with innovation leaders

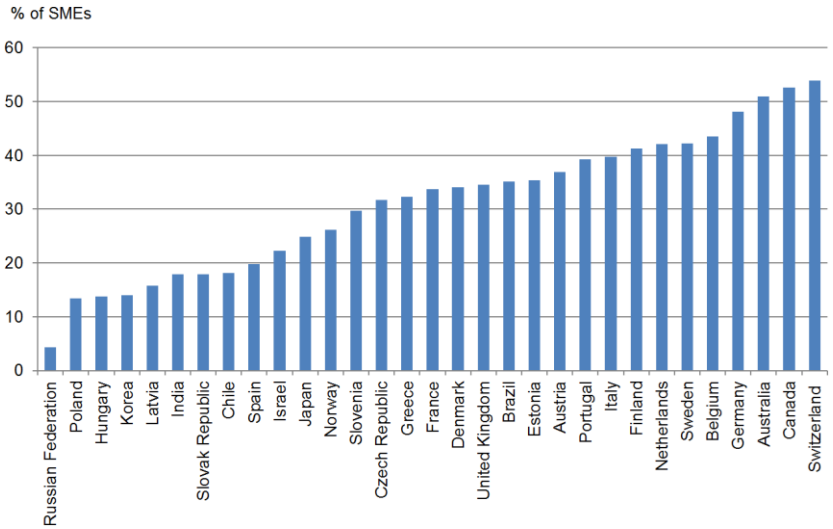
(OECD, 2015h; OECD, 2016a). This is frequently referred to as the "dual economy" problem, i.e. where the innovative, technologically advanced and highly productive sectors coexist with the traditional, low productive sectors that benefit little from new technology. Israel constitutes a case in point: the so-called "start-up nation" has a relatively small yet highly dynamic high-tech sector, which is the major driver of growth in the country, while the rest of the economy consists of traditional industries and service sectors characterised by low productivity and low wages. This dual economic structure has increased the levels of inequality and social unrest in the country (Lemarchand, Leck and Tash, 2016).

Low industrial inclusiveness thus hinders social inclusiveness. High-skilled workers in more productive firms progressively gain higher wages and benefit from regular on-the-job training and from constant interaction with other highly skilled individuals, ultimately increasing their innovation capacities. In turn, those working in less productive firms, even with similar capacities, see their wages stagnate or decline over time, have fewer training opportunities, and progressively have more difficulties move to highly productive jobs. These changes are even harder in contexts characterised by low geographical mobility of workers, rigid labour market regulations, or high levels of skills mismatch. As a result, workers with the potential to be highly productive might be trapped in low-productivity and low-innovative activities, or suffer from long periods of unemployment in case of mass layoffs (OECD, 2016a).

Industrial Inclusiveness: Barriers to innovation faced by laggard SMEs and start-ups

While some start-ups and SMEs are an important source of new ideas, technologies and business models, the bulk of SMEs in most countries are active in mature, traditional or low-technology sectors, characterised by low knowledge intensity and weak innovation capacities. In countries such as Poland, Hungary, Korea, Latvia, the Slovak Republic, Chile and Spain, more than 80% of SMEs can be considered non-innovative, and in most OECD countries shares are above 60% (Figure 3.5). Those firms may be a drag on productivity, and frequently experience problems surviving in a globalised world where technological changes (namely, changes brought about by digitalisation) are constant and rapid.

Figure 3.5. Innovative SMEs (as a percentage of total SMEs), 2010-2012



Notes:

1. SMEs are defined as firms with 10-250 employees. Innovative SMEs refer here to firms that implemented product and/or process innovations during the period under review (regardless of whether they introduced also organisation and/or marketing innovations). Product innovation is defined as the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses. This includes significant improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics. Process innovation is defined as the implementation of a new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software (OECD/Eurostat, 2005).

2. Data for Ireland, Luxembourg, Mexico and Turkey were not available at the time of publication.

3. For Australia, data refer to 2012-13; for Chile, data refer to 2009-10; for Japan, data refer to 2009-11; for Korea, data refer to 2011-13; for Mexico, data refer to 2010-2011; for Brazil, data refer to 2009-11; for the Russian Federation, data refer to 2011-13; for India, data refer to 2010-11.

Source: OECD, Innovation Indicators 2015, based on Eurostat Community Innovation Survey (CIS2012) and national data sources.

SMEs' poor innovation performance often stems from the barriers that particularly SMEs and start-ups led by individuals from disadvantaged groups and/or located in lagging areas face. These include[5]:

- *Barriers to mobilising financial resources* – Due to the high uncertainty linked to innovation projects, early stages of innovation are often costly and generate no immediate profits. SMEs and start-ups may not dispose of sufficient internal resources to finance such projects. High amounts of required collateral or little proof of previous performance may prove to be

barriers for SMEs to access credit. When investments required are substantial, access to external investment can be critical. Investors, however, may not have confidence in the project's potential, may not be able to assess the entrepreneurs' ability to manage the project and its risks, or simply may not be aware of the existence of the project.

- *Difficulties in attracting skilled human capital* – Access to skilled labour is key for innovation in firms. Skilled individuals can help generate new knowledge and innovations; are more able to recognise the value of knowledge created elsewhere, absorb it and apply it to new commercial ends (Cohen and Levinthal, 1990); and can support firms in identifying business opportunities and help them adapt to changing environments. SMEs sometimes have difficulties attracting and retaining highly skilled individuals, as larger firms can prove more attractive if they offer better salary and career prospects, including opportunities for job progression and advanced training. Reputation factors might also play a role.

- *Little access to new technologies and technological as well as managerial expertise* – In general, SMEs are slower to adopt new technologies and new organisational methods. Managers may not be aware of new technologies or organisational innovations that could be useful to them; may not recognise the potential benefits of adopting them; or may lack the managerial or technological capabilities to implement them.

- *Barriers to access domestic and foreign markets* – There are a range of factors that may hinder the opportunities SMEs have to enter domestic markets, such as burdensome entry requirements ("red tape"), bankrupcy regulations that are excessively punitive for failed companies, and high costs of hiring and firing, among others. Additional barriers arise for accessing international markets, this includes difficulties in contacting foreign costumers and the high costs of establishing and maintaining foreign distribution channels and marketing networks, among others.[6]

In addition to these barriers, *the current context in which digital innovation prevails might prove challenging for these small firms*: Digitalisation is a source of scale economies and winner-take-all market structures which may challenge small companies' market participation (Paunov and Guellec, 2017; OECD, 2016a).

Territorial inclusiveness: Lagging regions and poor urban areas

Benefits from agglomeration explain why industries (and particularly, highly innovative industries) tend to concentrate spatially: geographical proximity facilitates knowledge spill-overs and interactive learning; stimulates the creation of a larger pool of labour, leading to better matching between worker skills and jobs; and facilitates access to specialised suppliers and services (Marshall, 1890; Krugman, 1991). As a result, regions holding the greatest concentrations of innovative sectors tend to outperform other regions in terms of employment and overall economic growth.

Lagging regions (i.e. regions with per capita GDP below the national average GDP per capita) often perform poorly in terms of innovation, due to several factors. Connectivity constraints and (more frequently) the weak absorptive capacities of individuals and firms located in these regions hamper adoption of new technologies and innovations produced elsewhere. Even when firms with innovation capacities locate in those regions, they often face higher barriers to innovation, including difficulties in accessing skilled labour, finance and knowledge networks. For instance, firms located in northern regions of Sweden have been found to have more limited access to finance compared to those in the south of the country (Inlandsinnovation AB, 2014).

These barriers may have also contributed to the rising gap in productivity performance between regions at the productivity frontier (generally urban areas) and lagging regions (more rural, peripheral regions). At the European level, for instance, innovation capacities are particularly high in Denmark, Finland, Germany and Sweden, and relatively low in eastern and southern European countries – and that gap does not seem to be narrowing (Veugelers, 2016). Similar dynamics are apparent at the national scale: in the United Kingdom, spatial economic imbalance has widened over time, with London and the South East region concentrating most of the country's economic activity (Martin et al., 2015).

The capacity of lagging regions to catch up with innovation leaders might also erode with time, as innovative environments tend to attract talent and investments and enhance entrepreneurship, thus reinforcing the concentration of resources and innovation capacities in those areas (Florida, 2002; Glaeser, 1999). Metropolitan areas such as London, New York, San Francisco and Tokyo, for instance, attract highly productive activities and highly skilled individuals, not only nationwide but even on the global scale. As more skilled individuals move to cities, absorptive capacities in peripheral/lagging areas decrease. As a result, opportunities for people living in such regions are reduced.

Spatial segregation within metropolitan areas constitutes an additional challenge for social inclusion. The concentration of various dimensions of disadvantage (e.g. lower incomes, lower skill levels, etc.) frequently combines with stigmatisation of place of residence, making it more difficult for disadvantaged groups to access good quality jobs and move up the labour market ladder. Those individuals, even those living close to innovation hubs, can be locked in low-productivity and low-income traps, unable to reap the benefits of innovation and growth produced in their vicinity.

3.2. Innovation policies for tackling social, industrial and territorial inclusiveness challenges

3.2.1. Innovation policies and inclusive growth

Traditionally, innovation policies have focused on fostering growth. Innovation (i.e. the implementation of new or improved products or processes, or new marketing or organisational methods) is considered a key engine for growth: it enhances the productivity and competitiveness of national industries, and boosts business and job creation. Innovation-led growth has contributed substantially to improving income and well-being across all groups in society. To that end, most innovation policies focus on:

- providing appropriate incentives to promote innovation activities, in both the private and public sectors (e.g. tax incentives for R&D, grants for R&D, venture capital)

- investing in public R&D infrastructure (e.g. public research laboratories)

- removing barriers to innovation and entrepreneurship (e.g. anti-competitive practices preventing market entry, overly strict conditions for start-ups to access credit)

- improving the framework conditions for innovation (e.g. science and technology education, mechanisms to facilitate interaction among participants in the innovation system, measures to promote the mobility of public researchers).

Innovation policies may also foster inclusiveness, for example if they lead to the development of affordable goods and services tailored to the needs of lower-income groups (i.e. pro-inclusive innovations).[7] Moreover, inclusive innovation policies – the types of policies this chapter focuses on – by design aim at promoting inclusive growth. Innovation policies may also

unintendedly accentuate disparities, for instance if they provide opportunities only for individuals holding some specific skills (e.g. excellence scholarships and grants); offer incentives that in practice benefit only some firms or sectors (e.g. R&D tax credits, which sometimes mainly benefit large firms; public procurement requirements that often tend to favour incumbents instead of young innovative firms; research grants awarded based on past performance); or invest resources in certain regions (e.g. public research spending going to the regions where public laboratories are located).

3.2.2. Inclusive innovation policies

Inclusive innovation policies aim to remove barriers to the participation of individuals, social groups, firms, sectors and regions that are underrepresented in innovation activities. Their objective is to provide all segments of society with equal opportunities to successfully participate in and benefit from innovation.

Many countries have begun implementing inclusive innovation policies (see Annex A for examples from different countries). While most of these policies can be broadly classified by inclusiveness type (Box 3.3), in some cases they simultaneously address social, industrial and/or territorial inclusiveness challenges. For example, Ireland's *Competitive Start Fund for Female Entrepreneurs* aims to promote the integration of an underrepresented group –women– in entrepreneurship activities ("social inclusiveness") and to address critical financial barriers faced by start-ups ("industrial inclusiveness").

The instruments used by inclusive innovation policies are not new: they include well-known innovation policy instruments such as grants to fund research projects, innovation vouchers, and entrepreneurship education schemes. The novelty resides in the new angle from which they are conceived: they are designed to facilitate the participation in research, innovation and entrepreneurial activities of those groups that currently have fewer capacities or opportunities to do so.

Box 3.3. Inclusive innovation policies by type of inclusiveness

Inclusive innovation policies have explicit aims to contribute to one or more of the following objectives:

- *Social inclusiveness* – These policies aim to broaden the group of innovators by including in research, entrepreneurial and innovation activities individuals and groups that do not usually participate in those activities. Policies addressing social inclusiveness proceed either by building the innovation capabilities of disadvantaged groups, or by facilitating their access to opportunities to participate in innovative activities.

- *Industrial inclusiveness* – These policies aim to support innovation activities in less innovative firms (including micro-entrepreneurs, small and medium-sized enterprises and start-ups) and traditional sectors. The focus is on strengthening their innovation capacities, as well as on building the adequate business environment for innovation.

- *Territorial inclusiveness* – These policies target lagging and less innovative regions with the aim of narrowing the performance gap with leading innovation regions. They foster the innovation capacity of individuals and firms located in peripheral regions, as well as in disadvantaged neighbourhoods within large urban areas.

Inclusive innovation policies also often involve implementing several complementary policy instruments. For example, the *Encouraging R&D in Traditional Industries* programme in Israel offers both financial support (in the form of grants) and non-financial support (in the form of professional counselling services) to firms in traditional sectors that decide to undertake an R&D project. This is to ensure that firms make the most of the funding provided, and to guide them in the design of a more innovation-focused business strategy. Given the variety of policy instruments used and the multiple ways of combining them, this chapter classifies them by the following main objectives:

- Fostering the integration of disadvantaged groups in innovative activities (Section 3.2.2.1).

- Addressing barriers to entrepreneurship faced by disadvantaged groups (Section 3.2.2.2).

- Enhancing innovation in lagging areas (Section 3.2.2.3).

3.2.2.1. Instruments to foster the integration of disadvantaged groups in innovative activities

Building capacities

Researchers from disadvantaged or underrepresented groups frequently face significant barriers during their research careers (e.g. more difficulties in accessing funding, problems in combining research careers with familial responsibilities). These challenge their access to more senior positions in research institutions. Instruments to address such barriers include the provision of:

- *Targeted grants to fund research projects led by researchers from disadvantaged groups*. This approach is followed by *Thuthuka* programme in South Africa, which specifically targets black people and women at different stages of their careers. Applications are evaluated using several criteria, including quality, scientific contribution and potential for human capital development. Funding is granted for three years, conditional on satisfactory annual progress reports. In Korea, the Centre for Women in Science, Engineering and Technology (WISET) provides grants to support engineering research projects led by female graduate students, in order to support their research and leadership capabilities.

- *Funds to research institutions to improve the research environment for women*. An example is the *Programme to Support Research Activities of Female Researchers* in Japan. The programme's goals are to increase the number of women in research, improve their research skills, and support their appointment to leading positions. Plans designed by research institutions may include measures such as providing researchers (regardless of gender) with assistants during specific "life events" (e.g. childbirth, childcare, care of elderly relatives) so that they can balance research with personal responsibilities; establishing flexible employment arrangements, including flexitime, job sharing and part-time work; providing childcare services; and encouraging female students to pursue an academic career.

Entrepreneurship skills are crucial for starting and operating a business. These include skills in the fields of finance, marketing and human resources management, as well as capacities to identify new opportunities. Disadvantaged groups are likely to have less experience and a weak

knowledge base to start and manage a business. Instruments to build those capacities include:

- *Entrepreneurship education in schools.* Primary schools can play a key role in shaping positive attitudes towards entrepreneurship, while secondary school can incentivise the acquisition of certain technical skills, such as business planning and access to finance (OECD/EU, 2016). Other less formal activities might be highly effective in increasing the interest in entrepreneurship of students from most disadvantaged groups. The *Mosaic Enterprise Challenge* of The Prince's Trust in the United Kingdom is an annual inter-school competition where students aged 11-16 years, with mentor support, learn about establishing and running a business through a business simulation game. The winning team is then supported in developing and launching their business idea (Prince's Trust, 2016).

- *Entrepreneurship courses in the context of vocational education*. These courses allow reaching more disadvantaged groups that are less likely to attend higher education institutions. They should focus on strengthening practical skills to apply to real business situations. The strong links vocational education centres often have with the business community can facilitate their opportunities to engage in traineeships and strengthen their business-related skills through practical experience (OECD/EU, 2016).

- *Entrepreneurship training provided out of the formal education system* (e.g. courses within active labour market initiatives) may be particularly relevant for disadvantaged youth and older people with low levels of educational attainment (OECD/EU, 2016).

Another, more longer-term policy objective that can help integrate disadvantaged groups in innovation activities is to strengthen the scientific literacy of the general public. Relevant policy instruments include:

- *Investment in high-quality science education for all.* The *National Action Plan for Scientific Literacy* in China, for example, promotes increasing investment in compulsory scientific education and in public education infrastructure, including science and technology museums, with the long-term goal that all Chinese adult citizens achieve a basic level of scientific literacy by 2025.

To achieve this goal, it is crucial to guarantee that all segments of society have equal access to quality education.

- *Projects for communication regarding and popularisation of science and technology*. For example, the National Council for Science and Technology Communication (NCSTC) in India implements a range of initiatives to disseminate scientific knowledge, making use of folk, mass and social media. One popular initiative is the *Science Express*, a mobile science exhibition mounted on a train travelling across India since 2007. For four years, it showcased ground-breaking discoveries and the latest innovations in the field of modern science by using exhibits, models and audiovisual displays. Since 2015, it has aimed at raising awareness among all groups of society as to how climate change can be combated through mitigation and adaptation (Department of Science and Technology, 2016).

Addressing discrimination and stereotypes

Some groups in society are confronted with discrimination that reduces their employment prospects and their opportunities to engage in innovation activities. Addressing discrimination is complex, as it is not simply related to the aforementioned "taste discrimination" theory that is to be addressed explicitly in education (Becker, 1957). Much discrimination relates more to "statistical discrimination", i.e. contexts where stereotypes inform decisions because the other party (as e.g. an employer) does not have information on individuals and so judges an individual's potential performance based on perceived characteristics of a group (Phelps, 1972; Arrow, 1973). This is more difficult to address, particularly if a group has already been at a disadvantage in engaging in certain activities. Gender stereotypes, for instance, often render it much harder for women to engage in a research career in STEM. The challenge is amplified if favouritism towards one group leads to less support to outsiders (Goldberg, 1982; Cain, 1986; Feld, Salamanca and Hamermesh, 2016). Instruments to address discrimination and stereotypes include the following.

- *Awareness raising activities.* These can be targeted at the general public or at students in schools and universities. The *Programme to Support Research Activities of Female Researchers* in Japan, mentioned above, promotes research careers in STEM for women in high schools and colleges through promotional materials and events allowing girls to meet female senior staff in research positions.

- *Role models* are one of the most effective ways to tackle stereotypes. For example, Sweden's *Women Ambassadors* programme encouraged voluntary women entrepreneurs to act as "ambassadors" and share their experiences with other women. The ambassadors participated in events and made presentations about their backgrounds and success stories as entrepreneurs to high school, university and vocational training students, career advisors, and women with an immigrant background. Some of the ambassadors later acted as mentors or coaches. Similarly, Ireland's *Going for Growth* programme features the contribution of so-called "lead entrepreneurs" – successful women entrepreneurs who help inspire other women who are already owners and/or managers of a business and have been for at least two years. Lead entrepreneurs support these aspiring businesswomen in setting and achieving growth objectives for their businesses in interactive roundtable sessions where everyone can share experiences and thoughts (OECD/EU, 2016).

- *Mentoring programmes*. In Korea, *WISET's Girls Mentoring Program* aims to help young women in high school develop their college study plans, with female professors and college students as their mentors. An online mentoring system and cyber community also allow mentees to communicate and conduct online activities with other members. Participants can share their experiences, encouragement and information via small group communities.

Providing incentives to invest in (inclusive) innovation

Less innovative SMEs and firms in traditional sectors might lack sufficient incentives or resources to invest in innovation, or to increase the participation of disadvantaged groups in their innovation activities. Instruments to increase those incentives include:

- *Grants*, i.e. capital transfers from the government to the recipient with no repayment requirements. For instance, Israel's *Encouraging R&D in Traditional Industry Programme* incentivises firms in those industries to invest in research and development (R&D) projects through grants covering 50% of projects' expenses (labour costs, equipment, acquisition of intellectual property, etc.). The *Support Programmes for Companies from the Ultra-Orthodox and Arab Minority Communities*, also in Israel, incentivise companies that have at

least 33% of their share capital held by an entrepreneur of a minority group or from the ultra-Orthodox community to engage in product development projects by providing grants covering 85% of the project's budget (up to EUR 480 000). To promote female entrepreneurship, Ireland's *Competitive Feasibility Fund for Female Entrepreneurs* offers women-led early-stage companies with potential for success in global markets a grant to fund business feasibility studies, covering up to 50% of eligible expenditures. To avoid misuse of public resources, grant programmes frequently set precise conditions for their provision (e.g. conditions regarding the final use of the money, the requirement of private co-funding).

- *Repayable grants.* Israel's *Programme for Companies to Establish R&D Centres in the Periphery* promotes territorial inclusiveness by incentivising firms to locate innovation activities in less-developed regions. The programme requires large companies to repay the grants offered if commercial revenues are generated as a direct result of the R&D project supported, at a rate of 3% of the grant value per year on successful projects (smaller firms at a rate of 1.5% a year).

3.2.2.2. Instruments to address barriers to entrepreneurship faced by disadvantaged groups

Facilitating access to finance

Access to finance is often one of the major barriers for entrepreneurs from disadvantaged groups. Relevant instruments to address these barriers include the following.

- *Microcredit (or micro-loans),* aside from credit more generally, are very small loans to borrowers who typically lack collateral and a verifiable credit history, and thus have difficulties accessing credit from traditional banks. The *European Progress Microfinance Facility Programme* implemented in Lithuania, for example, provided micro-loans to women entrepreneurs with favourable conditions for credit provision and repayment. Credit was provided within 1-2 business days for companies with less than 10 employees; no fees were applied on the provision of loans; and clients were able to defer the beginning of credit repayment up to 12 months. The *Kiút* programme, implemented in Hungary as an adjusted version of the Grameen model, provided micro-

loans to groups of five individuals with low disposable income and located in disadvantaged areas (mostly from the Roma minority). One-year tenor loans had to be repaid weekly with an annual interest rate of 15%.

- *Equity financing* is another tool to help entrepreneurs raise enough financial resources to undertake their project. The government, generally through a state-owned enterprise or a government agency, acts as an equity investor, taking shares in the targeted business that provides it with some form of ownership. Consequently, entrepreneurs do not have to comply with regular payments to the investor; instead, the investor participates in the gains when they occur and has losses when the business performs badly. For example, Ireland's *Competitive Start Fund for Female Entrepreneurs* programme provides equity investment to women entrepreneurs to support costs associated with developing the business plan and making progress on key technical and commercial milestones, including salaries, travel expenses and consultancy fees. Successful applicants receive an equity investment of up to EUR 50 000 from Enterprise Ireland for a 10% shareholding in the company. Another example is in Sweden, where the government created a state-owned venture capital company to support firms in the country's northern regions with growth potential but facing difficulties in accessing finance due to their peripheral location (Inlandsinnovation AB, currently being integrated under the national development company *Saminvest AB*). Investments preferentially target early-stage companies, and account for 10% to 30% of company shares.

- *Financial education* is key to ensuring that disadvantaged groups can effectively access financial resources and make the most of them. To that end, financial education courses should focus on increasing the target group's awareness of the existence and conditions of the forms of finance available to them, and on strengthening their skills in making effective decisions in different financial contexts (OECD/EU, 2015; OECD/EU, 2016).

Financial support schemes are typically complemented with other measures to strengthen the capabilities of entrepreneurs and increase the chances of their ventures' success. Such measures can include training to build entrepreneurship skills, coaching and mentoring schemes, business development support (e.g. counselling, technology transfer assistance) and support for building networks.

Providing business development support

Business development support services aim to help entrepreneurs start a new business or improve the performance of their enterprise by enhancing their ability to compete in and access new markets. Support services include the following (OECD/EU, 2016):

- The *provision of information to entrepreneurs* about where they can go to seek professional assistance – for example through websites and media campaigns, or through public employment services and other institutions such as chambers of commerce. The *Initiative for Start-ups and Business Transfer* (IFEX) implemented in the German State of Baden-Württemberg, for example, launches public awareness campaigns (both online and through face-to-face seminars) that target immigrant entrepreneurs, informing them about existing support programmes that could help them strengthen their business skills, build networks or address the barriers to business development they might face.

- *Coaching and mentoring* develop entrepreneurial skills. While coaching focuses exclusively on honing skills, mentoring also aims at enhancing entrepreneurs' personal development (OECD/EU, 2015). Under the *Competitive Start Fund for Female Entrepreneurs* in Ireland, successful applicants are appointed a business mentor for 10 one-on-one sessions. Under the *Commercial Advisors Scheme of the Maori Innovation Fund* in New Zealand, Maori groups can contract commercial advisors to help their business development.

  Key factors for the success of coaching and mentoring schemes are the following, as set out in OECD/EU (2015):

  - Building trusting relationships with the mentor. For this reason, many initiatives seek coaches and mentors from the same business community as the target entrepreneur, or with previous experience working with them.

  - Ensuring a good match between the coach/mentor and the entrepreneur, by considering both individual and business characteristics.

  - Setting clear objectives of the relationship at the start, and tracking progress towards the goals.

  - Establishing a fixed duration for support, to avoid relationships of dependence.

  - Providing training to coaches and mentors to strengthen their ability to transfer knowledge, and improve their understanding of the specific barriers faced by entrepreneurs from disadvantaged groups.

- *Professional business counselling or advice to entrepreneurs* is frequently part of broader support schemes, and a condition for receiving financial support. For example, the *Innovation Fund for SMEs* in China provides both financial and professional advisory support for SMEs that aim at engaging in innovative activities. Similarly, the programme for *Encouraging R&D in Traditional Industries* in Israel provides professional counselling in addition to grants to those firms in traditional industries that decide to engage in an R&D project.

- *Assistance to access new markets*, both nationally and abroad. For example, the *Euroagri Foodchain* programme promotes products and technologies developed by its participants through the *EuroAgri FoodChain*'s network, to ensure that they do not go unnoticed abroad. *Centres for Creative Economy and Innovation* in Korea provide assistance to business start-ups to help them find investors and enter the global market.

- *Technology transfer assistance*. The *Envoy System* in China, for instance, promotes the adoption of advanced technologies in agriculture, by providing technology demonstrations and technology training by experts, among other support services. A different example is furnished by the Eastern Macedonia and Thrace Institute of Technology (Greece), which initiated a research collaboration with the European Organisation for Nuclear Research (CERN); the aim is to create a business incubator to diffuse CERN's existing technologies to the region's private sector.

Promoting networks

Another barrier faced by entrepreneurs from disadvantaged groups is their limited connection with other entrepreneurs or innovation actors. Instruments to address this barrier include:

- *Innovation vouchers*, i.e. small non-repayable grants used in many countries to help SMEs introduce small-scale innovations with the support of public knowledge providers, such as universities and public research institutes. The main purpose of innovation vouchers is to build linkages between SMEs and public research institutions, which will: i) stimulate knowledge transfer directly between public research and business; and ii) act as a catalyst for the formation of longer-term, more in-depth relationships (OECD, 2010d). Voucher programmes have been implemented in many countries, including Germany, Hungary, Ireland, the Netherlands and the United Kingdom.

  The range of activities that can be funded with innovation vouchers varies by programme, and private co-funding is often required. While the outcomes of collaborations also vary, there are many examples of successful collaborations that have led to the introduction of new or improved products, services or processes by SMEs. Another measure of programme success is the extent to which voucher recipients have further contracted public research organisations for follow-up assignments paid through other means (Box 3.4).

- *Entrepreneurial networks* can help entrepreneurs obtain financing; find business partners, suppliers, employees and customers; and get ideas for new products, processes, organisational methods and business models. Positive peer pressure can also play an important role in stimulating business growth and innovation. To be effective, these initiatives should allow for a great deal of interaction between the entrepreneurs in the target group and the wider business community, so as to enlarge the pool of resources they have access to. Such networks should also have clear objectives. For example, they can be aimed at building international connections to facilitate exporting, or connecting with potential clients or suppliers. While face-to-face interactions are always the most effective, the creation of online entrepreneurial networks can be an effective complementary initiative (OECD/EU, 2016).

Box 3.4. Innovation vouchers: Examples of impacts in different countries

Reports evaluating a number of relevant innovation voucher programmes show that participants deem this kind of co-operation opportunity very useful:

- All applicants in the Scottish Innovation Voucher programme indicated that the collaboration exceeded (35%) or met (65%) their expectations (BIGGAR Economics, 2010).
- Around 84% of participants in the Austrian IS and ISplus programmes reported a successful project, which ended with a new product placement on the market (48%), prototype development (12%) or test phase (24%) (KMU Forschung, 2015).
- The success rate in the German voucher programme was of around 66% (BMWi, 2015).

Evaluations also found that the majority of the participants intend to continue or actually continued the collaboration. Around 22% of the Scottish partners are already working on a new project, while 33% are discussing future project opportunities (BIGGAR Economics, 2010). Nearly 50% of the Austrian partners have already embarked on a continuation of the collaboration started in the framework of the IS and ISplus programmes, and a further 17% plan to do so (KMU Forschung, 2015). Finally, almost 60% of the German participants indicated their willingness to have a follow-up project (BMWi, 2015).

There have been several technology or process innovations developed and upscaled thanks to innovation voucher programmes. For instance, the Dutch company Diligent Energy Systems used an innovation voucher to contact the Technical University of Eindhoven to help improve the efficiency of the biodiesel production process using tropical plant Jathropa. With the help of Ph.D. students from the university, the efficiency was increased and brought close to more traditional biodiesel production processes, which made the upscaling of the project possible (EC, 2011). Another example is Axxium Ltd in the United Kingdom, which intended to start manufacturing “smart door locks” that could be remotely unlocked via a mobile device, enabling people with reduced mobility to move more freely. The company lacked the necessary technical expertise to develop electronic components for their products, but through the Innovation Voucher programme of the United Kingdom the company hired the University of Hertfordshire to develop the electronic locking mechanism. Their collaboration continued and the partner designed the actual lock and took the concept to market. The lock is currently being launched to the mass market (University of Hertfordshire, 2013).

Voucher programmes can however also face multiple challenges that might limit their effectiveness, if for example university research is little related to industry needs; if industry does not have adequate absorptive capacity or resources to implement innovations or proposed changes; if incentives for knowledge providers to engage with industry are low; if geographical distance limits regular or face-to-face interaction; or if such interactions only take place in the context of the programme but are not maintained in the future.

Sources: BIGGAR Economics, 2010; BMWi, 2015; KMU Forschung Austria, 2015; European Commission, 2011; University of Hertfordshire, 2016.

Improving access to talent by small businesses

Accessing talent remains a key barrier to SMEs, particularly when located in peripheral areas or led by disadvantaged groups. Instruments to address those challenges include:

- *Grants to recruit researchers.* To support SMEs in finding and recruiting highly skilled human capital able to manage and implement in-house innovation processes, the *H2020 SME Innovation Associate* programme, implemented in EU member states and other Horizon 2020 associated countries, provides grants to SMEs to cover the costs of employing a foreign post-doctoral researcher for up to one year (including salary and travel expenses). This is accompanied by a training package to maximise the benefits of the programme for both SMEs and researchers, while assuring smooth integration of the researcher into the business environment.

- *Access to specialised online job portals.* The *H2020 SME Innovation Associate* programme also offers all SME applicants the opportunity to benefit from publicising their job vacancies in the EURAXESS portal – the European Commission's researcher mobility portal. This increases the visibility of their job vacancies and increases the chances of finding good matches for the advertised positions.

3.2.2.3. Instruments to enhance innovation in lagging regions

Accessing global knowledge and technology

Innovation happens not only when knowledge and technologies that are "new to the world" are developed, but also when these are adapted and used in new countries, regions, sectors or firms. This form of innovation is more suitable for contexts with a relatively weak knowledge base, and it is less costly and less risky than creating new technology. Policy instruments to facilitate the acquisition and use of existing knowledge and technology and its adaptation to new local contexts include:

- *Demonstration of new technologies and training provided by S&T specialists.* In China, for example, agriculture in most lagging areas still depends on outdated technology. This hinders improvement of agricultural productivity and the well-being of rural populations. The *Spark Programme* (1986-2015) was the

first plan implemented to revitalise the Chinese rural economy through science and technology. It provided technology training to farmers, so as to change their traditional production methods for more technologically advanced ones. The *Envoy System* has also been implemented in China since 2002 to promote innovation in rural areas by sending qualified science and technology specialists to those areas to provide farmers with S&T services, including demonstrations, training and advice. More recently, S&T envoys' tasks switched from agricultural technology services to helping farmers set up as S&T entrepreneurs.

- *Financial support to projects that use science, technology and innovative solutions to address local challenges.* For instance, Colombia's *Ideas for Change* programme is implemented to allow vulnerable communities to identify specific needs and challenges through a virtual platform. The STI community (i.e. individual researchers, firms, universities and research institutions) can then propose specific solutions to their problems, which should be creative and involve low-cost technologies. Grants are provided to implement the selected solutions. Chile's *Prototypes of Social Innovation* programme issues calls for innovative solutions to local challenges on an online open innovation platform. Candidates present their ideas on the platform, where they interact with mentors and local communities in order to develop and improve their ideas. Final proposals are submitted for funding and the best solutions are selected. The innovative solution must, in addition to answering the specific social challenge and having potentially high social impact, be suitable for intellectual property protection, and be potentially replicable, sustainable and suitable for scaling up. The chosen solutions receive a non-repayable grant covering up to 80% of the project development (up to approximately USD 60 000), while applicants are responsible for the remaining percentage. Funding is provided in two phases: the first one covers proof of concept and is limited to CLP 4 million (approximately USD 6 000), while the second supports the development of a prototype of the social innovation, including testing with the recipient community as well as a sustainable business model and a plan for scaling up. Both programmes involve the active participation of local communities in identifying local challenges as well as in implementing the selected solutions.

Maximising the potential of existing assets

Lagging regions tend to have relatively weak human capital endowments as well as other disadvantages that hamper innovation, such as significant physical distance from innovative metropolitan areas. Nonetheless, these regions frequently have long traditions in specific agricultural or manufacturing sectors, and possess valuable traditional knowledge and/or other assets that make them singular. For instance, they might be endowed with rich natural resources and biological diversity, have a large share of young population with entrepreneurial ambitions, or have dense networks of social relations. Innovation policies that take into account these local assets and promote innovative ways of seizing their potential have good chances of being successful in fostering regional growth and territorial inclusiveness. In turn, it is necessary to avoid "picking winners": promoting the development high-tech industries in regions that lack the adequate human and physical endowments is likely to become a failed policy and a major waste of public resources (Hospers and Beugelsdijk, 2002; Tödtling and Trippl, 2005).

Relevant instruments include the following:

- *Design of tailor-made development plans, including with regard to research and innovation.* For example, to tackle territorial disparities with regard to research, development and innovation capacities in the United States, the *Experimental Program to Stimulate Competitive Research* (EPSCoR) provides awards to territorial jurisdictions to foster their research capabilities and improve their science and engineering research and education programmes. One of the programme's tracks provides selected jurisdictions with up to USD 20 million for five years to support physical, human and cyberinfrastructure improvements in research areas identified as having the best potential to improve the jurisdiction's R&D competitiveness. Mexico's *Productive Territories* programme, for example, designates technical teams in charge of designing development plans for specific poor rural areas, taking into account existing assets and local needs. The technical team also ensures that local communities access all federal support programmes for which they are eligible.

- Use *intellectual property protection, such as geographical indications, to increase the reputation of local products* (e.g. agricultural products and handicrafts). IP protection might generate resources for regional development and help integrate

previously excluded groups in innovation systems (Box 3.5). Support for SMEs to integrate IP protection as part of their business models where such protection is appropriate can also support innovative SMEs.

Box 3.5. Intellectual property protection in traditional sectors: Opportunities for fostering territorial inclusiveness

Intellectual property (IP) rights for traditional activities, including agricultural products, handicrafts and traditional knowledge, offer opportunities for inclusive growth in lagging areas, as they facilitate the integration of previously excluded local communities in innovation processes. Several types of IP rights are particularly relevant for traditional sectors.

- *Geographical indications* (GI) are signs used on products that have a specific geographical origin and possess qualities or a reputation that are due to that origin (WIPO, 2016a). GI can thus result in higher prices for local agricultural products, foodstuffs, handicrafts, wine and spirit drinks, for example, compared to those from other regions, generating resources for regional development and facilitating the integration of previously excluded groups in innovation systems. They might also have spin-off effects, for example in the areas of tourism or gastronomy. Success stories such as Café de Colombia, Roquefort cheese in France and Rooibos Tea in South Africa illustrate their potential (El Benni and Reviron, 2009).

- *Traditional knowledge* (TK) is a living body of knowledge passed on from generation to generation within a community, often forming part of its cultural and spiritual identify (WIPO, 2016b). Claiming local group or community ownership over traditional knowledge can help support communities in lagging regions to engage in innovation activities. In the area of healthcare, for example, traditional medicines – such as Ayurveda, which is native to the Indian subcontinent – can act as inputs for local groups to patent and develop innovations. Research institutions and companies can provide needed research capabilities to effectively turn products with economic potential into IP-protected products that generate economic returns for local groups. Products must pass regulatory tests before they can be sold on foreign markets, a process that also requires support from research institutions. It is worth noting that local entrepreneurs have also deployed non-IP strategies to successfully market these types of products.

- *Copyright* refers to the rights that creators have over their literary and artistic work; it is the main type of IP used for creative endeavours and in the entertainment industry.

IP ownership rights do not alone generate economic value to the economy or to specific groups. Substantial investment is also needed to maintain high product quality and develop effective marketing strategies to ensure brand recognition. It is the effectiveness of brand promotion srategies that has allowed for the success of the above-mentioned examples.

Source: OECD, 2014.

- *Identify areas of specific relevance for a region and train potential local entrepreneurs in those sectors.* This is the main objective of the *Science and Technology Entrepreneurship Development* programme in India. The analysis of region's potential is made by specialised agencies that receive governmental funds.

- *Support to regional governments to implement science, technology and innovation projects.* Colombia's *Royalties for Science, Technology and Innovation* programme is a case in point. The scheme devotes 10% of the royalties obtained from the extraction of non-renewable natural resources to finance regional STI projects that generate long-term capacities in the region, conditional on being consistent with public policies at the national, territorial and sectorial levels. The instrument also encourages the articulation of actors of the Colombian innovation system by favouring proposals submitted by regional governments jointly with universities, science parks and companies.

Attracting innovative firms to peripheral regions

Several attempts have been made across the world to try to attract firms (and particularly innovative, knowledge-intensive ones) to peripheral regions, including the following:

- *Technology parks*. In Korea, *technoparks* have been built to address the gap between the metropolitan area of Seoul and other more peripheral regions. Technology park development includes the construction of infrastructure (e.g. common business support facilities, incubators), locating of research centres and universities to increase the pool of human capital and promote R&D, implementation of networking programmes and incentives for joint R&D projects, and the provision of finance for tech-based SMEs and start-ups, including through venture and seed capital.

- *Special economic zones*. In Mexico, the establishment of special economic zones in four lagging regions of the country's south is under way, with the objective of bridging the gap with other regions in Mexico. Measures to attract foreign investments include fiscal incentives to firms investing and creating jobs in those areas, and investments in the local infrastructure and human capital.

- *Grants to promote business R&D in peripheral regions*. For example, to bridge the gap between the centre and the periphery, the government of Israel implemented a programme that provides grants to co-finance R&D expenses of large firms' R&D centres that relocate in the periphery, for a period of two to three years. The funding model offers government participation in the risks involved in establishing the R&D centre. Eligible costs covered by the grant are equipment, external expertise (consultants, studies, etc.) and labour costs (including overheads).

In order to make those policies successful in the long term and avoid the attraction of "footloose" industries (economic activities not tied to specific locations), adequate regional framework conditions for innovation are needed. Investments in human capital and infrastructures are often critical. Challenges in making these types of policy schemes work are large; there is scant high-quality evaluation evidence on the impacts of these policies to identify which conditions matter for success (Warwick and Nolan, 2014).

3.3. Rationales for implementing inclusive innovation policies

The rationales for implementing different inclusive innovation policies vary – but they all share a common goal, which is to tackle misallocation of resources in the economy that is due to inequalities and exclusion. This is critical to foster economic growth and job creation, as when resources in an economy are misallocated (e.g. workers with capacities to participate in innovative activities do not have opportunities due to discrimination), the economy performs below its potential.

This general rationale and other specific ones for implementing innovation policies for social, industrial and territorial inclusiveness are described below (Table 3.1).

Table 3.1. Summary of rationales for implementing inclusive innovation policies

Social, industrial and territorial inclusiveness		
• Tackle the misallocation of resources in the economy due to inequality and exclusion, fostering job creation and economic growth		
Social inclusiveness	**Industrial inclusiveness**	**Territorial inclusiveness**
• Reduce discrimination in the labour markets by demonstrating the potential of certain social groups and changing the attitudes of employers and investors towards them. • Foster social mobility and inclusion by integrating disadvantaged groups in more productive activities of the economy. • Promote diversity in research and business teams to support inclusion and growth.	• Tackle the problem of a dual economy (i.e. one divided into highly innovative/productive sectors and traditional/low production sectors) by improving the competitiveness of less innovative firms. • Promote entrepreneurship from disadvantaged groups so as to foster the emergence of new economic activities (e.g. activities addressing previously underserved needs).	• Foster the development of more productive and innovation-intensive activities in lagging regions, offering better opportunities for people living in those areas. • Increase the chances of other initiatives (e.g. investment in R&D and transport infrastructure) having their intended effects on innovation performance and growth. • Strengthen regions' economic resilience and reduce their dependence on transfers from the central government.

Note: Innovation policies for industrial and territorial inclusiveness indirectly support social inclusiveness. For presentation purposes, policies are classified in this section by main type of objective.

3.3.1. General rationale for implementing inclusive innovation policies

Inclusive innovation policies tackle in particular the misallocation of human resources (and to a certain extent technologies) across the economy as a result of the limited opportunities of some groups or firms to participate in innovation activities. Such misallocations may arise due to discrimination in labour markets, barriers to access to financial resources that specifically affect smaller players, and low geographical mobility of workers, resulting in significantly lower levels of productivity.[8] Tackling the specific barriers that challenge participation in innovation such as, for instance, limited access to resources on financial markets can complement innovation policy efforts. However, very often these policies alone are not sufficient because low

participation in innovation activities often stemps from a combination of barriers. Capacity-building is often also essential to raise participation in such activities. Consequently, innovation policies are an adequate means to addressing inclusive growth.

Inclusive innovation policies have the potential to reduce resource misallocation, leading to increases in terms of aggregate productivity and well-being, in particular by:

- Fostering the integration of previously disadvantaged groups in research or innovation activities, and by promoting entrepreneurship by those groups. The study of Hsieh et al. (2013) shows that the improved allocation of skills in the United States due to the integration of formerly discriminated groups in the labour markets, including African Americans and women, may have accounted for 15% to 20% growth in aggregate output per worker over the past 50 years.

- Promoting firm growth and job creation in the formal economy, e.g. through the support provided to early-stage start-ups and SMEs led by disadvantaged groups. The removal of barriers to their participation in innovation activities can further contribute.

- Addressing credit market failures faced by entrepreneurs from disadvantaged groups (e.g. overly strict conditions for accessing credit, high borrowing costs). Some studies point out that credit market failures might partly explain cross-country differences in productivity and adoption of new technologies (Banerjee and Duflo, 2005).

- Promoting technology transfer, i.e. the adoption of new technologies or organisational methods by firms in less innovative sectors (e.g. agriculture, traditional sectors). This is crucial, as barriers to technology adoption facing firms might at least partly explain differences in economic development between countries (Parente and Prescott, 1994; OECD, 2015h).

- Increasing the productivity and innovation performance of less innovative firms and sectors – e.g. through provision of training or business support services – which increases the productivity of resources used.

3.3.2. Rationales for implementing innovation policies for social inclusiveness

Reducing discrimination in labour markets

Some inclusive innovation policies address labour market discrimination, which is detrimental to well-being and economic performance. They do so by helping demonstrate the potential of certain social groups and changing the attitudes of employers or investors towards them. They thus create a dynamic whereby: i) recruitment is based on objective, non-discriminatory criteria, thus increasing the chances of recruiting the workers that are best suited for each job; and ii) future investments would be targeted to most efficient activities, regardless of the group undertaking them, thus making those investments more sustainable in the long run.

Discrimination has negative impacts on individuals and economies at large. Individuals suffering discrimination also suffer from lower incomes and poorer health status, stemming from higher psychological distress, lower self-esteem and related mental health problems (Choi et al., 2013; Versey and Curtin, 2016). In turn, firms that discriminate narrow the pool of employees considered in recruitment processes, resulting in lower productivity and profits (Lanning, 2010). At the aggregate level, discrimination can lead to depressed wages and underemployment for a high share of the discriminated population (Baldwin and Johnson, 1996). That might create a disincentive for these groups to invest in further education and training, as their (average) return on such investments are below that of non-discriminated groups, thus limiting future opportunities for those individuals and aggregate economic growth (Milgrom and Oster, 1987). This is because individuals who are being discriminated against will receive less for the same productivity, qualifications and skills, and would not have the same opportunities in the labour markets due to some identity factor, such as gender, race, age, disability status, or place of residence.

Fostering social mobility and inclusion

Inclusive innovation policies can foster both social mobility and inclusion by integrating disadvantaged groups into more productive activities of the economy, both by: i) enhancing their innovation-related skills; and ii) facilitating their access to opportunities, particularly by addressing specific barriers faced by these groups (e.g. when establishing their own businesses). The successful integration of disadvantaged groups in innovative activities is expected to improve their economic status and

general well-being (including in terms of job satisfaction), and increase their chances for upward social mobility. Inter-generational upward social mobility is also expected to have positive effects on economic growth by improving the allocation of talents and abilities in the economy (Galor and Tsiddon, 1997; Causa, Dantan and Johansson, 2009).

Integration of disadvantaged groups into productive activities is also likely to increase their involvement in the social, political and cultural life of society, and to strengthen their sense of belonging to a community. Social cohesion in turn benefits norms and institutional rules leading to less risky co-operation, increased innovation and creativity, and higher participation in civil society. Higher social cohesion can strongly enhance people's well-being (Eurofound and Bertelsmann Stiftung, 2014) and have positive impacts on the economy (Birdsall, Ross and Sabot, 1995; Easterly, Ritzen and Woolcock, 2006).

In addition, inclusive innovation programmes are ever more relevant as tax and redistributive policies have become less redistributive in many countries: taxes and transfers now lower inequality by about 29% in the sample of 13 OECD countries[9] where long-term data were available, which is less than in the mid-1990s (OECD, 2011a). This trend has negatively affected the low-income groups, particularly since the financial crisis. The main reasons for the decline in the redistributive capacity of taxes and transfers are the reduction in benefit generosity, the tightening of eligibility rules, and the failure of transfers to the lowest income group to keep pace with earnings growth (OECD, 2015e). In this context, public policies that foster inclusiveness without imposing long-term weight on public budgets, and that increase the chances of effectiveness of public funding become ever more relevant.

Promoting more diverse teams to support inclusion and growth

A number of inclusive innovation policies, by fostering the integration of underrepresented groups in innovation, research and entrepreneurial activities, promote diversity in those activities. This is particularly the case of policies aimed at increasing the participation of women and minority groups in public research activities, such as the *Programme to Support Research Activities of Female Researchers* in Japan and the *Thuthuka* programme in South Africa.

Diversity, both inherent (e.g. race, gender) and acquired (e.g. experience, educational and cultural background), is increasingly considered an asset for firms and research teams. For instance, Freeman and Huang

(2015) found that papers written by diverse groups of researchers received more citations and had higher impact than those written by people from the same ethnic group. Diversity may also help boost firms' innovativeness (Talke, Salomo and Kock, 2011) and may lead to more sales and profits (Herring, 2009; Talke, Salomo and Kock, 2011; Dezsö and Ross, 2012; Credit Suisse, 2012). While there are differences in findings regarding the impacts of different dimensions of diversity, it is generally considered that diversity can lead to more creative thinking and problem solving than would be the case in homogeneous teams.

3.3.3. Rationales for implementing innovation policies for industrial inclusiveness

Tackling the problem of dual economies

Inclusive innovation policies can tackle the problem of so-called "dual economies" –contexts where innovative, technologically advanced and highly productive sectors or firms coexist with the traditional, low productive sectors or firms that benefit little from new technology and lag behind in their productivity (OECD, 2015h; OECD, 2016a). These economic structures reinforce social inequalities and may even threat social stability, because those in the less productive sectors of the economy do not benefit from the advanced sectors. Inclusive innovation policies address this problem by enhancing the competitiveness of less innovative firms to help them avoid lagging further behind, in particular by:

- Facilitating their access to technologies or organisational innovations created elsewhere that could be useful in increasing their productivity. This involves increasing awareness of the existence of such technologies, as well as providing the necessary capacity building or financial support to help firms benefit from them. An example is the *Envoy System* and *Spark Programme* in China.

- Promoting small-scale innovations in less innovative sectors. For example, the *Encouraging R&D in Traditional Industries* programme in Israel provides support to traditional industries undertaking R&D projects, to help bridge the gap between less and more innovative industry sectors.

- Supporting SMEs and start-ups from more disadvantaged groups overcomes barriers. For instance, the *European Progress Microfinance Facility Programme* implemented in Lithuania

addresses the barriers women micro-entrepreneurs face in accessing financial services.

It is important to note that these policies support firms and sectors that have the potential to be economically profitable and innovative, and not those performing non-sustainable, declining or obsolete activities.

Fostering new economic activities

Some inclusive innovation policies support the emergence of new economic activities, leading to higher economic diversification. This is particularly the case of inclusive innovation policies that foster entrepreneurship among disadvantaged or underrepresented groups, such as *Competitive Start Fund for Female Entrepreneurs* in Ireland, as well as those that promote the development of innovative solutions for regional challenges, such as the *Prototypes of Social Innovation* programme in Chile. Some of these new activities may serve the needs of more disadvantaged or excluded groups, or geographical areas that were previously underserved, thus improving the well-being of these populations (OECD, 2015f).

Having several economic activities can raise economies' resilience to negative shocks in demand that may affect specific sectors. The more diversified the economy, the higher are the opportunities for risk diversification. In this view, higher diversification leads to more sectors open to investment, because of which a larger number of investors will invest in risky projects ensuring better perspectives for long-run growth. In spite of this, the debate on whether economic specialisation or diversification is more desirable to spur economic growth has still not concluded (Box 3.6).

Box 3.6. Economic specialisation and diversification: literature overview

The role of economic specialization and diversification in economic development is a much debated question in economics. Adam Smith was the first to describe the benefits of specialisation of nations in terms of absolute advantages. He argued that nations should specialize in goods they could efficiently produce and trade them for others they could not produce so efficiently. David Ricardo later formulated the classic trade theory based on comparative advantage, which shows that even countries that do not have absolute advantage in the production of any products or services benefit from specialising in the production in which they have a relative production advantage and importing others, no matter the product and no matter the degree of specialisation.

At the same time and aside from issues related to the effect of shocks, the structural models of economic development suggest that countries should diversify their economies from simple to more sophisticated production technologies in order to achieve sustainable and less volatile growth (UNIDO, 2009). Koren and Tenreyro

(2007) show that poor countries tend to specialize in sectors with relatively simple production technologies and a narrow range of inputs (as the theory of comparative advantage proclaims) and therefore are more vulnerable to economic shocks. Van der Ploeg and Poelhekke (2009) find that specialization in sectors producing and processing raw materials results in more volatile economic growth since commodity products are often subject to volatile global market prices. Nonetheless, resource abundance can be used as a springboard for diversification, moving to related production sectors (Ferreira and Harrison, 2014; Hesse, 2008; Herzer and Nowak-Lehnmann, 2006).

Reconciling both perspectives, some recent studies highlight that richer, more developed countries may be better off if – after a certain level of diversification – they "re-specialize" in certain high-productivity sectors: Imbs and Wacziarg (2003) were the first to find a non-linear relationship between diversification of production and GDP per capita, namely a U-shaped pattern whereby countries in the early stages of development diversify production and specialise at higher income levels. Klinger and Lederman (2006) and Cadot et al. (2011) find a similar U-shaped pattern in the case of export diversification. In contrast, Parteka and Tamberi (2008) and De Benedictis et al. (2009) find that economic diversification and growth are positively associated in all stages of economic development.

Sources: Cadot, Carrere and Strauss-Khan, 2001; De Benedictis, Gallegati and Tamberi, 2009; Ferreira and Harrison, 2012; Herzer and Nowak-Lehnmann, 2006; Hesse, 2008; Imbs and Wacziarg, 2003; Koren and Tenreyo, 2007; Parteka and Tamberi, 2008; UNIDO, 2009; Van Der Ploeg and Poelhekke, 2009.

3.3.4. Rationales for implementing innovation policies for territorial inclusiveness

Many territorial inclusiveness policies respond to the rationales described above that relate to social and industrial inclusiveness. Rationales specifically for territorial inclusiveness policies include fostering the development of more productive and innovation-intensive activities in lagging regions, by supporting entrepreneurship and the development of these activities. Strengthening the innovation capacities of lagging regions (i.e. the absorptive capacity of individuals and firms located there) also increases the chances of other initiatives, such investment in R&D and transport infrastructure, to have their intended effects on innovation performance and economic development. Increasing the innovation capacities of peripheral, less developed regions is also expected to strengthen their economic resilience and reduce their dependence on transfers from the central government.

3.3.5. Inclusive innovation policies complementing other policy tools

In their diverse objectives, inclusive innovation policies are complementary to other policy tools, particularly to education policies. The latter include policies to ensure equal access to high-quality education (from

early childhood to tertiary level); to encourage attendance at school of children from disadvantaged backgrounds; to promote high educational attainment by all segments of society; and to reinforce STEM and entrepreneurship skills. Improvement in and promotion of vocational education are also likely to enhance the participation of individuals from disadvantaged groups in more productive activities, as they are more likely to enrol in these programmes than in tertiary-level education.

Inclusive innovation policies are also complementary to labour market policies. These include measures to support women's participation in the labour market, such as policies on maternity and paternity leave; activation programmes for the unemployed, which facilitate their transition to higher-productivity jobs; measures to integrate immigrants and minorities into the labour markets; and programmes to promote quality apprenticeships, internship programmes, and on-the-job training. Such programmes increase individuals' opportunities to progressively adapt to changes in job requirements, particularly for those with lower levels of education. More generally, unemployment insurance programmes allow for smoothing the consumption patterns of job losers, while minimum wage regulations ensure that "fair" wages are paid to unskilled workers. These measures, the specificities of which vary greatly across countries, are important tools against vulnerability and social exclusion.

Finally, the quality of life of individuals relates to access to good-quality public services in addition to benefiting from inclusive innovation policies that facilitate their access to opportunities in more productive sectors. Public services that are key to inclusiveness, financed through progressive tax systems, include public education and health systems, social housing, public transportation services, and public childcare and elderly care services.

3.4. Specific implementation challenges and policy responses

Inclusive innovation policies, in focusing on disadvantaged groups (social inclusiveness) and laggard industries and regions (industrial and territorial inclusiveness), need to address some specific challenges that do not apply to the same extent to innovation policies more generally. Notably, they need to raise the target group's awareness of the policy programmes and increasing their involvement (Section 3.4.1); establish programme selection criteria that allow to effectively reach the target group and support innovation activities (3.4.2); build the target group's capabilities to undertake activities promoted by the programme (3.4.3); and build the expertise of public sector officials and experts deploying the programmes (3.4.4).

Other general policy design prerequisites for inclusive innovation programmes, similar to other innovation policies, include having an in-depth understanding of the actual needs of the target group before setting policy objectives, and articulating these objectives in a clear way. Institutional barriers and ensuring adequate evaluation of policy impacts also need addressing. More detail on those general principles are discussed in the OECD Innovation Strategy (OECD, 2015g).

3.4.1. Ensuring the involvement of the target group in policy programmes

The target group of inclusive innovation policies (e.g. minority groups, less innovative SMEs, firms in traditional sectors) might in some cases not be aware of, be misinformed about or be unwilling to engage in the programmes for which they could be eligible. Linguistic barriers and low access to conventional media by the target group, among other factors, might hamper the effectiveness of communication and dissemination measures built around the programme. For example, implementation the *Prototypes of Social Innovation* programme in Chile was initially hindered by the misunderstanding of the notion of "social innovation" among the target groups, which led to low levels of participation in workshops aimed at identifying major social challenges at the local level.

Often the target groups of inclusive innovation policies might also have had little previous contact with governmental programmes, or feel an aversion to the prospect of long bureaucratic application processes. As a result, they might not trust governmental intervention or might not perceive the potential benefits from it, leading to low levels of engagement to the programme and/or resistance to its implementation. This is different from innovation policies that target the strongest performers; those often have long-standing relationships with governmental agencies and consequently will be much more ready to engage. For example, in the context of the *Ideas for Change* programme in Colombia, some communities in more remote areas were initially reluctant to have the government and the research community provide solutions to their needs, due to the lack of trust. During the implementation of the *Kiút* programme in Hungary, convincing the target group (mostly low-income individuals from the Roma minority with no experience in dealing with bureaucratic procedures) to apply to the programme became an important implementation challenge. This partly explains the fact that, from the original aim of 400 recipients, only 138 finally received microloans. Similarly, during the implementation of the *European Progress Microfinance Facility Programme* in Lithuania, the bank in charge of providing loans to (mainly female) micro-entrepreneurs had difficulties allocating the funding due to lack of demand (in part due to

expensive rates on products): from EUR 5 million available, only EUR 1.91 million were committed.

The following approaches have been used to address those challenges (Table 3.2):

- In the framework of a programme, design an outreach strategy that is tailored to the target group. This might include using the media channels that are most widely used among the members of the target group, general awareness raising campaigns and role models.
- Engage the target group in the design and/or implementation of the programme.
- Communicate the objectives, activities and benefits of the programme to the target group through a member of the same community or group (e.g. a supportive community leader, a member of a traditional industry association), or someone who has previously benefited from the programme. Role models (e.g. successful women entrepreneurs or researchers) can also play a key role in encouraging potential benefitiaries to engage in programmes.
- Promote interaction among the target group, the STI community and government actors. This includes the creation of online platforms where different actors in a community can interact to identify local challenges and possible solutions.
- Provide information about the benefits of science and technology, research and innovation.
- Streamline and simplify administrative processes linked to the programme, so that target groups are not discouraged to apply as a result of complex bureaucratic procedures.

3.4.2. Establishing selection criteria to reach the target group and support innovation activities

Overly strict competitive selection criteria might disqualify individuals from disadvantaged groups as well as laggard firms and regions. For example, the *Thuthuka Programme* in South Africa could not receive the necessary number of applicants as the eligibility criteria were very demanding. The Latvian *Measure for Commencing Commercial Activity or*

Self-Employment programme, which aimed to support business creation by unemployed individuals, encountered similar challenges (OECD/EU, 2016).

In turn, eligibility criteria that are not specific enough (e.g. vague definitions of what are considered innovation activities, lagging firms or disadvantaged groups) and insufficient monitoring of policy implementation may result in policies benefiting firms that are not in need for such funding. In other cases, some firms might define as "innovative" some of their usual activities, or introduce changes to comply with requirements but with no effective long-lasting impacts on inclusiveness and the innovation performance of firms (such as recruiting workers from minority groups without giving them the opportunity to engage in research), with benefiting from funding the only objective. For example, some benefitiaries of the *Hungarian Innovation Voucher* programme were found to use vouchers to finance their "usual" innovation activities. This is known as the "crowding out" effect of public funding.

The following approaches have been used to address those challenges (Table 3.2):

- Establish selection criteria that go beyond skills and past performance to also value applicants' motivation and potential for success, taking into account the objectives of the intervention.
- Clearly define the scope of activities that could be supported and plan monitoring activities to confirm effective implementation of the programme. This could also involve setting rewards for results.
- Establish criteria to select firms with the potential to become profitable businesses and create jobs.
- Provide public support that is conditional on the participation of the private sector in financing the programmes, and establish fixed monetary and temporal limits for the provision of public funding. This increases chances of public funding being allocated to projects with positive returns on investments and long-term impact.
- Involve third party organisations, experts and the target group itself in designing the programme's structure, including the application procedure and the eligibility and award criteria.
- In some cases, equity investment can be an adequate alternative to loans and grants to reduce the risk of moral hazard.

3.4.3. Building the capabilities of those in the target group to undertake activities promoted by the programme

The lack of sufficient capabilities among the targeted group or within the targeted industry sector or region may prevent achievement of the programme objectives. For instance, under the *Productive Territories Programme* in Mexico, local development plans identify, support and implement economically relevant business opportunities for disadvantaged groups. The success of the programme has however been limited, in that many projects did not start or, where they did, they remained unprofitable because of shortcomings in the entrepreneurial skills of those involved. Hungary's *Innovation Voucher programme*, which helps SMEs engage in innovation with the help of research institutes, universities or independent experts, has also so far not met expectations. Only few firms engaged, and in a range of regions research institutions and universities did not have adequate capabilities to support them. Hungary's *Kiút* programme, which provided micro-loans to low-income groups (mainly from the Roma minority) to foster self-employment, also had a high rate of defaulted loans (around 54% on 31 October 2012).

The following approaches have been used to address those challenges (Table 3.2):

- Develop and deliver inclusive innovation programmes as part of broader development strategies. Programmes aimed at supporting laggards need to integrate from the beginning capacity building and other activities to tackle unfavourable conditions limiting the innovativeness of firms and/or regions.

- Where possible, tailor programmes to the capabilities of the target group. These adjustments, however, should not lead to a lowering of selection criteria that end up not supporting innovation (e.g. by funding ultimately non-innovation activities).

- Invest in capacity-building activities that include not only formal education but also coaching or mentoring to foster entrepreneurial skills.

- Invest in universal, high-quality basic scientific education. Such investments are crucial to enhance the innovation capacities of all individuals, regardless of their socio-economic background and geographical location, and therefore to ensure more inclusive societies. These effects are only evident in the long term.

3.4.4. Building the expertise for deploying the programmes

Limited expertise in building and deploying inclusive and STI-intensive projects sometimes hampers the effective implementation of programmes. For example, the implementation of the *Royalties for Science, Technology and Innovation* programme in Colombia was hampered by the lack of experience of regional authorities (outside the area of Bogota) in structuring proposals for STI-intensive projects, which had to be subsequently evaluated and accepted by the national government. This discouraged applications and led to low take-up of available funds.

Some programmes also face difficulties in attracting and retaining technical, financial and other experts and advisors with adequate skills to deploy the programmes on the ground, which might prevent their successful and timely implementation. For example, the *Productive Territories* programme in Mexico, which critically relies on experts to implement business plans, suffers from shortage of staff in regions. The *Kiút* programme also proved difficult to implement because of the wide range of skills required to field workers (as they were requested to act simultaneously as mentors, community workers and loan agents).

The following approaches have been used to address those challenges (Table 3.2):

- Have teams of experts assist regional authorities, to enhance their capacities to design and execute projects.

- Involve third parties in addition to regional authorities in the design of specific projects (e.g. research organisations and actors from departments other than where projects are to be executed).

- Set up a targeted recruitment process to select experts to deploy programmes on the ground, where conditions of everyday work are clearly specified – including the challenges that might have to be faced – to ensure that jobs are offered to the candidates that best fit the job requirements.

- Provide tailored training to experts, mentors, counsellors or advisors before implementing the programme, with the objective of reinforcing their capacity to face both expected and unexpected challenges.

- Recruit experts that belong to or have experience working with the target group and/or the region where the programme is being implemented. Such experts have a good knowledge of local conditions that might hinder adequate deployment of programmes and of how to address them, and are likely to be more committed to the objectives of the programme.

- Involve specialised intermediary institutions and use ICT solutions when an adequate number of experts cannot be accessed. The ICT solutions may include online databases maintained by central or regional bodies to register experts and online platforms. These may be especially useful in cases where local knowledge is less important than technical or industrial expertise.

Table 3.2. Implementation challenges of inclusive innovation policies: Recommended policy responses and examples

Challenge: Ensuring involvement in policy programmes by the target group	
Policy response	**Examples**
Design an outreach strategy that is tailored to the target group	• A marketing campaign targeting black researchers was designed for the most recent rounds of the *Thuthuka programme* in South Africa (which aims to award grants to researchers from historically disadvantaged groups), since it had previously failed to attract the preset target number of black applicants. The new marketing campaign, implemented prior to the start of new calls for proposals, identifies the institutions where potential candidates reside and tries to attract them with a communication mix consisting of direct communication (including via social media) with carefully targeted potential applicants, and face-to-face communication. Assistance during the application process is also offered to further promote participation, including support in research proposal writing, budget elaboration and research project management (NRF, 2014). • The A*wareness of the Right to Identity* project, implemented in Bolivia by the United Kingdom and Sweden, aimed at mitigating social exclusion of indigenous communities that do not own any documents of identification and therefore are hindered in their rights to access basic services. An efficient communication mix was used in the framework of the project to promote improved political and citizen participation of excluded indigenous people. It comprised mass media campaigns (both in Spanish and indigenous language); advocacy aimed at Congress and key decision makers; local fairs and expositions; forums for consultation and debate; and locally trained peer facilitators working in schools, peasant unions and women's organisations (OECD, 2012c). • In the *Euroagri Foodchain* programme, information days were organised and consultation services were offered to properly present the programme and reflect on doubts and comments of potential participants.
Engage the target group in the design and implementation of the programme	• The *Prototypes of Social Innovation* programme in Chile tries to identify local challenges through a process of co-ordination and collaboration among all regional actors; the process includes interviews and meetings with different social groups (including owners of small businesses, government employees, students, workers and social activists). A call for innovative solutions to those challenges is then issued on an online open innovation platform, where solutions can be publicly discussed and then submitted to the "Prototypes of Social Innovation" solution competition. • The *Ideas for Change* programme in Colombia allows vulnerable communities to identify their specific needs through a virtual platform, after which the STI community can propose specific solutions to their problems. • In Mexico, the *Productive Territories Programme* aims to reduce poverty through tailor-made development plans for poor rural

	communities. Technical expert teams elaborate and validate these plans in collaboration with the local communities, which ensures that the specific needs of the targeted community and the actual financial and technical opportunities are adequately identified. The plans count on local support for their implementation.
Communicate the objectives, activities and expected benefits of the programme to the targeted group by a member of the same community / social group	• The *Encouraging R&D in Traditional Industries* programme in Israel relied on the close collaboration with the Manufacturers Association of Israel (MAI), the representative body of all industrial sectors, to reach out to targeted firms and increase their engagement in the programme. • The *Support Programme for Companies from "Minorities sector"* in Israel relied on close collaboration with vibrant civil society organisations to reach potential entrepreneurs from minority groups, including through the organisation of workshops and orientation days. • The *Programme to Support Research Activities of Female Researchers* in Japan aims at increasing the number of women in research, organising meetings between female senior staff in research positions and high school and college female students. • To tackle mistrust against central government projects among the Roma population, the *Kiút* programme in Hungary employed social workers and other experts who informed the local stakeholders of the most important details of the project in their own environment.
Promote the interaction between the target group and the STI community and government actors	• The *Ideas for Change* programme in Colombia invited vulnerable communities to identify specific needs that are affecting their quality of life through a virtual platform. Their challenges are passed on to the STI community (including universities, research groups and technological development centres), who through the same virtual platform propose different solutions that are creative and adaptable to low-cost technologies. Solutions are then selected in regional committees in which the communities with prioritised problems participate. This participatory and collaborative process fosters an atmosphere of trust, and ensures that implemented STI solutions have been accepted by all parties.
Provide information about the benefits of S&T, research and innovation	• The *Encouraging R&D in Traditional Industries* programme in Israel included providing traditional industry managers with training about the relevance and benefits of R&D processes (75% of which was funded by the government). • The *National Plan for Scientific Literacy* in China aims to strengthen S&T primary education and raise awareness about their benefits in people's lives.
Streamline and simplify administrative processes linked to the programme	• In Israel, to ensure targeted groups do not feel discouraged from applying to the programme as a result of complex bureaucratic procedures, the time allowed for authorities to provide official responses to applications to the *Encouraging R&D in Traditional Industries* programme was shortened from 4.5 months to 10 weeks from submission of the request.

Challenge: Establishing selection criteria to reach the target group and support innovation activities	
Policy response	**Examples**
Establish selection criteria that go beyond skills and past performance, to value applicants' motivation and potential for success	• The *Mature Entrepreneur* programme in Poland targeted unemployed or inactive individuals aged 50-64 who wanted to create a business. The programme introduced measures to select candidates with the highest chances of succeeding in their entrepreneurial venture. Applicants had to submit a written application, undergo an interview, and make a short oral presentation about their business ideas and motivations. Selected applicants were provided with 150 hours of training during which they developed their business plans. At the end of the training, only the most motivated and diligent participants with a feasible business plan got the one-time grant (OECD/EU, 2016).
Clearly define the scope of activities that could be supported and plan monitoring activities to confirm the effective implementation of programmes	• The Science and Technology Entrepreneurship Development (STED) programme in India aims to enhance the development of lagging areas by promoting self-employment in S&T sectors. While grants to implementing agencies are allocated for four years, yearly continuation of the project is contingent on satisfactory performance. Performance of projects is evaluated quantitatively and qualitatively by the STED Expert Advisory Committee, which meets two to three times a year at the project site to assess progress. A committee member and an officer from the National Science & Technology Entrepreneurship Development Board secretariat also regularly visit sites to monitor its evolution and suggest mid-term corrective actions if the targets are not being met. In extreme cases, the project may be terminated mid-term.
Establish criteria to select firms with the potential to become profitable businesses and create jobs	• To be eligible to receive grants from the *Competitive Start Fund* in Ireland, companies must demonstrate that they are capable of creating ten jobs and realising sales of EUR 1 million within the following three years. Their application is then evaluated based, among other criteria, on their ability to deliver key commercial and technical milestones over the following twelve months, and on the expected impact of an investment of EUR 50 000 on the execution of their business plan.
Provide public support conditional on the participation of the private sector in financing the programmes	• The *Large companies' R&D Centres in the Periphery* programme in Israel provides grants to large firms, covering 65% to 75% of the expenses of R&D centres created in peripheral regions for 24 to 36 months. • The *Competitive Feasibility Fund for Women Entrepreneurs* in Ireland provides grants to fund feasibility studies covering up to 50% of eligible expenditures, up to a maximum of EUR 25 000.
Involve third party organisations and experts in designing the programme	• In the context of the European Union's Framework Programmes for Research and Innovation aimed at SMEs (industrial inclusiveness) or *regional programmes* aimed at lagging regions (territorial inclusiveness), the European Commission and national bodies organise local workshops and develop

structure	online questionnaires for potential target groups in order to be able to design the most effective innovation initiatives. • The Italian region of Piedmont has improved the bottom-up identification of innovation policy priorities by promoting sustained dialogue among various innovation stakeholders (such as the regional executive council, representatives from the most innovative companies in the region, employer associations and trade unions, regional universities, research organisations, etc.) (OECD, 2009b).
Use equity investment as an alternative to loans/grants when appropriate	• In China, the *Innovation Fund* to support enhancement of the innovation capacities of local SME includes equity investments among its policy instruments (World Bank, 2013b). • Enterprise Ireland also provides equity financing to innovative start-ups, for instance through the *Competitive Start Fund for start-ups in the design sector*.

Challenge: Building capabilities among target groups to undertake activities promoted by the programme	
Policy response	**Examples**
Develop and deliver inclusive innovation programmes as part of broader development strategies	• In order to tackle the unfavourable general conditions that might hold back successful implementation of the *Special Economic Zones Programme* in targeted regions in Mexico, and to ensure that local residents and firms benefit from it, the programme foresees the design and implementation of other policies improving the human capital endowment through education, the improvement of health services, the expansion of financial services, and the development of public infrastructure.
Tailor programmes to the capabilities of the target group	• In Mexico the *Productive Territories Programme* aims at reducing poverty through tailor-made development plans for poor rural communities. Teams of technical experts elaborate and validate these plans in collaboration with the local communities, which ensures that the specific needs of the targeted community and the actual financial and technical opportunities are adequately identified. • In India, implementing agencies of the *Science and Technology Enterpreneurship Development* programme analyse the target region's potential and identify 3-4 technology areas of specific relevance. Potential entrepreneurs are then identified, trained and provided with support to launch their micro-enterprises in those sectors.
Invest in capacity-building activities	• The *SME Instrument* of the EU's Horizon 2020 framework programme not only provides a grant to SMEs planning to undertake an innovative project, but also supports them with coaching services for up to 15 days, which may include assistance in business development (e.g. analysis of potential business opportunities, development of a marketing plan), organisation (e.g. mobilisation of the SME's human and financial capital) and co-operation (e.g. planning innovation partnerships) (EC, 2016). • The *Spark Programme* in China promoted innovation among rural populations with the provision of technology training to farmers and rural entrepreneurs.
Invest in universal, high-quality basic scientific education	• China has launched the National Action Plan for Scientific Literacy, which aims to improve the national scientific literacy needed for inclusive innovation, by investing in education – in particular basic education in underdeveloped regions – and popularising science and technology

Challenge: Building adequate expertise of public sector officials and experts deploying the programmes	
Policy response	**Examples**
Provide expert assistance to regional authorities to enhance their capacities to design proposals and execute projects	• The *Royalties for Science, Technology and Innovation* programme in Colombia created teams of experts to provide assistance on the ground to regional governments (*gobernaciones*) with lack of previous experience in bulding STI-intensive projects. The teams help them structure proposals (which have to be evaluated and accepted by the national government) and execute projects. The central government is also developing a portfolio of standardised projects to be promoted in regions with limited use of their share of STI royalty funds.
Involve third parties in addition to regional authorities in the design of project proposals	• The *Royalties for Science, Technology and Innovation* programme in Colombia also favours interregional proposals involving research organisations and other innovation actors from regions other than where the project is to be executed. This measure aims at enhancing the capacities of regional authorities in project design and ensuring that proposals meet the programme requirements.
Set up a targeted recruitment process to select experts to deploy programmes	• The *Productive Territories Programme* in Mexico has introduced changes in the selection process of experts to deploy the programme on the ground. In particular, the programme establishes that the conditions of everyday work are clear to the applicants, including the challenges that might have to be faced, so as to ensure that jobs are offered to the candidates that best fit the job requirements.
Provide tailored training to experts, mentors, counsellors or advisors before the start of the programme	• The *Kiút programme* in Hungary introduced training courses for field workers, as often these social workers were well-prepared but had few business development skills (e.g. legal and financial knowledge), crucial to assist the target group in developing their business activity. • The *Step by Step to the Labour Market* programme, implemented in Vukovar (Croatia), promoted self-employment among disadvantaged women through the provision of psychological counselling, as well as ICT and entrepreneurship workshops. To ensure that workshop trainers were fully prepared for the specific needs and interests of the target group, they had to undertake a number of training courses provided by the employment service (OECD/EU, 2016).
Recruit experts that belong to or have experience working with the target group and/or in the target region	• The *Ethnic Coach for Ethnic Minority Entrepreneurs* programme, in Denmark, enlists the help of ethnic minority and immigrant entrepreneurs as coaches, in order to assist people from the same ethnic community in starting their own businesses. These coaches provide professional advice related to regulatory and social norms, business plan development, available funding sources and personal skills development (OECD/European Commission, 2013).

Involve specialised intermediary institutions and use ICT solutions when an adequate number of experts cannot be accessed	• In the framework of the *Euroagri Foodchain* programme, all project applications must be assessed by evaluators that are experts in the fields related to the project. Since the objective of the programme is to develop multi-disciplinary, cross-sectional projects, there is a shortage of appropriate project evaluators at a local level. Therefore a dedicated expert database was developed for identifying appropriate experts who can evaluate new project proposals from the scientific, innovative, financial and business points of view. • The *Honey Bee Network* in India, a not-for-profit organisation that developed an extensive database of inclusive innovations and aims to diffuse this vast knowledge by, among other means, connecting grassroots innovators with scientists and engineers possessing the necessary expertise.

Notes

1. www.oecd.org/inclusive-growth/.

2. An interactive policy toolkit containing examples from different countries of policies that address territorial, industrial and social inclusiveness challenges has been developed and is available in the OECD-World Bank Innovation Policy Platform.

3. The countries in question are Australia, Austria, Belgium, Canada, Finland, France, Germany, Greece, Italy, Korea, Luxembourg, the Netherlands, Norway, Portugal, the Slovak Republic, Spain, the United Kingdom and the United States. In the case of the United Kingdom, the geographical coverage of the data is limited to Great Britain (excluding Northern Ireland).

4. More broadly, social inclusion is frequently defined as both the process and the outcome of efforts to ensure that all individuals and segments of the population, regardless of their socio-economic background, gender, age, ethnic origin, religion, place of residence or disability status, have equal opportunities to contribute to and benefit from economic prosperity; have a voice in decisions that affect their lives; and have the opportunity to fully and actively participate in the political, social and cultural spheres of society.

5. A full overview of the barriers to innovation faced by SMEs can be found on the Innovative Entrepreneurship module of the Innovation Policy Platform (https://www.innovationpolicyplatform.org/content/innovative-entrepreneurship).

6. More information on access to foreign and domestic barriers and how it affects innovative businesses can be found here: https://www.innovationpolicyplatform.org/content/access-foreign-and-domestic-markets . For more insights on barriers to SMEs' access to international markets, see OECD (2008) and OECD (2009a). A glossary of barriers can also be found here: http://www.oecd.org/cfe/smes/glossaryforbarrierstosmeaccesstointernationalmarkets.htm

7. The OECD publication "Innovation Policies for Inclusive Growth", published in 2015, focuses specifically on analysing the contributions of "inclusive innovations", i.e. innovations that serve the welfare of lower-income and excluded groups. It explores the obstacles and market failures they face, the factors that facilitate their scaling up, as well as how

innovation policies can support such innovations. For more details, see OECD (2015f).

8. Hsieh and Klenow (2009), measuring across-firm misallocation in manufacturing sectors in China and India, found that there is a sizeable misallocation relative to the United States, and that removing it would increase the total factor productivity (TFP) by 30-50% in China and 40-60% in India. Busso, Madrigal and Pagés (2010) quantified the potential gains in TFP that can be achieved by reallocating resources more efficiently across firms in Latin American countries, and concluded that reallocation of capital and labour would raise aggregate TFP in the region between 40% and 120%, depending on the time frame and countries. Other consequences of such misallocations may include labour market distortions (e.g. a large-sized informal economy), firm-level challenges in recruiting staff with appropriate skills, and high gender inequalities (OECD, 2016b). All of these are visible in Latin America. Estimates show that nearly 55% of workers in the region are informal (Bosch, Melguizo and Pagés, 2013), and more than 35% of firms in most countries report difficulties recruiting adequately skilled labour, significantly above rates in other emerging regions such as East Asia and Pacific, Eastern Europe and Central Asia. Furthermore, the average labour force participation rate for women in the region is 56% compared to 83% for men (OECD/ECLAC/CAF, 2015).

9. Australia, Canada, the Czech Republic, Denmark, Finland, Germany, Israel, the Netherlands, Poland, Sweden, Switzerland, the United Kingdom and the United States.

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Annex A. Toolkit on innovation policies for inclusiveness

Table A.1. Overview of policy cases

Ideas for Change – Colombia **2012-14 – *Social inclusiveness***			
Rationale: Various communities live in conditions of extreme poverty and vulnerability.	*Objective:* Find solutions to challenges faced by poor and vulnerable communities, particularly in the environment and energy fields.	*Target:* Poor and vulnerable local communities with unmet needs, particularly relating to the environment and energy fields.	*Instrument:* Grants provided to firms, universities and research institutions that can solve identified local challenges in the environment and energy fields. Such challenges are previously identified in consultation with local communities.
Initiative for start-ups and business transfer – Germany (Federal State of Baden-Württemberg) **2012-present – *Social inclusiveness***			
Rationale: The firms of immigrant entrepreneurs face higher exit rates that those from non-immigrant entrepreneurs.	*Objective:* Foster immigrants' entrepreneurship and their business success.	*Target:* Immigrant population (actual and potential entrepreneurs).	*Instruments:* Public awareness campaigns, including through information web pages and seminars; financial support for training and counselling initiatives for immigrant entrepreneurs provided by business chambers and other organisations.
Support programmes for companies from the ultra-Orthodox community and from minority communities– Israel **2014-present – *Social inclusiveness***			
Rationale: Israel is a world leader in high-tech and technological innovation, but some communities are generally not involved in such activities.	*Objective:* Encourage and support entrepreneurship by the ultra-Orthodox community and the Arab minorities.	*Target:* Minority groups (ultra-Orthodox entrepreneurs and Arab entrepreneurs – including Druze, Bedouin and Circassians).	*Instrument:* Grants covering 85% of the approved budget, up to NIS 2 million (EUR 478 000), notably for start-ups' product development.

Programme to support the research activities of female researchers – Japan **2006-present – *Social inclusiveness***			
Rationale: The share of women researchers in Japan is very low, particularly in the fields of science and engineering. Few are in leading positions.	*Objective:* Increase the number of women in leading positions in research, particularly in science, technology, engineering and mathematics (STEM).	*Target:* Women researchers.	*Instrument:* Funds to research organisations to develop and implement measures aimed at improving the research environment for women researchers; awareness-raising activities in high schools and colleges to encourage women to take up careers in STEM disciplines.
Centre for Women in Science, Engineering and Technology, Korea ***2001- present – Social inclusiveness***			
Rationale: Women's participation in R&D activities in STEM fields is low in Korea. Female scientists and engineers hold fewer permanent and fewer management positions than men.	*Objective:* Foster women's participation in science, engineering and technology research and industry	*Target:* Women at different stages in their careers in STEM fields.	*Instrument:* Grants to support engineering research projects led by female graduate students; support for female researchers returning to R&D activities after a career break (e.g. due to maternity); and mentoring programmes for young women in high school.
Social problem-solving R&D project, Korea ***2001-present – Social, territorial and industrial inclusiveness***			
Rationale: Social problems (e.g. socio-economic polarisation, ageing population, climate change) need to be addressed and research can contribute.	*Objective:* Solve social problems by strengthening public participation in the processes of R&D projects.	*Target:* Citizens, local communities, corporations, public institutions and social service organisations	*Instrument:* Identify social problems through feedback from the public and provide financial and non-financial support to researchers and experts to address those challenges.
European Progress Microfinance Facility Programme – Lithuania **2007-13 – *Social inclusiveness***			
Rationale: Women entrepreneurs in Lithuania have little access to financial services.	*Objective:* Foster women's entrepreneurship by facilitating their access to financial services.	*Target:* Self-employed women or micro-enterprises and SMEs either owned by women or employing a majority of women.	*Instrument:* Micro-loans (with favourable conditions on credit provision and repayment).

Maori Innovation Fund (*Te Pūnaha Hiringa*) – New Zealand **2014-present – *Social and industrial inclusiveness***			
Rationale: Maori enterprises are frequently not engaged in the innovation system, and suffer from low productivity.	*Objective*: Help Maori collectives to increase their skills, knowledge and networks so they can realise the economic potential of their assets.	*Target:* Maori collectives, including trusts, incorporations, post-settlement governance entities and similar organisations.	*Instrument:* Financial support to contract a commercial advisor to provide professional business advice and mentoring; training in governance, management, strategic planning and other business skills.
Thuthuka* programme – South Africa** **2001-present – *Social inclusiveness			
Rationale: Researchers from disadvantaged groups are underrepresented in terms of the positions that they hold and in accessing funding in the national research sector.	*Objective:* Develop human capital and improve the research capacities of researchers from underrepresented groups.	*Target:* Researchers from disadvantaged groups, particularly women and black people.	*Instrument:* Grants for research projects proposed by researchers from disadvantaged groups.
Competitive Feasibility Fund for Female Entrepreneurs Programme – Ireland **2012-14 – *Social and industrial inclusiveness***			
Rationale: Entrepreneurs frequently lack the necessary financial resources to investigate the viability of an innovative business idea. Few female-led start-ups have grown successfully.	*Objective:* Assist female-led new start-up companies and female entrepreneurs in investigating the viability of innovative business propositions with a high potential for exporting.	*Target:* Women entrepreneurs.	*Instrument:* Grant for funding the proposed feasibility study, covering up to 50% of eligible expenditures with a maximum of EUR 25 000.
Competitive Start Fund for Female Entrepreneurs Programme - Ireland **2012-present – *Social and industrial inclusiveness***			
Rationale: Start-ups frequently lack the necessary financial resources to launch new products internationally. Few female-led start-ups have grown successfully.	*Objective:* Provide female-led start-ups with critical early-stage funding to reach key commercial and technical milestones and launch new products internationally.	*Target:* Women entrepreneurs.	*Instrument:* Equity investment of up to EUR 50 000 for a 10% shareholding in the company for costs of developing a business plan and making progress on key technical and commercial milestones, and non-financial support (counselling from a mentor).

National Action Plan for Scientific Literacy – China 2006-2020 – *Social inclusiveness*			
Rationale: Scientific literacy among the general population (particularly among the poor in lagging areas) is low. This hinders economic development and innovation performance.	*Objective:* To increase general scientific literacy in the country, with the objective of providing every adult citizen with basic scientific literacy by 2050.	*Target:* All citizens, with the focus on disadvantaged populations from underdeveloped regions.	*Instrument:* Investment in compulsory public education with a focus on science across the country; investment in education infrastructure (e.g. S&T museums), particularly in lagging areas; organisation of popular science activities (e.g. National S&T week).
Kiút* programme – Hungary 2010-12 – *Social inclusiveness			
Rationale: Poor people, especially the Roma minority, are frequently not part of the formal economy.	*Objective:* Enable poor people to establish their own business, with the objective of integrating them in local production systems.	*Target:* People around or below official poverty line, with a specific focus on the Roma minority, people living in lagging regions and women.	*Instrument:* Micro-loans and non-financial support (e.g. administrative help, training on financial and business issues).
Productive Territories Programme – Mexico Pilot phase – *Social inclusiveness*			
Rationale: Rural poverty in Mexico is severe due to a lack of productive businesses and corresponding employment opportunities.	*Objective:* Reduce poverty and increase productivity of rural households in Mexico, by developing community-level plans to support economically relevant business opportunities for poor rural households, enhance their productive capacities, and ensure their effective access to and use of public programmes for which they qualify.	*Target*: Poor rural households (to be eligible, households need to be beneficiaries of the social programme Prospera and live in rural municipalities).	*Instrument*: A technical team develops a tailored development plan for each location, taking into account existing assets and local needs. The community is involved in the elaboration and validation of such plans. The technical team also seeks access to the different federal support programmes and implements the programme.

H2020 SME Innovation Associate – EU Member Countries and other countries associated with Horizon 2020 2016-18 (Pilot phase) – *Industrial inclusiveness*			
Rationale: European SMEs have difficulties accessing the skills and knowledge needed to manage and implement in-house innovation processes in their national context.	*Objective:* Support SMEs in recruiting highly skilled researchers from other countries in order to turn their innovative idea into a viable project.	*Target:* SMEs and start-ups with innovative ideas.	*Instrument:* Grant to cover costs of employing a researcher for up to one year (including salary, travel expenses and others); training package to maximise research outcomes and impact for both the SME and the researcher.
Innovation vouchers programme – Hungary 2016-18 – *Industrial inclusiveness*			
Rationale: Micro-enterprises and SMEs frequently lack the necessary funding and in-house expertise to innovate.	*Objective:* Support SMEs innovation performance by helping them to connect with universities and research institutions to support their innovation projects.	*Target:* Micro, small and medium enterprises (MSMEs) seeking to develop an innovative product, service or process.	*Instrument:* Non-repayable grants to finance innovation consultancy or innovation support services provided by universities and public research institutes.
Innovation vouchers programme for the design sector – Ireland 2015 – *Industrial inclusiveness*			
Rationale: The majority of small businesses in the design sector do not have the scale or the resources necessary to engage in in-house research while also lacking links to outside research sources that could furnish relevant knowledge.	*Objective*: Assist SMEs in gaining the knowledge needed to explore a targeted business opportunity, sourced from higher education institutes and public research bodies.	*Target:* SMEs in the design sector.	*Instrument:* Innovation voucher for SMEs to explore a business opportunity or solve a problem with the assistance of a registered public knowledge provider. Two types of vouchers, each worth EUR 5 000: 1) standard vouchers; 2) co-funded fast track vouchers, which require the company to contribute 50% of the project costs.

Competitive Start Fund for the design sector – Ireland **2015-present – *Industrial inclusiveness***			
Rationale: Start-ups in the design sector frequently lack the necessary resources to reach key commercial and technical milestones.	*Objective:* Provide young companies in the design sector with critical early-stage funding to help them reach key commercial and technical milestones and launch new products and services in the international marketplace.	*Target:* SMEs in the design sector.	*Instrument:* Equity investment of up to EUR 50 000 for a 10% shareholding in the company. Investment to support costs of developing a business plan, building prototypes, building foreign market entry plans and/or securing third party investment. Firms also receive technical support.
Encouraging R&D in traditional industries – Israel **2005-present – *Industrial inclusiveness***			
Rationale: Traditional industries in Israel suffer from low productivity. In general they are low-tech, and their engagement in innovation activities is much lower than for traditional industries in the United States or Europe.	*Objective:* Encourage traditional industries to invest in R&D, for the country to reach 80% of the labour productivity of traditional industries in the United States and cater to the local market.	*Target:* Traditional industries as defined by the Israel Central Bureau of Statistics (including mining, rubber and plastic, food, beverages and tobacco, textile, leather products, paper, wood products).	*Instrument:* Grant of 50% from the approved budget for the R&D project and provision of professional counselling services.
Centers for Creative Economy and Innovation – Korea **2014-present – *Industrial and territorial inclusiveness***			
Rationale: In Korea, there are large gaps in innovation capacities across regions (capital area versus the rest of the country) and firms (large firms and conglomerates versus SMEs and start-ups).	*Objective:* Promote business start-ups and innovation by small and medium-sized companies, and build conditions for innovation in different cities and provinces across the country.	*Target:* Small and medium-sized enterprises, and potential start-ups.	*Instrument:* Business consultation services for start-ups; creation of networks including SMEs and innovation actors; assistance in (among others) R&D and marketing.

Commission for Corporate Partnership, Korea **2010-present – *Industrial inclusiveness***			
Rationale: The productivity gap between large enterprises and SMEs is large in Korea.	*Objective:* Improve the relationship between large enterprises and SMEs, reduce social polarisation, and strengthen national competitiveness.	*Target:* SMEs and large enterprises.	*Instrument:* Identification and dissemination of successful win-win growth models, and of best practices for corporate partnership. Identification of types of activities that are suitable for SMEs.
EuroAgri Foodchain **2014-18 – *Industrial inclusiveness***			
Rationale: The European agri-food sector may gain in competitiveness if it engages more in international R&D co-operation, currently low in the industry.	*Objective:* Increase the competitiveness and innovativeness of the European agri-food industry by supporting R&D projects in one of the members of EUREKA, an open platform for international co-operation in innovation.*	*Target:* SMEs, large companies, research institutions and universities in the agri-food sectors that intend to introduce an innovation.	*Instrument:* Support varies depending on the case; it can include the provision of grants as well as advisory services, and promotion of products and technologies across countries.
Innovation Fund for SMEs – China **1999-present – *Industrial inclusiveness***			
Rationale: Lack of finance restrains the development of SMEs; government intervention could act as a catalyst for more private investments by signalling the potential of these sectors.	*Objective:* Enhance the S&T and innovation capabilities of SMEs.	*Target:* SMEs nation-wide.	*Instrument:* Financial support (grants, loan interest subsidies for new product development and pilot production, and equity investments); and advisory services.
Large companies' R&D Centres in Israel's Periphery programme – Israel **2010-present – *Territorial inclusiveness***			
Rationale: Central Israel has high income and is home to many technology-based industries while peripheral regions have low income and weakly innovative sectors.	*Objective:* Encourage large companies to establish R&D centres in lagging regions in order to narrow the gap with Central Israel.	*Target:* Large leading R&D-investing companies.	*Instrument:* Grant covering 65-75% of the R&D expenses of R&D centres created in peripheral regions for 24-36 months. Larger companies are required to repay the grants at a rate of 3% of the grant value per year on successful projects

Technoparks – Korea **1997-present – *Territorial inclusiveness***			
Rationale: Innovation activities are mainly concentrated around Seoul, while most other regions lag behind in terms of their innovation capacities.	*Objective:* Provide infrastructures and managerial and technical support to firms located in peripheral regions to reduce the gap between the Seoul area and others.	*Target:* Peripheral regions.	*Instrument:* Development of technology parks (eighteen are currently in operation). Among other instruments, this involves provision of infrastructure (e.g. incubators) and R&D funding to R&D centres; support to develop human capital in strategic regional industries; and incentives for joint R&D and funding to firms (e.g. credit for tech-based R&D, venture and seed capital).
Special Economic Zones – Mexico **2016-present – *Territorial inclusiveness***			
Rationale: There is an important gap between the north of the country (richer and more industrialised) and the south (with high poverty rates and an economy based mainly on agriculture).	*Objective:* Foster economic development in three lagging regions in the south of Mexico, so as to address the gap between north and south. Attracting foreign investment is expected to lead to job creation and increase production and trade revenues, improving the quality of life for people in those regions.	*Target:* Peripheral regions (three lagging regions in southern Mexico).	*Instrument:* Establish of four special economic zones in which firms investing and creating jobs would benefit from: fiscal incentives; foreign trade facilities; streamlined regulations for doing business; special customs regulations; increased investment in competitive infrastructure; measures to increase regional productivity (e.g. training of workers) and to foster sustainable regional development (e.g. provision of social infrastructures).

Experimental Program to Stimulate Competitive Research – United States **1980-present – *Territorial inclusiveness***			
Rationale: Uneven geographical concentration of research, development and innovation activities.	*Objective:* Assist jurisdictions that have historically received little federal R&D funding in developing and strengthening their research capabilities, and improve STEM research and education programmes at their universities/colleges.	*Target:* Jurisdictions (states or territories) that have received little support for research over the past three years (equal to or less than 0.75% of the total NSF Research and Related Activities budget).	*Instrument:* Federal awards co-financed by individual jurisdictions (states or territories).
Spark Programme – China **1986-2015 – *Territorial inclusiveness***			
Rationale: In rural areas, agriculture often depends on outdated technology, and does not have the expertise to use modern techniques. This hampers productivity and welfare improvements.	*Objective:* Enhance the innovation performance of the rural economy through science and technology and popularise science and technology in rural areas.	*Target:* Rural areas.	*Instrument:* Technology training to improve the skills of farmers and rural entrepreneurs; management training; support to projects that use S&T and know-how from research institutes to solve local technology programmes, including technical demonstrations, product design and development of quality control techniques.
Prototypes of Social Innovation programme –Chile **2014-present – *Social inclusiveness***			
Rationale: Innovation and new technologies offer opportunities to solve social challenges, but those with the capacity to develop solutions often do not know the specific challenges communities face.	*Objective:* Develop proofs of concept and prototypes of innovative solutions to meet social/regional challenges through open innovation.	*Target:* Regions and communities facing specific social challenges.	*Instrument:* Grants to develop proofs of concept and prototypes of new solutions to meet major regional challenges. An open call for innovations is issued, encouraging individuals, companies, universities and others to innovate.

Royalties for Science, Technology and Innovation programme – Colombia **2012-present – *Territorial inclusiveness***			
Rationale: Regional inequalities are sizeable including in innovation performance.	*Objective:* Increasing the scientific, technological, innovation and competitiveness capacities of regions.	*Target:* Regions with weak innovation performance.	*Instrument:* Fund to support regional STI activities that contribute to the production, use and absorption of knowledge by industry and society.
Envoy System – China **2002-present – *Territorial inclusiveness***			
Rationale: In rural areas, agriculture often depends on outdated technology, and does not have the expertise to use modern techniques. This hampers productivity and welfare improvements.	*Objective:* Allow for more innovation among rural populations by dispatching S&T specialists to the countryside and promoting innovative entrepreneurship in the rural areas.	*Target:* Farmers in rural areas.	*Instrument:* Qualified S&T specialists provide farmers with S&T services, including demonstrations of new technologies, training and personalised consulting.
Science and Technology Entrepreneurship Development - India **Initially launched in 1985 and reformulated in 1996-97–present – *Territorial inclusiveness***			
Rationale: Less developed regions have large numbers of unemployed youth with the potential to launch micro-enterprises, but lacking the capabilities and opportunities to build such enterprises.	*Objective:* The programme aims to promote the development of lagging areas by supporting micro-enterprises.	*Target:* Micro-entrepreneurs in lagging regions.	*Instrument:* Financial support is provided to selected implementing agencies (educational or research institutions, government or non-government agencies with experience in promoting micro-entrepreneurship) for 4 years. The agencies analyse the region's potential and identify 3-4 technology areas of specific relevance. Potential entrepreneurs are then identified, trained and provided with support.

***** Eureka has 41 member countries, www.eurekanetwork.org/content/which-countries-are-eureka-members.

CHAPTER 4. INCLUSIVENESS AND INNOVATION IN HIGHER EDUCATION

Higher education plays a crucial role in providing people with skills that support innovation and more inclusive growth, but a number of important questions remain as to what extent the recent changes in higher education sector allow more students, notably from under-represented groups, to engage in the new innovation economy. This chapter begins by discussing the skills needed for knowledge-based societies and the importance of higher education in equipping the highest possible share of individuals with those skills. Despite the expansion of tertiary education over the past 30 years, persistent challenges of equality in access to higher education raise the question of the inclusion of children from traditionally deprived groups in the new opportunities of the innovation economy. The chapter then points to policy instruments to address these challenges and presents a few innovative policies worldwide that seek to foster inclusiveness by enhancing the participation and the retention of underprivileged students and discusses the pedagogical potential of information and communication technology in this area.

Introduction

Today more than ever, higher education institutions are expected to respond to the social and economic needs of society and to equip people with skills for innovation. In recent decades, many OECD countries experienced rapid expansion and diversification in higher education, which was supported by government through increases in the number of publicly funded university places. However, in spite of this expansion, a large share of students from traditionally deprived groups – those who are disabled, have low income, come from rural areas and are from ethnic or linguistic minorities – do not fully benefit from these new opportunities, and consequently may not be able to fully participate in the innovation economy.

As in all other sectors, innovation is essential in higher education to bring about qualitative changes, as opposed to the quantitative expansion seen so far. These changes are needed to improve efficiency, increase quality and foster equality of learning opportunities (OECD, 2014d; 2016a). At the same time, education can promote innovation in society at large by adopting teaching, learning or organisational practices that help to foster "skills for

innovation" (Winner, Goldstein and Vincent-Lancrin, 2013). Innovation in higher education can therefore be seen as constituting the core of a more qualitative growth of higher education.

Skills required for innovation – technical skills, creative and critical thinking skills, as well as social and behavioural skills – can be fostered through appropriate teaching practices and curricula. But a number of important questions remain as to how to allow more people to access higher education so that they are prepared for the new innovation economy, and how innovation in education itself can help build more inclusive education.

Within the framework of the Innovation Strategy for Education and Training within the OECD Centre for Educational Research and Innovation (CERI), work on "inclusive innovation" looked at innovations in the education sector meant to provide access to quality services and resources to students from poor and other underprivileged backgrounds. A first seminar organised in July 2014 with the Government of India and the Confederation of Indian Industry discussed the efforts involving innovation undertaken by governments, non-profit organisations and companies to offer universal quality education to all, including underprivileged populations (OECD, 2014c). This chapter takes the discussion further by focusing on access to and completion of higher education for students from underrepresented groups. It builds on a second seminar, organised in March 2016 with the government of Chile, on "inclusive innovation in higher education". Most if not all OECD countries face the same issues with higher education, and are making efforts to address inequalities with the objectives of improving the quality of human resources, and strengthening social cohesion.

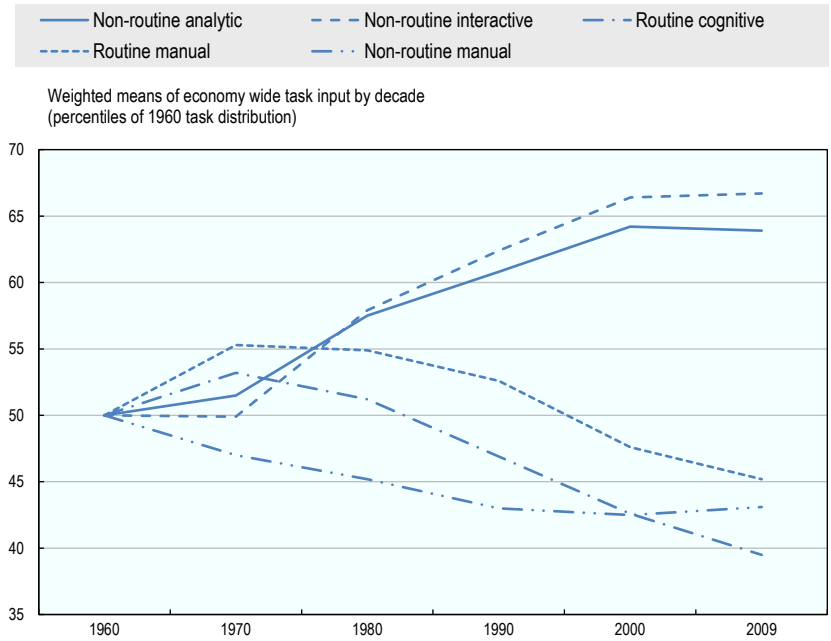
4.1. Inclusive education for innovation

4.1.1. The skills required for innovation-driven societies

Policy makers are confronted with the challenge of boosting economic growth while ensuring that gains remain socially inclusive. Recent research shows that when income inequality rises, economic growth falls. In most OECD countries, the gap between rich and poor is at its highest level in 30 years. Today, the richest 10% of the population in the OECD area earns 9.5 times more than the poorest 10%. By contrast, in the 1980s the ratio stood at 7:1. Rising inequality is estimated to have knocked more than 4 percentage points off growth in half of the OECD countries over two decades (OECD, 2014b). New sources of growth have to underpin a strong and sustainable future, and in that context innovation is seen as a key driver

that can help address poverty and directly improve the well-being of different groups in society.

Figure 4.1. Trends in the demand for skills



Notes: Autor and Price (2013) argue that what really determines the substitutability of tasks (and jobs) by computers and machinery is the amount of routine that they involve. Routine tasks (both manual and cognitive) are easily programmable and can be performed by computers at economically feasible costs, in the sense that they follow explicit rules. On the contrary, non-routine tasks are less well defined and codified and, as things currently stand, cannot be performed by computers. They define 5 categories of tasks: 1) Routine manual tasks: physical work following explicit and repetitive rules; 2) Non-routine manual tasks: physical work requiring flexible response; 3) Routine cognitive: clerical and information-processing tasks following explicit rules; 4) Non-routine analytic: tasks requiring highly specialized knowledge and the ability to solve problems using abstract thinking in relatively independent ways; and 5) Non-routine interactive: tasks requiring the capacity to create and provide value through complex interpersonal communication and/or intense interaction with others.

Source: Based on Autor and Price, 2013, Table 1.

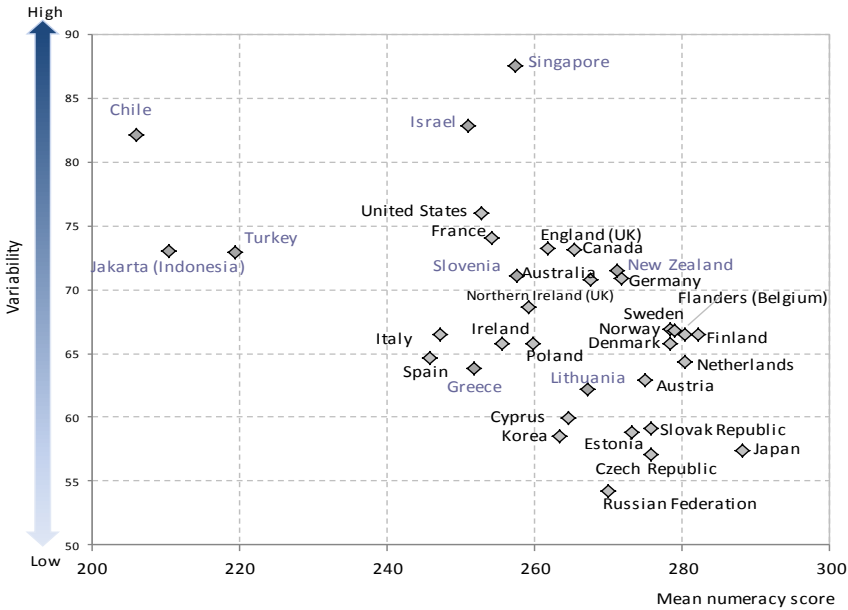
Innovation holds the key to ongoing improvements in living standards, as well as to solving some of the pressing social challenges facing OECD member countries and non-member economies alike. But countries increasingly seek to know more about the types of skills that support innovation and the best ways to develop them. Skilled people play an

important role in innovation through the new knowledge they generate, the way they adopt and adapt existing ideas, and their ability to learn new competencies and adapt to a changing environment. The analysis of two international databases of tertiary-educated professionals five years after their graduation (Reflex and Hegesco) by Avvisati, Jacotin and Vincent-Lancrin (2013) shows that a broad mix of specialisations and qualifications is needed for innovation. Comparing the job requirements of highly innovative and non-innovative jobs, the skills most important for innovation – that distinguish innovators from non-innovators – are creativity ("come up with new ideas and solutions") and critical thinking (the "willingness to question ideas") followed by the "ability to present ideas to an audience", "alertness to opportunities", "analytical thinking", "ability to co-ordinate activities", and the "ability to acquire new knowledge". These results confirm recent trends in the US labour market that also show a changing demand for skills (Autor and Price, 2013). Modern economies need more innovative workers with high levels of proficiency for non-routine cognitive tasks, including analytic skills such as problem solving and interpersonal skills (Figure 4.1).

The Survey of Adult Skills (2012 and 2015), a survey that is part of the OECD Programme for the International Assessment of Adult Competencies (PIAAC), assesses adults' (16-65 year-olds') proficiency in three key information-processing skills that are needed for the completion of work tasks: literacy, numeracy and problem solving in technology-rich environments (OECD, 2016b). Average adult proficiency in information-processing skills varies considerably among the countries covered by the survey, although the average scores for many countries fall within a relatively limited range. There are also considerable differences in the extent of the variation or dispersion of proficiency across countries. A sizeable proportion of adults show a poor level of literacy and numeracy skills for a sizeable proportion of adults. Figure 4.2 illustrates this for numeracy scores: the interquartile range remains high in all the participating countries.

Figure 4.2. Average and variability of numeracy scores[1]

Relationship between mean numeracy proficiency score and variability



Notes: The measure of variability used is the interquartile range (difference between the third quartile minus first quartile). Countries in black font participated in the first round of PIAAC (2012); countries in blue font participated in the second round of PIAAC (2015).The sample for the Russian Federation does not include the population of the Moscow municipal area.

Source: Survey of Adult Skills (PIAAC) (2012, 2015), Table A2.5.

4.1.2. Higher education graduates and skills for innovation

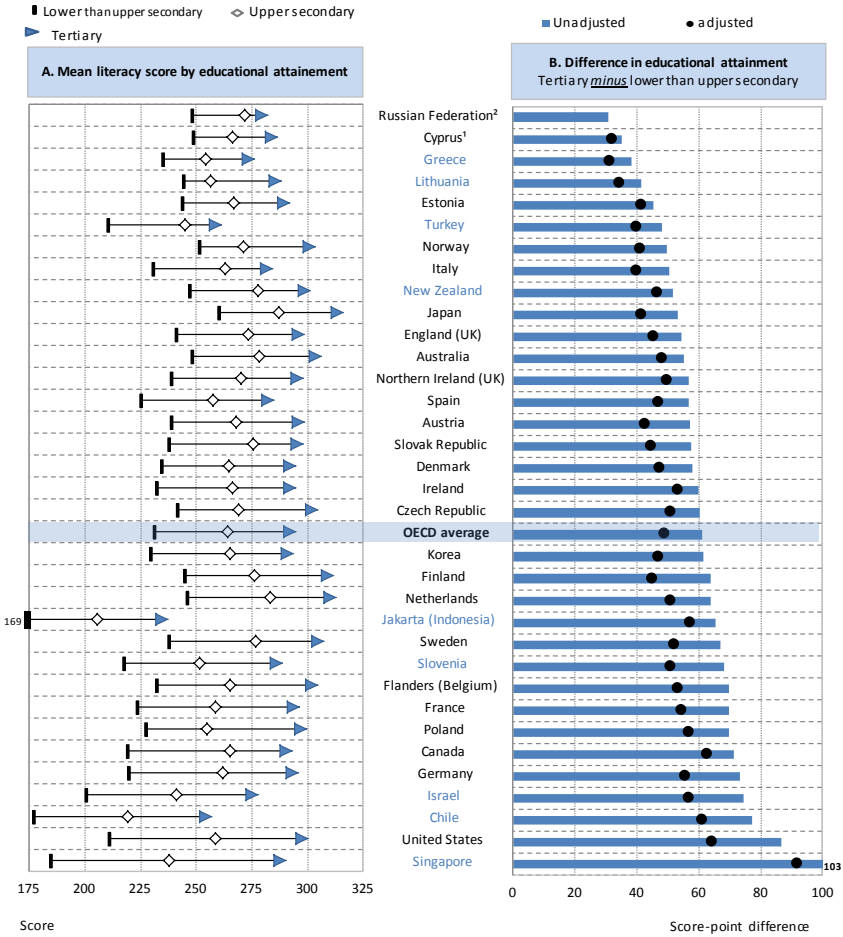
Learning and skills development can take place in many different contexts and in many different forms. The link between education and proficiency is complex. People with higher ability are likely to be both more proficient in information-processing skills and to have earned higher educational qualifications, in which case the direction of causality would run from proficiency to education, rather than the other way round. More highly educated individuals are also more likely to be employed, which gives them more opportunities to practice their skills and prevents (or slows down) the decline in certain cognitive functions normally associated with ageing. However, knowledge and skills are also acquired through education and training programmes delivered by educational institutions such as colleges and universities. Educational institutions are in fact the only institutions

whose primary and explicit goal is to equip individuals with the proficiency in some of the skills they need in order to participate fully in society.

In all countries, 25-65 year-olds who have completed tertiary education scored higher in both literacy and numeracy than adults who have completed upper secondary education. The latter, in turn, scored higher than adults who have not completed upper secondary education. Across OECD countries participating in the survey, tertiary-educated adults scored 292 points on the literacy scale on average, while adults with upper secondary education scored 264 points, and those without upper secondary education scored 231 points (Figure 4.3). The differences in score by educational attainment are generally even larger in the case of numeracy proficiency. Even if accounting for other socio-demographic characteristics (family backgrounds, age, etc.) tends to reduce the gap in proficiency associated with educational attainment, the effect of such other background characteristics is weak, and does not vary greatly from one country to another. This is further evidence of the strong link between tertiary education and proficiency in information-processing skills.

Figure 4.3. Differences in literacy proficiency, by educational attainment[2]

Adults aged 25-65



Notes:
1. The sample for the Russian Federation does not include the population of the Moscow municipal area.
2. All differences in panel B are statistically significant. Unadjusted differences are the differences between the two means for each contrast category. Adjusted differences are based on a regression model and take account of differences associated with other factors: age, gender, immigrant and language background and parents' educational attainment. Only the score-point differences between two contrast categories are shown in panel B, which is useful for showing the relative significance of educational attainment vis-a-vis observed score-point differences. Lower than upper secondary includes ISCED 1, 2 and 3C short. Upper secondary includes ISCED 3A, 3B, 3C long and 4. Tertiary includes ISCED 5A, 5B and 6. Where possible, foreign qualifications are included as the closest corresponding level in the respective national education systems. Adjusted difference for the Russian Federation is missing due to the lack of language variables.
3. Countries and economies are ranked in ascending order of the unadjusted differences in literacy scores (tertiary minus lower than upper secondary).

Source: Survey of Adult Skills (PIAAC) (2012, 2015), Tables A3.1 (L) and A3.2 (L).

The analysis of Reflex and Hegesco (Avvisati, Jacotin and Vincent-Lancrin, 2013) shows that a significant proportion of professionals with tertiary education degrees from all fields work in highly innovative jobs. Over 45% of tertiary graduates from any field participate in innovation. Science and engineering graduates are more likely to participate in some form of innovation (over 60% of them do), but a significant percentage of graduates from other fields also have a highly innovative job — 55% for a tertiary education graduate on average, and about 58% for arts and agriculture graduates. This means that an overly exclusive focus on the training of scientists and engineers to promote innovation is largely misplaced, given that other graduates also contribute significantly to innovation. In sum, the rise in the share of the tertiary graduate population – whatever the field of education – is relevant to developing the innovation potential of all countries.

4.1.3. Why should we care about inequalities?

Given that higher education is expanding (in terms of enrolment), the key question is whether that can contribute to a lowering of social inequality. An inclusive education will only be successful if it reaches a much larger segment of excluded populations than it currently does. Efforts to address inequalities in higher education by facilitating the integration of students from traditionally deprived groups will help to improve the quality of human resources and social cohesion. At the individual level, fairer access to higher education should also foster the current and future well-being of these students, as educational attainment and skills proficiency influence many aspects of everyday life, such as engagement, self-confidence, health and, of course, professional outcomes (OECD 2016b).

The costs of inequality and dropout in higher education are considerable, for both individuals and societies. Investing in equality in education and in reducing dropout brings returns. Raising the skills of individuals increases their employability and productivity. More broadly, cognitive skills of individuals have been strongly associated with economic growth over the past four decades (Hanushek and Woessmann, 2009). Adults with higher skills proficiency are more likely to be employed and to earn higher hourly wages. On average, across the OECD countries that participated in the Survey of Adult Skills, the median hourly wage of salaried employees scoring at level 4 or 5 on the literacy scale is 65% higher than that of workers scoring at or below level 1 (OECD, 2016b). Underdeveloped human capital may hamper productivity growth and limits the effective and full use of resources (Heckman, 2011). Individuals with lower education levels typically have higher unemployment risks, less stable jobs, and more difficulties in facing the economy's demands for ever-

increasing flexibility and coping with technological transitions. In OECD countries, 85% of the population with a tertiary education were employed in 2015, while only 53% of those who had not completed an upper secondary education had a job (OECD, 2016c).

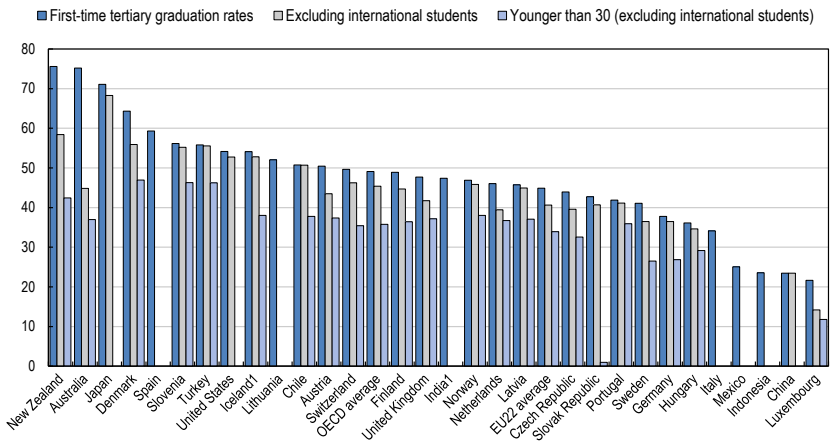
The efforts made for more social equality in higher education are also a source of innovation (OECD, 2008b). Implementing plans for the inclusion of disadvantaged students requires the joint mobilisation of all stakeholders concerned at one level or another by the future of the student. That modification thus modifies the relationship between institutions and their environment. By placing diversity at the heart of the institutions' concerns, such plans encourage awareness of the challenges imposed by a knowledge-based society; development of human capital thereby pave the way toward economic and social well-being for all. In sum, they help modernise higher education.

4.2. Inclusiveness in higher education: inequality in access and retention

4.2.1. Expansion in higher education enhances the skills of a larger share of the population

The expansion of tertiary education has been remarkable in recent decades. Average annual growth in tertiary enrolment over the period 1991-2004 stood at 5.1% worldwide (OECD, 2008b) and the number of students in tertiary education has increased in practically all OECD countries. Globally, in 2013 it is estimated that 67% of young adults in OECD countries will enter tertiary education at least once during their lifetime if current patterns of enrolment continue (OECD, 2015b). Some countries have very high tertiary entry rates mainly because of popular short-cycle programmes. In Chile, for example, around 89% of young people are expected to enter tertiary education at least once in their lifetime with 45% of them entering short-cycle programmes, while in 6 out of 30 OECD countries (Belgium, the Czech Republic, Finland, Germany, Italy and Portugal), the latter percentage is 1% or less. Some 16% of tertiary education students across OECD countries enter short-cycle programmes, as do 12% of tertiary students in the 21 members of the European Union that are also members of the OECD. In most countries, the largest proportion of tertiary students enters bachelor's degree programmes (ISCED 6): on average, 57% of young people will enter one of these programmes during their lifetime. Many OECD countries invest heavily to provide education beyond the bachelor's level. Around 22% of students across OECD countries are expected to enter a master's programme over their lifetime, and 14% of domestic students are expected to enter those programmes before the age of 30.

Figure 4.4. First-time tertiary entry rates (2014)



Notes:
1. Year of reference for Iceland and India is 2013.
2. Mismatches between the coverage of the population data and first-time graduates data mean that the graduation rates for those countries that are net exporters of students may be underestimated and those that are net importers may be overestimated. The first-time tertiary graduation rate excluding international students accounts for this.
3. Countries are ranked in descending order of entry rate at tertiary level.
4. First-time tertiary entry rates stand for the estimated proportion of people who are expected to enter tertiary education for the first time during their lifetime.

Source: OECD, 2016c, Table A3.1.

Schofer and Meyer (2005) suggested that throughout the 20th century, tertiary systems expanded faster in more advanced economies to developing and emerging countries. Conversely, enrolment increased at a slower pace in ethnically and linguistically diverse countries, suggesting that competition among different status groups leads to underrepresentation of particular groups. Expansion was also slower in countries with centralised educational systems, where governments had greater capacity to limit growth. Starting around the 1960s, the rate of increase in enrolments became considerably higher in all types of countries, suggesting that this worldwide trend is linked to "the rise of a new model of society: increasing democratisation and human rights, scientisation, and the advent of development planning" (Schofer and Meyer, 2005:916).

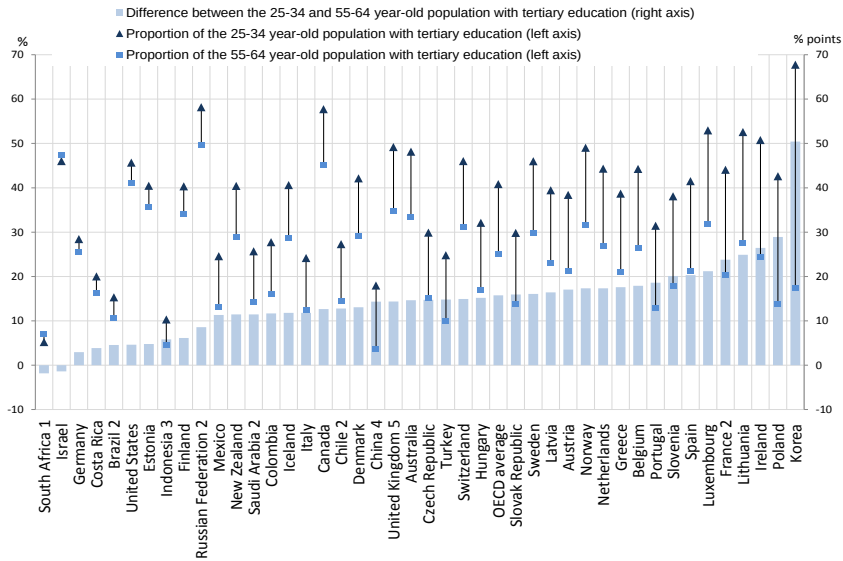
The expansion of graduates from tertiary education over the generations followed the expansion in tertiary enrolment. Over the past 30 years, almost all OECD countries have seen significant increases in the educational attainment of their populations, as can be observed by comparing the educational attainment of younger and older adults. By 2014, about one in three adults in OECD countries held a tertiary qualification,

including qualifications from more technical tertiary programmes as well as from universities. In all OECD and partner countries except Israel and South Africa, the share of younger adults with tertiary qualifications is larger than that of older adults with the same level of qualification. On average, the difference between the generations (55-64 year-olds compared with 25-34 year-olds) in tertiary attainment is about 16 percentage points. The speed of the expansion varies considerably. In Chile for instance, the difference in tertiary attainment between the two age groups is less than 13 percentage points (14% versus 27%). Among the countries with the highest tertiary attainment rates, small differences between the generations, such as those observed in Israel, the Russian Federation and the United States, could reflect the fact that these countries also have the highest tertiary attainment rates among 55-64 year-olds.

Enrolment rates aside, there are large differences in the levels of tertiary education most people have attained. Across OECD countries, 27% of 25-64 year-olds have at least a bachelor's degree or equivalent. In Belgium and Luxembourg, over 35% of adults hold this degree, but in Austria, Chile, France, Italy, Mexico and Turkey, that percentage is less than 20%. On average across OECD countries, 16% of 25-64 year-olds have earned a bachelor's degree or equivalent, 11% have earned a master's degree, and about 1% have earned a doctoral degree or equivalent.

Figure 4.5. Percentage of younger and older tertiary-educated adults and percentage-point difference between them

(25-34 and 55-64 year- olds, 2014)



Notes:
1. South Africa: Year of reference 2012.
2. Brazil, Chile, France, Korea, the Russian Federation, Saudi Arabia: Year of reference 2013.
3. Indonesia: Year of reference 2011.
4. China: Year of reference 2010.
5. The United Kingdom: Data for upper secondary attainment include completion of a sufficient volume and standard of programmes that would be classified individually as completion of intermediate upper secondary programmes (18% of the adults are in this group).
Countries are ranked in ascending order of the percentage-point difference between the 25-34 and 55-64 year-old populations with tertiary education.

Source: OECD, 2015b, Table A1.4a.

4.2.2. Does higher enrolment in education guarantee more equality?

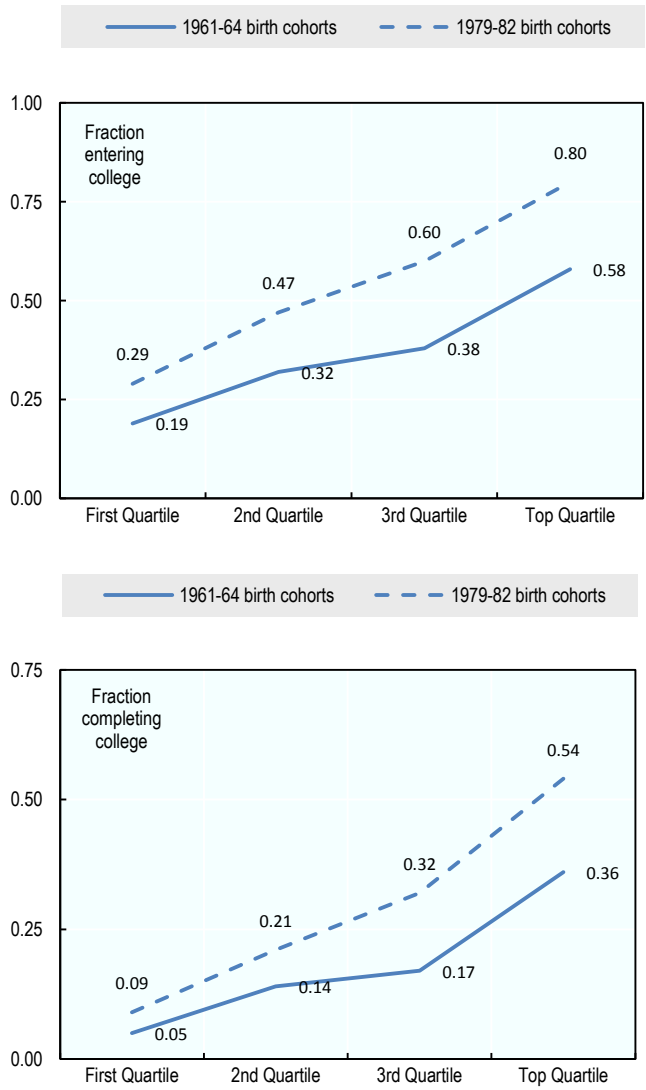
As enrolment in higher education has increased, access to it has become more broadly based in most OECD countries, so that quantitative inequalities have been effectively lessened. There is however no systematic relationship between expansion and equality. Inequality can be measured in different ways and seen from different perspectives. Abundant research (Shavit and Blossfeld, 1993; Raftery and Hout, 1993; Boliver, 2010) has argued that inequalities are likely to persist during periods of expansion. The idea is that inequalities "maximally maintain" until participation of the most

privileged group reaches a saturation point – that is to say, social differentials in educational transitions would only diminish when children of privileged parents have universal access and fully benefit from the new opportunities. For instance, in the United States, whereas the proportion of poorer students entering higher education increased from 19% to 29% between 1979 and 1997, the difference with more advantaged students raised from 10 to 22 percentage points. In other words, a child from the richest quartile was six times as likely as one from the poorest to access college in 1979 (odds ratio=5.88). In 1997, the child was 10 times as likely (odds ratio=9.8). The same conclusion could be drawn considering the completion of levels in higher education. The relative chance in completing a college degree was more than 10 times higher for privileged students than for the poorest (odds ratio=11.9).

Although it may work in some periods or contexts, the "maximally maintained inequality" (MMI) hypothesis has recently been challenged or qualified by Shavit, Arum and Gamoran (2007) among others. These authors highlight that education should not be regarded simply as a "positional good" whose value depends solely on the education of others. Education includes also intrinsic personal benefits that are not exclusively economic (OECD, 2007a). Wider enrolment rates in higher education do not necessarily lead to greater social mobility but have a positive effect on social inclusiveness and social progress by fostering other aspects of people's well-being and participation in collective activities. The second aspect of quantitative openness is apparent from the social make-up of students in higher education. While students from upper middle class backgrounds (or even higher on the social scale) accounted for a significant proportion of the student population a few decades ago, their proportions have decreased although they remain overrepresented. The student experience in higher education has thus changed qualitatively for those from all social backgrounds, with a truly greater social mix – and varied consequences in terms of the real social capital of institutions (OECD 2008a). The socio-economic composition of higher education systems has generally become much broader and closer to that of society in countries where higher education has expanded.

Recent data tend to show that the influence of socio-economic background on access to higher education, or the likelihood of graduating, has in fact diminished in recent decades in many countries and increased in just a few. There is no causal relationship or systematic association between expansion of higher education and a lowering (or increase) of social inequalities of opportunity.

Figure 4.6. Fraction of students entering/completing college in United States, by income quartile and birth year



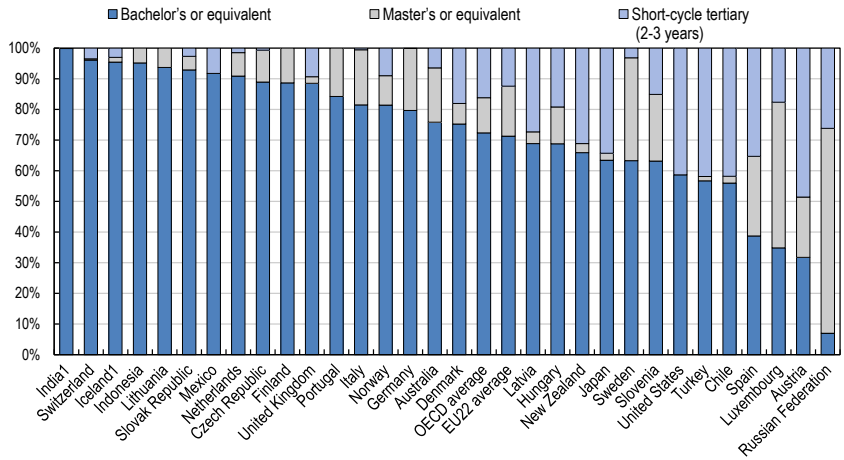
Source: Bailey and Dynarski, 2011.

All in all, it is reasonable to say that the expansion of higher education is usually followed by a decrease in inequalities of opportunity, as has been observed in many countries, even if this trend has occasionally discontinued or stagnated. However, the fact that inequalities decrease or increase tells us nothing about the absolute degree of inequality, so that a country in which inequality is increasing may still be more egalitarian than one in which inequality is diminishing or remains unchanged. Moreover, although a valuable goal in itself that is likely to improve society's inclusiveness, a decrease in social inequalities in higher education does not necessarily lead to greater social mobility, which ultimately depends first on the transition between higher education and the labour market, and then on career paths themselves.

4.2.3. Diversification and stratification in higher education

Increases in the numbers of students have been accompanied by a diversification of course levels, fields of study, types of institutions and educational sectors in most OECD countries. In the 1980s and 1990s, problems generated by "mass higher education" led to the introduction of new types of institutions (e.g. colleges, polytechnics) and programmes to cope with an increasingly differentiated student population. Along with these structural transformations, further changes in the conception and organisation of tertiary education have also occurred. In some countries, performance indicators have been introduced to monitor institutions' results and distribute funding resources. Moreover, several higher education systems have experienced a growth in institutional autonomy, the introduction of tuition fees, the establishment of restrictive criteria for undertaking studies in specific fields, and the development of university rankings or "league tables" (Eurydice, 2000; OECD, 2008a).

Figure 4.7. Distribution of first-time graduates by level of education, 2013



Notes:
1. Year of reference 2012.
2. Countries are ranked in descending order of the percentage of first-time graduates at bachelor's level or equivalent.
3. A first-time graduate is a student who has graduated for the first time at a given level of education during the reference period. Therefore, if a student has graduated multiple times over the years, he or she is counted as a graduate each year, but as a first-time graduate only once.

Source: OECD, 2015b, Table A3.2.

When access to a given education level grows, the qualitative differentiation within that level may become increasingly important for occupational and non-occupational outcomes. The most stratified higher education systems are more likely to reproduce inequality, because if qualitative differences among programmes at an educational level are relevant for subsequent school and professional careers, upper class families will choose the best educational options in order to favour their children in the occupational attainment process (Lucas, 2001). Similarly, students from lower classes are channelled, or place themselves, into less prestigious and less remunerative fields, institutions, or sectors (Brint and Karabel, 1989). Pierson and Wolniak (2003) note that the establishment and growth of the two-year community colleges have had a dramatic impact on the character of post-secondary education in the United States. They suggest that the existence of two-year colleges has substantially increased both the access to tertiary education and the social mobility of numerous individuals whose education might otherwise have ended with secondary school. However, they indicate that a major critique in the literature on the two-year college posits that, while it may function to guarantee equality of opportunity for

access to tertiary education, in relation to four-year colleges and universities it has not provided equal opportunity in terms of the outcomes or benefits of higher education.

4.2.4. Main factors explaining inequalities

A. Inequalities in access regarding family background of students

Inequalities in access to higher education can come from specific objective conditions of low-income families. For example, higher education implies important direct and indirect costs for poor families. Poor students also benefit from limited parental and out-of-school community support. Moreover, as shown by Becker and Hecken (2008), for lower class families it is rational to opt for shorter and more vocational courses, because this choice minimises the risk of academic failure. Then, at all transitional stages in education and especially that of eligibility for higher education, children from disadvantaged backgrounds, whose achievement levels are the same as those of their more privileged peers, generally have fewer opportunities to continue their studies or to choose courses that are as ambitious. This may be because of real or perceived financial pressures, or be due to different aspirations.

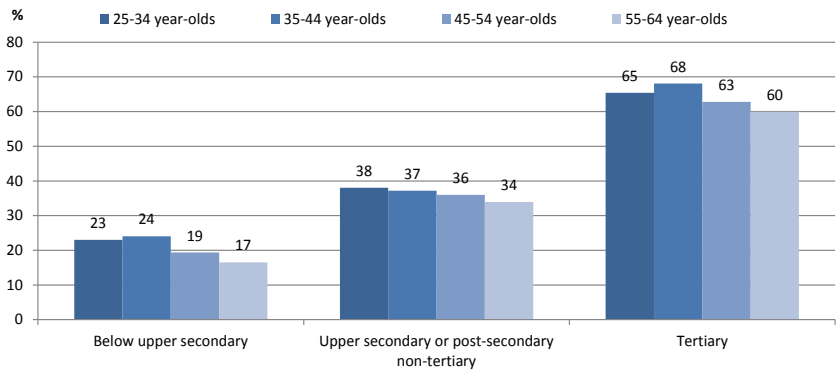
At the international level, there is a general lack of comparability of equality in tertiary education as a result of the heterogeneity of national data available. Depending on the countries, equality issues in terms of access and completion are measured, for instance, by ethnicity, gender, income, geographical origin and parental education. An additional complexity is that data are not compiled on a systematic basis (categories for collection or frequency of collection may change over time). Nevertheless, some international trends on the fairness of access in higher education can be drawn by inequality measures based on parental education and family income.

Parental educational attainment

The level of educational attainment has risen significantly in recent years, especially among younger adults. Looking at the data in light of people's parental educational attainment points to greater opportunities to attain higher levels of education, and a continuous increase in opportunities to attain tertiary education. At the same time, the data also confirm the impact of parents' educational attainment on their children's attainment.

The differences in the proportions of tertiary education graduates from more or less educated families are for the most part stable across generations. Some 23% of younger adults whose parents did not attain upper secondary education attained tertiary education themselves, compared with 65% of adults of the same age whose parents also attained tertiary education (a difference of 42 percentage points). Among 35-44 year-olds, this difference is 44 percentage points (24% and 68%, respectively), 43 percentage points among 45-54 year-olds (19% and 63%, respectively) and 43 percentage points among older adults (17% and 60%, respectively). These trends show that there is room for reducing inequalities of access to tertiary education related to parental educational attainment.

Figure 4.8. Percentage of adults who completed tertiary education, by age group and parents' educational attainment, 2012



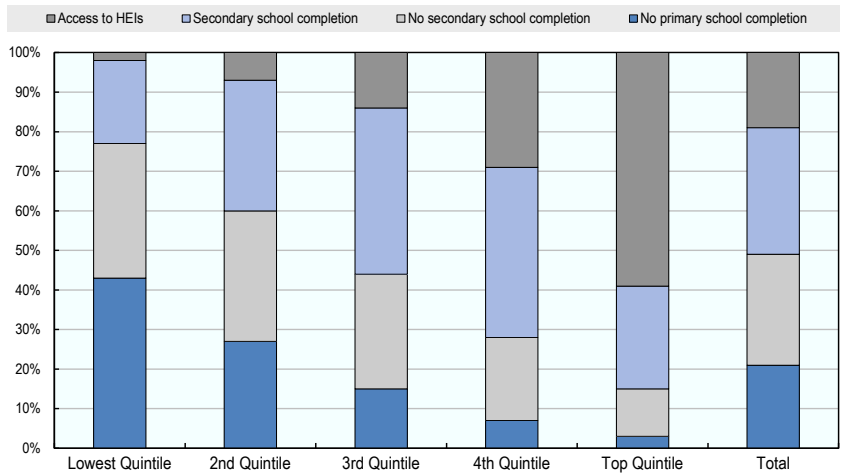
Note: Averages.
Source: Survey of Adult Skills, OECD, 2014 a, Table A4.2.

Family's income

Statistics on the family income of students is difficult to obtain. For legal and cultural reasons, few data are available at the international level and it is necessary to rely on national cases to draw any conclusions. These national examples show a pattern similar to that for parental educational attainment: while younger generations from poorer families have (slightly) more access today than in the past, the difference of access between the top and lower income groups is significant. This is the case in the United States (see Figure 4.6), but also in other OECD countries (see Shavit, Arum and Gamoran, 2007). In some countries, Brazil for example, the situation evolves slowly, in line with the scenario of "maximally maintained inequality" evoked above. For example, in 1995, the proportion of access to higher

education for the 1st income quintile was about 0% and for the 5th quintile 23% in Brazil. In 2009, the percentages were respectively 3% and 59% (see Figure 4.9).

Figure 4.9. Attainment of people between 18 and 24 years old according to family income in Brazil in 2009



Source: Brazilian National Household Sample Survey (PNAD) (2009), Brazilian Institute of Geography and Statistics (IBGE).

B. Transition from secondary to tertiary education and inside higher education

Social inequalities in higher education are also partly the consequence of earlier schooling at primary and secondary levels. Children from disadvantaged backgrounds often perform less well at school and are thus less likely to be eligible for higher education. This occurs for a variety of nutritional, social, economic, cultural and educational reasons that make them face these transitional stages from a more difficult position than children from more privileged backgrounds (OECD, 2007).

One clear challenge countries face as a result of the diversification of tertiary education is the nature of the articulation with secondary education. Larger proportions of disadvantaged groups tend to study in the vocational tracks of upper secondary education. Attention should be paid to the links between non-academic tracks in upper secondary school and non-university sector provision in tertiary education, including bridging education programmes designed to assist students in developing the skills necessary for success in tertiary education. Institutional diversity within tertiary education

should be closely associated with curricular diversity in upper secondary school, and with recognition of non-academic tracks as valid for access to tertiary education.

This also calls for particular attention to the transfers between different types of higher education institutions, and in particular between vocationally oriented and academic higher education institutions. If disadvantaged students do access tertiary education, they are more likely to attend vocationally oriented higher education institutions. If transfers were enhanced between the two types of institutions or programmes, then these students might have a better chance of earning higher-level degrees, which provide access to better and higher-earning occupations. In addition, more disadvantaged students are more likely to enter lower-status higher education institutions compared to those from better-off families; increased options for transfer would help them move to higher-status higher education institutions, even if there are some barriers to overcome. Andres (2001) analyses transfer arrangements from community college to university in British Columbia using a sample of students who accomplished the transfer. The findings reveal that while the majority of students in that study support transfer as a viable and even preferable route to university degree completion, they identify the various obstacles to a successful transfer: difficulty gaining access to useful information; problems understanding transfer policies, practices, and procedures; and declines in grades following transfer to university.

4.3. Innovative policies for educational inclusiveness

4.3.1. Programmes that aim to adapt the organisation of the higher education sector

Higher education policies are most often comprised of measures meant to enhance the inclusiveness of participation in education. Efforts can focus on the organisation of the higher education sector in order to increase the participation of underprivileged students. Four mechanisms can be highlighted: the openness of higher education institutions; the availability of tertiary education opportunities in remote areas; the financial incentives for institutions to promote diversity; and targeted grant schemes for underprivileged students.

Openness of higher education – If a tertiary education system limits entry to qualified students (as a result of capacity limitations) and therefore does not accommodate demand for tertiary education, individuals from disadvantaged backgrounds are more likely to be among the individuals

excluded. In Brazil, for example, higher education is perceived as a privileged means to social mobility. Most Brazilian families, however, cannot afford to send their children to private institutions, which have more enrolment capacity than their public counterparts. As a result, the government had to develop mechanisms to increase access to public higher education institutions and/or create scholarships to private institutions. The Brazilian Federal Government has implemented a series of policies to address the demands for more and better higher education, including a programme to support reorganisation and expansion plans for universities in 2007. With this programme, in return for a significant investment (about USD 900 million) the federal government aimed specifically to double the number of students in the classrooms and increase the number of undergraduate courses of the federal public universities in the next ten years (Ministry of Education, 2008). Another example of strategy, as in Chile (see Box 4.1), is to reserve guaranteed places in public higher education for students from underrepresented groups.

Availability of tertiary education in remote areas – Countries have adopted a number of strategies to improve the accessibility to tertiary education of populations from rural or isolated areas. These range from the location, or relocation, of university campuses to the development of distance learning services. The objective is to improve the propensity to participate in tertiary education. For example, in India the University of Kashmir has opened three satellite campuses in Leh, Kupwara and Kargil – three hilly, inaccessible districts – with funding assistance from the central government. In the same way, the older Indian institutes of technology (IITs) and Indian institutes of management (IIMs) – India's premier engineering and management institutions – established eight new campuses in small towns, including Rohtak in Haryana state, Raipur in underdeveloped Chhattisgarh state, Ranchi in Jharkhand state, Tiruchirappalli in Tamil Nadu, Jodhpur in Rajasthan, and Mandi in the hill state of Himachal Pradesh.

Financial incentives for higher education institutions – Many countries use special provisions in mechanisms to allocate public funds to higher education institutions as a means to encourage the enrolment of students from underrepresented groups, typically through a funding premium per each student. For example, the current higher education equality policy in Australia aims to remove barriers to access to higher education for all Australians, with a particular focus on assisting groups experiencing significant educational disadvantage. Allocation of the Higher Education Participation and Partnerships Programme (HEPPP) funds to eligible higher education institutions by the Department of Education and Training is based upon a formula that takes into account the universities' number of domestic students from a low socio-economic background and of students from

regional and remote areas, as well as the retention and success ratios for these groups.

Box 4.1. Effective Accompaniment and Access to Higher Education Program (PACE)

The Accompaniment and Effective Access to Higher Education Program (PACE) emerged in Chile as the first public initiative on inclusive participation in higher education on a national level. Its main goal is to support the right to higher education for all, ensuring effective access to students from underrepresented schools who have demonstrated high levels of performance in their educational pathways (MINEDUC, 2015a, 2015b). The programme aims to improve equality, diversity, and quality in higher education. It also intends to inspire new perspectives for students who are still in secondary schools (Escudero, 2015). Contrary to other programmes, PACE is designed and financed by the Ministry of Education, and its implementation depends directly on collaboration and co-ordination between the Regional Ministerial Departments (SEREMIS), who rely on the Ministry, and the holders and directors of the beneficiary schools and the universities who participate in the programmes (Escudero, 2015).

The PACE programme consists of two main components. The first one refers to the accompaniment of disadvantaged students by the partnered high education institutions working in conjunction with the school establishments in academic support activities that focus on general knowledge development (MINEDUC, 2014). Each higher education institution supports a school establishment through facilitators (Escudero 2015) who, alongside the classroom teachers, offer supplementary reinforcement workshops in mathematics, language, and socio-emotional management skills to secondary school students, through a professional development workshop. Together, the higher education institutions and the educational establishment that they support must design an implementation methodology for activities that identify the best strategies for each distinct situation, in order to prepare the students in the best possible way (Escudero, 2015). The second component consists of reserving guaranteed spaces in higher education for students whose performance is in the top 15% of the participating schools. It also provides an accompaniment in higher education to enhance retention in the system (MINEDUC, 2014). In order to apply for a guaranteed space with PACE for higher education, student must complete a variety of academic requirements.

Targeted grant schemes – A number of countries have developed publicly funded grant schemes targeted at underrepresented undergraduate students. In addition, most countries provide higher education institutions with special funds to be distributed as grants to students from underrepresented groups. The Office for Fair Access (OFFA) in England, for example, conditions its access agreements – documents drawn up by universities and colleges as a condition of charging tuition fees above the basic level – on the provision of bursaries for students from underrepresented groups (OFFA, 2014; see Box 4.2).

Box 4.2. National strategy for access and student success in England

The Office for Fair Access (OFFA) is the independent public body that regulates fair access to higher education in England. It promotes and safeguards fair access for people from lower income and other underrepresented backgrounds, making sure that universities and colleges have adequate measures in place to attract disadvantaged students and to support them during their studies and as they prepare to move on to work or further study.

The main way it does this is by approving and monitoring access agreements – documents drawn up by universities and colleges as a condition of charging students with tuition fees that are above the basic fee. All publicly funded universities and colleges in England must have an access agreement approved by OFFA in order to be allowed to charge higher tuition fees. In these documents, institutions set out specific commitments and targets to protect and promote fair access to higher education, student success and progression. These terms refer to three specific goals: 1) raising aspirations and attainment among potential applicants from underrepresented groups and encouraging them to apply to higher education ("access"); 2) retaining and supporting undergraduate students from disadvantaged backgrounds through their studies ("student success"); and 3) supporting undergraduate students from disadvantaged backgrounds to progress beyond their course to employment or postgraduate study ("progression"). An access agreement should also set out the tuition fees the institution intends to charge; the milestones and objectives it chooses to use to monitor its progress in improving access; and working estimates of the higher fee income it expects to receive and to spend on access measures.

A total of 172 universities and colleges have approved access agreements for 2015-16: 123 higher education institutions and 49 further education colleges.

- In the academic year 2013-14, universities and colleges spent USD 893 million on access measures under their access agreements, not including funding contributed by the government for the National Scholarship Programme. This was 28% of their income from fees above the basic level. The three main expenditure items were the following:

- USD 131.6 million on outreach activities for people with the potential to succeed in higher education (e.g. forming and sustaining links with communities and employers; mentoring to help potential students improve their GCSE and A level grades; summer schools offering a taste of university life to children who may not have a family background in higher education).

- USD 109.3 million on student success activities, to help students stay on course and achieve their full potential (e.g. induction programmes to help students settle into university life; pastoral and study skills support; mentoring to improve employability).

- USD 619.5 million on bursaries, scholarships and fee waivers for lower-income students and other underrepresented groups. The vast majority of this money (88%) went to the poorest students, i.e. those with a household income under USD 35,550.

4.3.2. Programmes providing accompaniment to students from underrepresented groups

Efforts to fight inequalities can also focus on the accompaniment of students from underrepresented groups, in order to favour their retention and their success in graduation.

Design of programmes fitting the interests of a wide range of students – The need to diversify tertiary education reflects a pool of prospective students in the secondary system that is larger and more diverse than before, with respect to social backgrounds, academic preparation and interests. Further diversification of tertiary education systems creates opportunities for more disadvantaged groups who may not otherwise gain (or wish to gain) access to the more traditional academic forms of tertiary education. This is the case in Australia, where the indigenous population is underrepresented in the university system. According to the *Review of Higher Education Access and Outcomes for Aboriginal and Torres Strait Islander People* (Australian Government, 2012), Indigenous people represented 2.2% of the overall population, but only 1.4% of student enrolments in universities in 2010. The Review noted the poor recognition given to Aboriginal and Torres Strait Islander studies, and the lack of visibility of Aboriginal and Torres Strait Islander cultures and knowledge on many campuses. One of the most important factors identified as leading to Aboriginal and Torres Strait Islander students' premature withdrawal from studies included social or cultural alienation caused by the academic demands of study, and insufficient academic support. The Review proposed numerous recommendations to improve the higher education outcomes for these people, such as the reinforcement of bilingual education and the development of curriculum and programmes focused on their community needs.

Providing disadvantaged students with information about the benefits of tertiary education – As a result of a given disadvantage, some students might be misinformed about the benefits and costs of tertiary education (Barr, 2004). This is especially the case for those students who live in an environment that does not encourage their participation in educational activities, for example when the educational background of people in their community is low. In these conditions, students may underestimate the net benefits of tertiary education and decide not to undertake tertiary studies. One of the big challenges then is to make poor people change their preferences and behaviour, rather than just lift the obstacles that are assumed to prevent them from behaving "rationally". The College Ambition Program (CAP) (Schneider, 2015) is a good example of an innovative programme locally driven by schools, researchers and administration. The underlying

purpose of CAP is to promote a school culture in which all students are encouraged to visualise themselves as college applicants, particularly in the STEM fields, with their teachers, administrators, and parents sharing these expectations. CAP tries to increase entry into STEM postsecondary fields, to help prepare students academically via STEM-focused course planning and college entrance exam preparation; to increase student interest and motivation to participate in STEM fields; and to help them chose the right college.

Targeted support within higher education institutions during the course of studies – The growing proportion of disadvantaged students enrolled in tertiary education makes the ongoing issue of their retention and programme completion an increasingly important concern in tertiary education. Support targeted at disadvantaged students within higher education institutions during the course of studies (e.g. induction programmes, remedial education, tutoring services) may be effective in improving completion rates of disadvantaged students. For example, to remedy the lack of social diversity among the first-year students, Sciences Po (France) set up in 2011 a new admission track, the Equal Opportunity and Diversity Programme, intended for students from some high schools located in "priority education areas". These are areas identified by the government that are endowed with additional means to face the social and school difficulties of their pupils, because the rate of underprivileged students is over the national average. Students from the high schools associated with this programme benefit from special pedagogical interventions during the school year before the admission process, and from mentoring during their schooling at Sciences Po. Currently however, there is little evidence of the impact of institutions' support programmes on increased access to the more selective higher education programmes. The difficulty lies in the fact that activities labelled as "institutional support programmes" are very diverse, and the outcomes are highly dependent on the particular circumstances in which those programmes are developed.

4.3.3. New technologies for higher education: The way forward?

Several ongoing trends in technology create wider opportunities for successful inclusive innovation in education. Indeed, recent years have seen accelerated developments in the pedagogical potential of information and communication technologies (ICT) to improve traditional school teaching and learning methods at all levels, and to offer greater diversity in the delivery of open and distance-learning programmes. ICT offers opportunities for tackling barriers to inclusive participation in higher education.

ICT brings to education the capacity to reach massive audiences with consistent quality of content, and to target groups with specialised needs. The impact and repercussions of ICT are twofold. First, it may help significantly to increase delivery and coverage of educational services to the different segments of society, by offering more varied and flexible programmes able to respond to an increasing and diversified demand. Secondly, it may have considerable impact on the quality of education, in as much as it transforms the traditional teaching-learning process. But the issue of equality in participation in higher education must be addressed when ICT policies are adopted, lest existing inequalities are worsened by the digital divide (OECD, 2000).

Massive Open Online Courses (MOOCs) give students the opportunity to engage with learning in an open format via the Internet. MOOCs offer a different experience from traditional university courses in several key ways, even if these courses rarely offer formal qualifications. Firstly, the course is generally offered for free and its online nature means it knows no geographical boundaries, making it accessible to many more students than traditional learning formats. Secondly, the format allows people to learn in different ways: it offers students a way of collaborating and engaging with the course material in the way they feel most comfortable and to progress at their own pace. MOOCs are on the rise in the United States but also in most other OECD countries and partner economies. For example, the edX platform, a collaboration between Harvard and the Massachusetts Institute of Technology, offers its free open courses to people from all over the world. But the effectiveness of MOOCs is not yet well established (Jacqmin and Belleflamme, 2014), and they should probably be seen more as a complement to than a substitute for traditional higher education courses. The biggest concern is over the level of engagement of students with the course.

Open Educational Resources (OER) are "teaching, learning and research materials that make use of tools such as open licensing to permit their free reuse, continuous improvement and repurposing by others for educational purposes" (Orr, Rimini and Van Damme, 2015). OER can also help to achieve fairer access to higher education and could play a key role for more inclusive education. Many learners are indeed excluded from high-quality learning opportunities because of the requirements of place, time and pace of learning. OER offered as digital resources enable the extension of educational resources beyond a set place and time of provision, and allow provision at an appropriate pace for the learners. Socially excluded groups and communities would benefit most from the availability of such more flexible opportunities to access learning resources (Lane, 2008). Since its introduction however, OERs have not noticeably disrupted the traditional

business model of higher education or affected daily teaching approaches at most institutions. Traditional textbooks still dominate most tertiary courses.

Currently there is no evidence that the introduction of new technologies in higher education improves the participation of disadvantaged students in higher education. But they certainly help to provide more opportunities to access quality education and higher education domestically and worldwide, for example through open universities and other similar arrangements. Recent research using a dataset containing nearly 500 000 courses taken by over 40 000 community and technical college students in Washington State shows that the online format had a significantly negative relationship with both course persistence and course grade, indicating that the typical student had difficulty adapting to online courses (Xu and Jaggars, 2013). While online learning may not be more effective (yet) than face-to-face learning, it meets the needs of some students who would otherwise not be in a position to study, and therefore contributes in its way to the inclusiveness agenda.

4.4. Conclusion

The expansion of higher education provides strong opportunities for knowledge-based economies and appears to be a key factor for more inclusive growth. Many countries are conducting innovative policies to improve fair access to tertiary education institutions, with the aim of equipping with skills needed for the 21st century the largest possible share of students, especially the students from traditionally underrepresented groups. Some innovations in education, notably ICT-based innovations, may also help some students with special education needs to fully participate in higher education.

Notes

1. *Note by Turkey:*
The information in this document with reference to "Cyprus" relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Turkey recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the United Nations, Turkey shall preserve its position concerning the "Cyprus issue".
Note by all the European Union Member States of the OECD and the European Union:
The Republic of Cyprus is recognised by all members of the United Nations with the exception of Turkey. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.

2. See note 1.

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Making Innovation Benefit All:
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