PART II

Chapter 4

Regions Matter for Innovation

Innovation is increasingly seen as the key to increasing or sustaining long-term job creation and economic growth, particularly in economies struggling with heavy debt burdens and the challenge of fiscal consolidation. While economy-wide policies are clearly important, innovation tends to be a highly place-based activity. The present chapter therefore looks at evidence on the role of regions in fostering innovation and at the ways in which regions could better support innovation-driven growth.

Evidence shows the critical role of innovation as a durable source of regional growth. The effects of innovation-related investments are longer lasting than those in physical infrastructure (see Chapter 1). And different forms of innovation investment are needed for regions depending on their growth pattern. Regions with lower-skilled workers are less resilient with respect to the recent crisis in terms of jobs (see Chapter 2). Regional and local budgets are being squeezed, where pressures to meet short-term needs may result in insufficient investments for sources of long-term growth (education, research, etc.) (see Chapter 3). It is therefore critical that regions support national growth efforts through innovation, and the regional diversity of innovation systems implies a place-based element to such support (Box 4.1). To tackle these issues, two questions need to be addressed:

- How should national innovation policies take into account this regional dimension?
- How can regions support innovation that is relevant for their regional development goals?

Box 4.1. **Global trends in innovation and implications for regional and national policy co-ordination**

- Global trends in innovation are changing the nature of regional sources of competitive advantage, but given that the landscape of technology-based innovation is not flat and there is a diversity of regional profiles within and across countries, some elements of a place-based approach are essential.
- Increasing collaboration within regions and across regions in clusters and global networks is one of these trends, with networks changing over time as technologies mature, with some regions maintaining leadership and others gaining or losing at an international scale.
- Trends in national innovation policies as well as regional development policies are placing a greater role on regions given the collaborative nature of innovation-related processes as well as expectations for higher economic and social returns.
- Regions therefore have strategic choices (building on current advantages, transforming, or catching up), and the smart policy mix of instruments across different policy areas depends on the region's competences and type of innovation system.
- As national and regional, as well as local and supranational, governments are all promoting different innovation policy instruments, better ways to work together, and with the private sector, are needed to maximise impact.

Regions are competing in a changing and global innovation context

A number of global trends are shaping the innovation environment for regions

The OECD Innovation Strategy has highlighted a number of trends with respect to innovation that determine different roles for regions (see Box 4.2).[1] Globalisation is reshaping the innovation process world wide, with a dual effect on regions. On the one hand, it increases the need to identify possible sources of growth from within a region, as

Box 4.2. **Trends that frame regional efforts to support innovation**

The term innovation is used to describe many different phenomena, from scientific discoveries to simply "thinking outside of the box" through creativity and design. The OECD identifies four types of innovation in firms: the implementation of a new or significantly improved product (good or service); a new or significantly improved process; a new marketing method; or a new organisational method in business practices, workplace organisation or external relations. Such innovations are technological (product or process), as well as non-technological (marketing and organisational). An innovation may have different degrees of novelty. It does not have to be new to the world; it may be new to a market/sector or simply new to the firm/institution. The OECD is considering extending guidelines for innovation measurement to public sector innovation and innovation for social goals.

The latest data on innovation reveals several trends that frame regional efforts to support innovation:

- **Intangible assets and innovation beyond R&D:** Innovation results from a range of complementary assets beyond research and development (R&D), such as software, human capital and new organisational structures. Investment in these intangible assets is rising and overtaking investment in physical capital (machinery and equipment) in Finland, Sweden and the United States, for example.
- **Mixed modes of innovation:** Firm-level innovation data reveal complementary strategies. Most innovative firms introduce both product and process innovations, as well as marketing or organisational innovations. This is true for firms in both manufacturing and services. There are, of course, differences by sector and firm size. For instance, a larger share of firms in services than in manufacturing introduce only marketing or organisational innovation.
- **Collaboration and networks are essential:** Firms that collaborate on innovation spend more on innovation than those that do not. This suggests that collaboration is likely to be undertaken to extend the scope of a project or to complement firms' competences more than to save on costs. Collaboration is used in innovation processes whether firms perform a lot of R&D, a little R&D or no R&D at all. In this respect, policies that stimulate collaboration and networks will have an impact on the entire spectrum of innovative firms. Collaboration is also observed in the sciences. Production of scientific knowledge is shifting from individuals to groups, from single to multiple institutions, and from national to international arenas.
- **Convergence of scientific fields and multi-disciplinary/interdisciplinary research:** There is evidence that increasingly, innovations are achieved through the convergence of scientific fields and technologies. For example, nanoscience research has arisen from the interaction of physics and chemistry and is interdisciplinary in character. Environmental research is one example of multi-disciplinary research. This requires creating spaces for interaction and cross-fertilisation of different areas of knowledge.

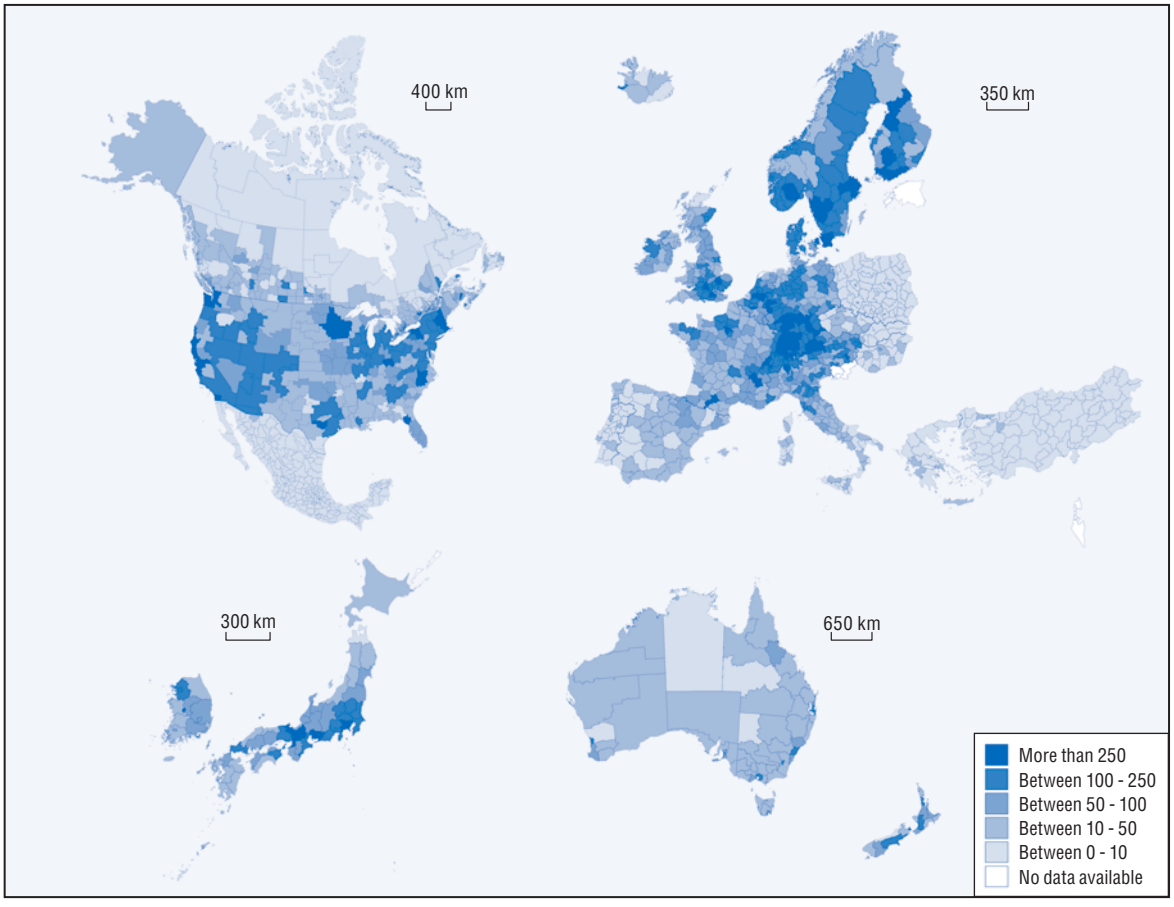
Source: OECD (2010a), "Innovation to Strengthen Growth and Address Global and Social Challenges: Key Findings", *Ministerial Report on the OECD Innovation Strategy*, *www.oecd.org/dataoecd/51/28/45326349.pdf*; OECD/Statistical Office of the European Communities, Luxembourg (2005), *Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data*, The Measurement of Scientific and Technological Activities, OECD Publishing, 3rd Edition, *http://dx.doi.org/10.1787/9789264013100-en*; and OECD (2010b), *Measuring Innovation: A New Perspective*, OECD Publishing, *http://dx.doi.org/10.1787/9789264059474-en*.

well as retain firms and skilled talent. On the other hand, it creates opportunities for organising research and production across borders, favouring the mobility of talent and increasing the opportunities for international collaboration. Strong knowledge- and technology-intensive regions may benefit from greater opportunities for networking and exchange with their foreign counterparts, so that they can play a leading role globally. In less knowledge-intensive regions and peripheral areas, the knowledge or technological gap can increase if appropriate policies are not put in place. International flows of investment, production resources and talent, may shift the balance of national and regional resources.

The geography of innovation activity is not flat

Different forms of innovation are concentrated in particular OECD regions. There exist hotspots where knowledge and research are generated, as well as regions that have firms effective at transforming existing knowledge into new products and services. The most common measures that reflect technology-based innovation are R&D investment and patenting (Figure 4.1). These activities are most concentrated in the top regions of

Figure 4.1. **Patents per million inhabitants, average 2005-07**



Note: Counts are based on patent applications filed under the Patent Cooperation Treaty (PCT), at international phase, by priority date and inventor's region of residence, using fractional counts. The regional breakdown is provided at Territorial level 3 (TL3). This map is for illustrative purposes and is without prejudice to the status of or sovereignty over any territory covered by this map. The map is cropped for ease of display.

Source: *OECD Regional Statistics Database* and *OECD REGPAT Database*.

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knowledge-intensive OECD countries. Around 13% of OECD regions account for half of total OECD R&D investment. The share of a country's R&D expenditure carried out by the top region ranges between 80% in Ireland to 21% in Italy. The top 20% OECD regions account for more than 70% of total OECD Patent Cooperation Treaty (PCT) patent applications. Skilled human capital, a critical input for the knowledge economy, is also concentrated in certain regions. Often it is the capital region of a country, by far, with the highest share of workers with tertiary education.

But regional positions shift over time, which vary by technology, especially as technological capabilities spread across more regions. Regional leaders vary by technology. And as technologies mature, the share of patenting by the top 20 regions has diminished. The top 20 regions for telecom patent applications (PCT) accounted for 78% of patents in the period 1977-79, but only 67% in the period 2005-07. Guangdong (China) was not in the top 20 in the late 1970s, but by the mid-2000s was second just after California (the United States). For biotechnology, that share of the top 20 declined from 76% to 52%. And for renewable energies, the change was even more pronounced, from 77% to 42%. Central Denmark was not in the top 20 in the late 1970s, but by the mid-2000s was third.

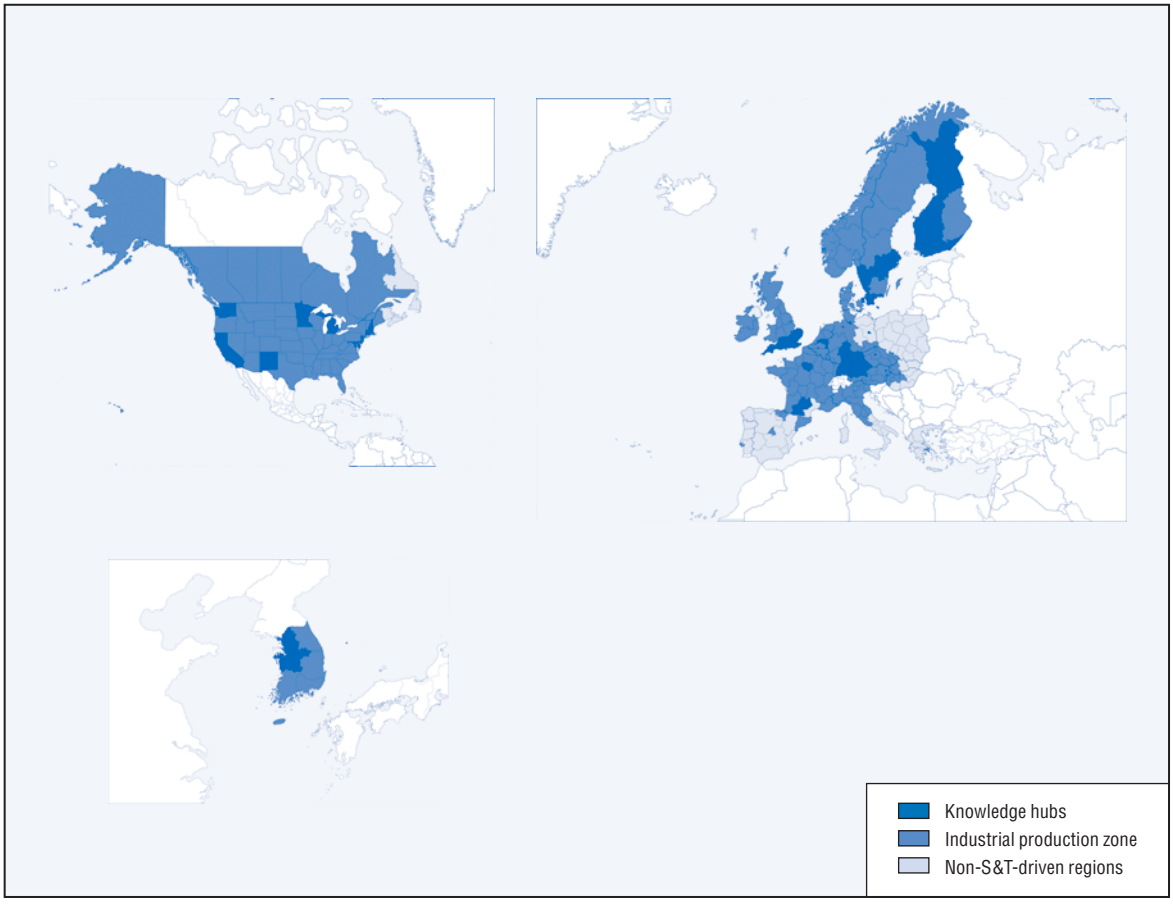
Regions may add value by investing in non-technological innovations, talent and creativity. Regional governments can play a significant role in supporting a creative business and cultural environment that attracts skilled talent, including the "creative class", and favours innovation. Non-technological innovations can boost productivity in firms through improvements to organisational and marketing methods. Such support often includes targeted services for small and medium-sized enterprises and professionals, such as the programmes to support excellence in management in the Basque Country, Spain. Regions with a strong industrial base, such as Baden-Württemberg in Germany, recognise the synergies between the creative sectors and other sectors of the economy in their public innovation support.

Therefore different regional innovation profiles imply different patterns for growth. Multiple types of regional innovation systems co-exist within the same country. An OECD analysis using a series of socio-economic and innovation-related variables identified eight types of regions that are grouped into three categories: knowledge hubs; industrial production zones; and regions that are not driven by science and technology (S&T) (Figure 4.2). While countries with many regions may show a wide diversity of regional types, such as the United States, this is also true for countries with far fewer regions, such as Hungary, Korea or the United Kingdom. This diversity implies two lessons. First, national policies ignoring regional differences may miss some of their targets. Second, regions cannot simply adopt the same solutions as elsewhere and expect the same results.

Collaboration is part of the innovation process

There are very different collaboration strategies by inventors across OECD regions (Figure 4.3). Such differences are due to the size of regions and countries but also the nature of key patenting actors, such as large multi-national firms. Some regions have a relatively low share of co-patents with foreign co-inventors, but a high variety of foreign partners. This is the case for big technology hubs, such as California and Massachusetts in the United States or Bavaria in Germany, where many of their potential collaborators are located nearby, but remain internationally connected (top left quadrant). Some regions, particularly in Asia, adopt a more inward-oriented model, showing a reduced number and share of foreign co-inventors from outside the region (bottom-left quadrant group). Some

Figure 4.2. **Different regional innovation profiles that drive growth**



Note: This map is for illustrative purposes and is without prejudice to the status of or sovereignty over any territory covered by this map. The map is cropped for ease of display. Only regions with available data on the 12 analysis variables were included.

Source: Ajmone Marsan, G. and K. Maguire (2011), "Categorisation of OECD Regions Using Innovation-Related Variables", *OECD Regional Development Working Papers*, No. 2011/03, *http://dx.doi.org/10.1787/5kg8bf42qv7k-en*.

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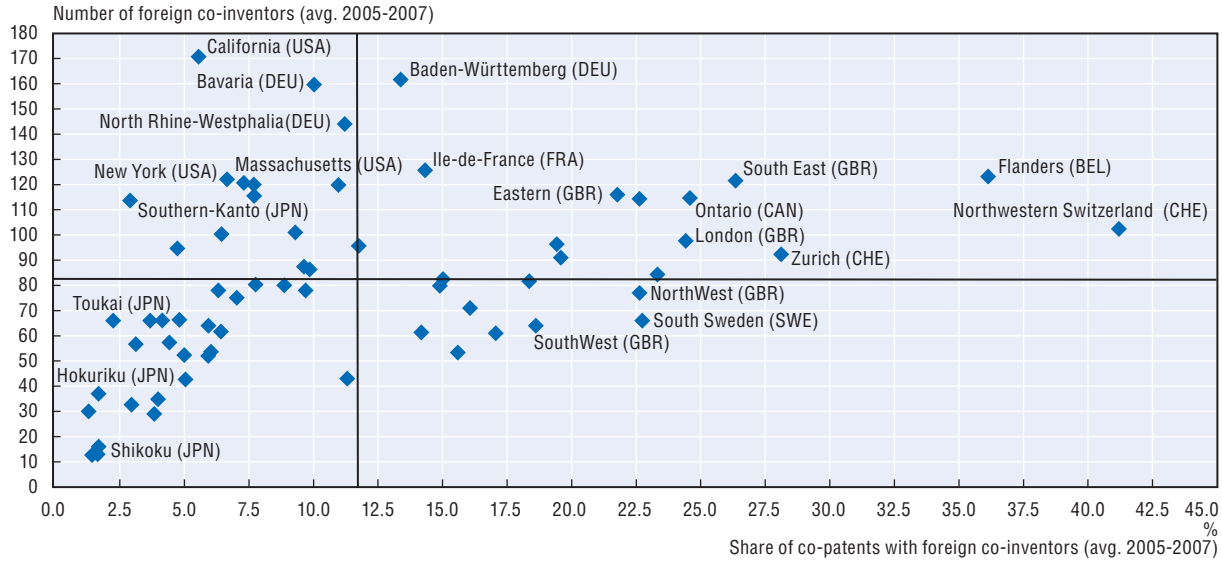
regions have a higher share of their co-invention partners from abroad, but a less diversified number of partners, such as in south Sweden or the northwest region in the United Kingdom (bottom-right quadrant). Finally, some regions are very international in both the share of co-patents as well as the diversity of partners, such as Ontario (Canada) and several European capitals like Île-de-France (includes Paris), London and Zurich. A focus on the telecommunications sector reveals that some regions account for a comparable share of world patenting: Guangdong (China), Southern Kanto (Japan) and California (the United States). California patents, however, are three times more likely to be the result of collaboration and have three times as many regional partners.

Regional roles in networks depend on technology and national setting. The propensity to collaborate varies more by region than by sector. And the structure of networks within countries differs based on the location of key assets like firms and research centres. For example, the country-level networks in large federal countries like Germany and the United States show a multi-hub structure. In some technologies, particular regions play a premier role, such as California and Massachusetts in biotechnology. In other countries,

Figure 4.3. **Variety and intensity in foreign patent collaboration by region, 2005-07**

Top 20% of OECD TL2 regions (by number of total PCT applications)



Source: OECD (2011), *Regions and Innovation Policy*, OECD Reviews of Regional Innovation, OECD Publishing, *http://dx.doi.org/10.1787/9789264097803-en*.

StatLink http://dx.doi.org/10.1787/888932520726

such as France, resources for inventive activity are more geographically concentrated, and the national network of regions has one clear hub region (Île-de-France, *i.e.* Paris) and depending on the technology, possibly a secondary hub like Rhône-Alpes in biotechnology.

Over time, there is a widening of networks and a changing role of regions in those networks. For all technologies, the number of regions active in co-invention networks has quadrupled, from 99 in the period 1977-79 to over 400 in the period 2005-07. The number of regional connections increased over 23 fold.[2] In biotechnology, the number of regions in the global network increased from 62 in the period 1985-87 to 215 by 2005-07. In the 1980s, key regions in Germany, Sweden and the United States played the most prominent role in the global network. In the 1990s, US states took over this central role while by 2005-07, German regions rejoined US states to be at the core of international collaboration. But some regions, even if they are not the top patenting regions, nevertheless have competences that allow them to be well connected to these leading regions. This is the case for biotechnology of several Swedish regions, Oslo (Norway), Capital Region – Copenhagen (Denmark), Helsinki (Finland) or Lombardy (Italy).

Emerging economies are taking advantage of these windows of opportunity. Before 2000, neither China nor India produced patents in "green" technologies in collaboration with regions in other countries.[3] In the last five years, Shanghai (China) and Karnataka (India) have tripled the number of partner regions around the world with which they co-patent in green technologies. Guangdong in China has jumped to be the second largest region for patenting volume in the telecommunications sector. Nevertheless, while Beijing has little patenting volume in the sector, it plays an important "gatekeeper" role for China in terms of integration in the international telecom co-invention network.

International networks both reinforce regional differences and serve in some cases as an opportunity. The leading co-invention network players often preserve their connectivity advantages over time. In fact, they tend to increase the number of international connections at a faster rate than regions with few connections. But there are regions with transformation or catching-up strategies that have proven effective. For example, the region of Catalonia, Spain has been actively supporting its biotechnology sector and its international linkages. The region has moved over the last 30 years from the bottom fourth quintile to the first quintile in terms of number of regional connections within the sector's global network. Evidence shows that a few regions have a large number of international connections, but many more regions are poorly connected. Therefore, increasing the connectivity of the vast majority of lesser connected regions can have a large net impact.

Innovation and regional development policies: A double paradigm shift

A regional development policy approach can focus on competitiveness and innovation

Innovation has been brought to the core of the regional development agenda. In contrast with compensatory policies of the past, regional development policies have evolved into a much broader family of longer term development policies designed to enhance regional competitiveness. They are therefore a tool for contributing to aggregate national innovation and economic performance. The magnitude of innovation-related efforts in regional development policy can be quite substantial. For example, the European Union (EU) Framework Programme for Regional Development 2007-13 foresees a budget of around EUR 86 billion for innovation support, broadly defined.

Regions are called to identify and build on their own development potential and are best able to identify complementarities across policy areas. With the change in regional development policy approaches, regions themselves need to better identify what constitutes their regional advantages. This process may not always be obvious. For example, the Milwaukee area in Wisconsin (the United States) was told by a major consulting firm that there is no "water" cluster in the area. However, regional actors noted strengths in water research in local universities, the importance of efficient water use among its many food and beverage firms, and the presence of considerable fresh water nearby. All of these factors are leading the region to promote its water-related competences and to build connections with other regions globally.

New demands on national innovation policies imply a greater recognition of regions

OECD countries are increasingly incorporating the regional dimension in science, technology and innovation (STI) policies. Several national STI plans mention the importance of innovative places and innovation hubs, such as plans in France and the United Kingdom. Some STI plans note the fact that disparities across regions are a problem for national innovation goals, such as in Hungary and Mexico. Other countries highlight the ways that different levels of government can work more effectively together. One modality is partnership. Countries that have promoted this approach include Denmark and Norway. There are also countries that seek to promote greater coherence and alignment of spending across levels of government, particularly for countries where the regional level has more autonomy to spend its own funds, such as stated in STI plans for Austria and Canada. This increased focus on regional dimensions is supported by an evolving nature in innovation policy approaches that further highlight the role for regions.

Innovation for social well-being and environmental sustainability

Governments are recognising that, beyond economic growth, innovation should serve social goals as a new measure of progress. The concept of green growth (see Chapter 5), for example, highlights that environmental sustainability and economic growth are mutually reinforcing and interdependent strategies, not an either/or policy trade-off. Public funds for innovation and research are increasingly oriented towards finding solutions for social challenges such as environmental sustainability, ageing, or healthcare. In such areas, regional authorities have both the room and the mandate to act. This is observed, for example, in local green public procurement and regulations, as well as innovations in services for the elderly. It also necessitates policy experimentation, such as the Toronto Hydrogen Village in Canada. Furthermore, sub-national governments in the OECD are responsible, on average, for two-thirds of a country's public investment. They have a vital role to play in the greening of that investment and the use of public procurement to spur innovation.

A more systemic approach to innovation policy

Policy makers increasingly recognise that innovation is a systemic phenomenon involving interactions among firms, universities, research centres, specialised service providers, and others. Along with classical market failure arguments, the "systemic failure" rationale is gaining support as a justification for innovation policy. The systems failure approach gives way to a broader range of intervention areas than the traditional instruments of R&D support via subsidies and tax incentives or funding of public research organisations. Given that many systems are more localised than at national level, strengthening those relationships that benefit from geographic proximity can strengthen the regional innovation systems that drive healthy national innovation systems.

Innovation policy accountability

Governments are increasingly called to show the economic and social impacts of their science, technology and innovation investments. As a result of fiscal imperatives and a new approach to the role of innovation policy, the returns to investment are receiving greater scrutiny. There are a number of challenges for determining the impact of such STI investments. There is considerable uncertainty in the innovation process and in the impact of different investments; sometimes a long timeframe is required to measure payoffs. But the impacts of such investments need to be translated into economic growth in a place. The relationships between firms, universities, research centres, and other actors serve to capitalise on these investments to make them more productive. The regional dimension of innovation dynamics as well as the role of regional governments to render more productive these investments, again, calls for this greater recognition of regions in innovation policy.

How can regions support innovation-driven development?

When opening the black box of regional innovation policies, the scope for regional action depends on several interdependent factors simultaneously. They include:

- institutional position, or scope for regions to take policy action given the distribution of STI competences in the country context;
- regional innovation system, including regional strengths and weaknesses for innovative activities and the relationships across firms, universities, and other institutions; and
- strategic choices made by regions to transition their economies to be more knowledge-intensive with higher levels of productivity.

It depends in part on the regional role for innovation policy

The range and nature of competences devolved from central governments to the regions is influential in framing regional innovation policies. Belgium, Canada, Germany, Spain and the United States are among countries where regions have been granted many competences for STI policy. At the other end of the spectrum, regions in small or centralised countries such as Greece, New Zealand and Portugal are not expected to play as significant a role in innovation promotion in their countries. Even in countries with no formal regional devolution of STI policies, regions may still develop regional innovation strategies. In some cases, regional innovation strategy documents have been adopted, but a lack of resources prevents their effective implementation. The differentiation between the degrees of devolution of competences is more blurred in reality than depicted in Table 4.1, but it illustrates the framework for different policy choices.

Table 4.1. **Regional competences in science, technology and innovation policy**

Degree of devolution in STI policy competences and resources		Federal countries	Countries with elected regional authorities	Countries with non-elected regional level/decentralised state agencies
Significant control of STI powers and/or resources by regions		Austria, Australia, Belgium, Brazil, Canada, Germany, Switzerland, the United States	Italy, Spain, the United Kingdom (Scotland, Wales, Northern Ireland)	
Some decentralisation of STI powers and/or resources to regions		Mexico	Denmark (autonomous regions), France, the Netherlands, Norway, Poland, Sweden (pilot regions)	Korea, Sweden (except pilot regions), the United Kingdom (English regions)
No decentralisation of STI powers	Regional innovation strategies		The Czech Republic, Denmark, Portugal (autonomous regions), the Slovak Republic, Turkey	Hungary, Ireland, Portugal (mainland)
	Innovation projects only		Chile, Japan	Greece, Finland, Iceland, Luxembourg, New Zealand, Slovenia

Note: The degree of devolution of competences in innovation-related matters is subject to change. Information reported in this table refers to the first semester of 2010.
Source: OECD (2011), *Regions and Innovation Policy*, OECD Reviews of Regional Innovation, OECD Publishing, *http://dx.doi.org/10.1787/9789264097803-en*.

And those competences at regional level for STI policy may differ within the same country. This can occur by design, such as in the United Kingdom where the devolved administrations (Scotland, Wales and Northern Ireland) have a more autonomous role, including for STI policy, relative to the English regions. Even if regions have similar formal powers, there may be *de facto* differences due to regional size, assets or financial capacity. Survey results show that in many countries, only some regions use particular policy instruments while others do not.

The role of regions in STI policy development and implementation derives from different aspects of STI policy competences. Regions may be active in: *i)* setting the overall strategy and framework; *ii)* developing policy; *iii)* financing policy; *iv)* implementing programmes and instruments; and *v)* assessment/evaluation (of strategies, programmes and instruments). National governments were reported by OECD countries as being more important than regions for most of these factors, with a couple of exceptions in federal countries. Other exceptions are noted with respect to implementing policies, whereby a region may not be ranked as high as a national government on strategy setting and

financing, but may nevertheless play a key role in implementing policy. The relative importance of regions can also be influenced by supranational authorities. This is observed notably in regions of some EU countries that are large recipients of Structural Funds.

There are no harmonised statistics on the relative share of regional spending in total public R&D or STI-related expenditures, but the regional shares are large in some countries. In Belgium, China and Germany, for example, those shares of different aspects of STI spending (typically public expenditure on R&D) can be 50% or greater. In other countries, that share may be less than 10%, such as for Austria, a federal country, or Denmark, a unitary country. As countries do not typically track this share or its evolution systematically (using any country-specific definition, let alone internationally comparable definitions), country responses to an OECD survey give some rough estimates. Reporting countries indicated almost uniformly an increase in the regional share over the last five years, with several countries indicating that this share probably changed by more than 5%.

Regions have strategic choices to boost their innovation-driven growth

The specifics of a regional strategy will depend on a wide range of factors. Certain strategies are more or less relevant for certain types of regional innovation systems. And the policy tools put in place to achieve those goals will depend on the regional scope for STI policy action. At least three strategic approaches are set out in the sections below.

Build innovation capabilities around current advantages

Some regions, at a given moment in time, benefit from key knowledge and technology assets. Such regions, typically dominant in leading technologies, have accumulated capacities and are usually well placed to progress to the next frontier. This is the case for California (the United States), Baden-Württemberg (Germany), the Fukuoka region (Japan), and South Netherlands, among other global knowledge hubs. These regions have a variety of strong firms, private or public research centres, and competence centres acting in public-private partnership mode, all active in creating and exploiting new knowledge. Such regions face the challenge of reinforcing their leadership in particular sectors, and in maintaining their high standard of living. A key question for regions in this position is how to build on current advantages while leaving room for experimentation and diversification into future models. The leading regions of the past are not always those that will lead in the future. Even regions that are not world technology leaders have different potential advantages to build on.

Support socio-economic transformation

After a history of successful and promising development, many regions find themselves needing to readjust to respond to global trends. Many regions that have been industrial production zones are likely to seek this strategy. Such regions may have promoted a strategy to include the technology and knowledge content of manufacturing, like the Nagano province in Japan, Nuevo León in Mexico and Lower Austria. Regions formerly dependent on traditional automotive or naval industries are finding it necessary in the current global economy to reconfigure their regional development strategies. Examples include Piedmont (Italy) and the Detroit area (the United States), both affected by the transformation of the automotive industry, and Bremen (Germany), which was heavily dependent on the naval industry. Another example is the Basque country in Spain, which underwent an initial transformation in the 1980s and is pursuing a new diversification strategy today. Such

regions need first to recognise the relevance of transformation and identify a new frontier. The second step is to identify possible levers for transformation, such as: attracting high-skilled labour; fostering productive use of regional traditions and knowledge; and identifying potential partnerships in national strategies, among many others.

Catching up and creating a regional knowledge base

The most challenging strategies concern regions that lag behind in income per capita, productivity growth and employment generation. A significant number of OECD regions need to formulate a strategy to catch up and to create knowledge-based capabilities. They do not currently operate in a science-and-technology-driven model of growth. Almost all advanced countries include lagging regions that need to raise standards of living and quality of life as well as improve the provision of services. These regions suffer from the absence of high value-added economic activities and a general lack of infrastructure and relevant services. However, there are interesting examples of catching up that have been observed over time. Korea's regions have made rapid progress in the aggregate productivity of manufacturing. In less than 30 years, many of its regions formerly less advanced than those in Latin America have already surpassed those levels to be among the global technology leaders. Other regional competitive advantages beyond resource-intensive science investments may also be used to create knowledge-based capabilities.

Strategic choices require a "smart" mix of policy instruments

The policy mix of instruments should correspond to the objectives of the strategy. The balance between various types of instruments should be adapted to those strategic objectives. The interaction across instruments and different policy fields is also relevant. Synergies between policy instruments need to be encouraged while avoiding policies that conflict with each other's goals. Policy fields may include science and technology but also entrepreneurship and education policies, among others. The challenge is that not all these instruments and policy areas come from one place; they originate in different ministries and levels of government. Therefore, a successful innovation policy mix is not solely determined by the quality of the design and implementation of each component individually, but also the synergies achieved between the different components in a particular place.

Policy instruments may target knowledge generation, diffusion or exploitation, or multiple objectives simultaneously. Knowledge generation includes the specific incentives and regulations for the production of scientific and technological knowledge, including mechanisms to attract talent, and specific incentives for supporting R&D activities in firms. In general, regional action tends to focus on instruments that support knowledge diffusion and take agglomeration effects and proximity into consideration. Many regions are also active in knowledge exploitation, which includes measures directed towards the demand side of innovation, in support of the application of existing knowledge into new products and services. Technological extension services, business development support and human capital development are some of the traditional mechanisms used to encourage innovative business practices.

Accordingly, the new generation of innovation-policy instruments tends to reflect a more systemic approach to innovation. This new approach seeks to minimise boundaries between generation, diffusion and exploitation by offering a mix of support that bundles instruments for all three phases. This approach internalises the potential policy conflict

across different sectoral policies. For example, the new generation of science and technology parks, in addition to their emphasis on knowledge diffusion between different agents, tends to offer complex services intended to encourage both knowledge generation and exploitation. Policy packages to support high-tech start-up firms could combine physical facilities, financial support, mentoring and coaching services, training, services for intellectual property management, access to research facilities, and linkages to technology platforms or networks. The impact of a more systemic approach to the role, missions and profile of regional innovation agencies established in many OECD regions is another sign of this new approach.

There are different tools for effectiveness of public action to leverage private efforts

Instruments are used at multiple levels of government

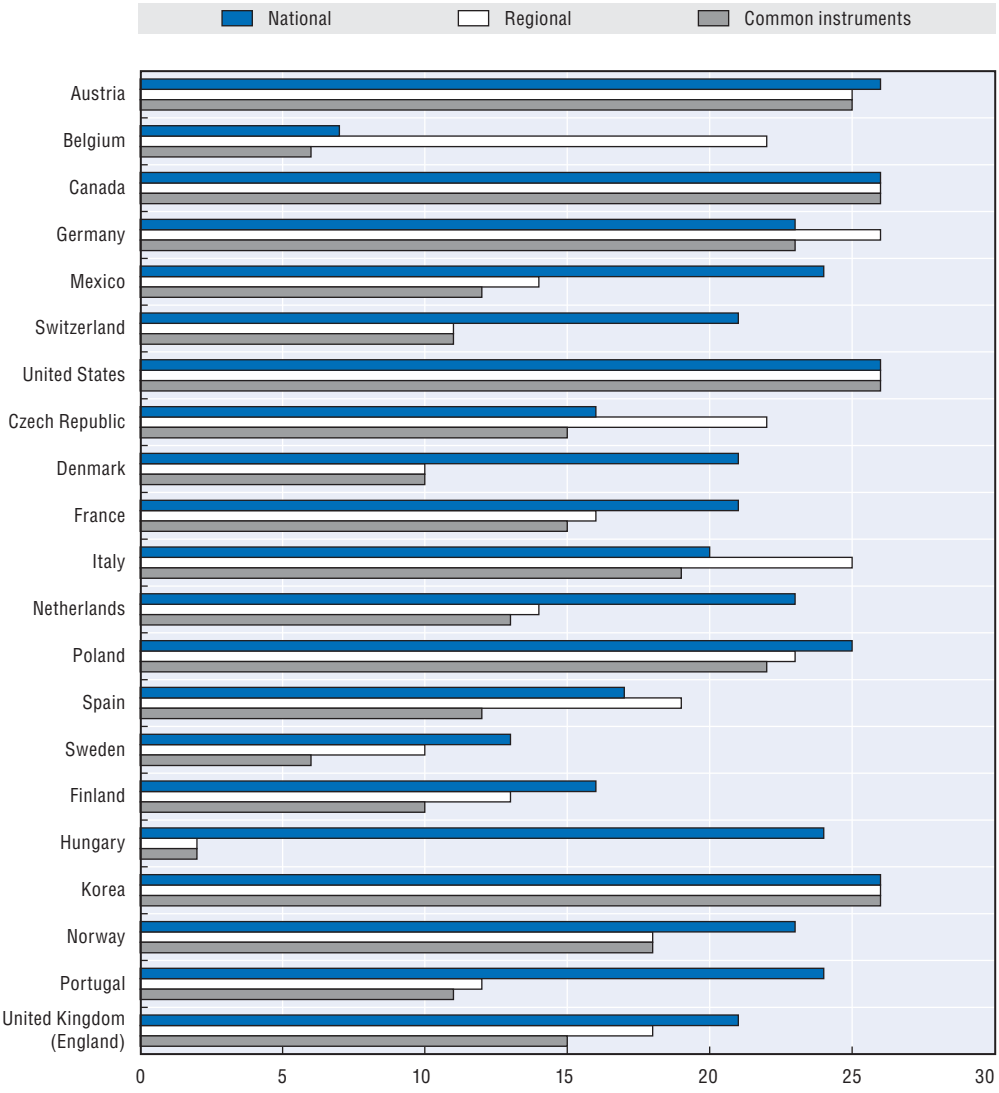
Innovation systems require multiple prerequisite conditions that both national and regional policies influence. National governments are more active than regional governments in certain innovation policy instruments, as reported by member countries in a 2009 OECD survey. Scholarships for postgraduate studies and R&D investment support are areas where national governments are much more active, notably for public subsidies to private R&D (almost twice as common) or tax credits for private R&D (more than three times as frequent). Promotion of scientific co-operation is also more commonly a role of national governments, but nevertheless more than half of the reporting countries also use this instrument at the regional level. Financing via public development banks, public venture capital funds and guarantees are also more common at the national level relative to the regional level.

But certain STI instruments are as common or more so at the regional level. For high-level strategic bodies and technology-foresight exercises, regions are almost as active as national governments. Regions are also financing R&D in public entities, but to a somewhat lesser extent in private entities. Technology transfer activities and innovation advisory services are promoted by regions in most reporting OECD countries. Programmes to support clusters and excellence hubs are frequently used at both levels, but more so at the regional than national level. Incubators and science and technology parks are also more common at the regional (and local) level.

As a consequence, many of the "same" instruments are used by more than one level of government in the same country, as there is not always a strict division of labour. Country structure does not fully determine the number of instruments at the regional level or the share in common with the national level (Figure 4.4). Austria, Canada, Korea and the United States, for example, report that both national and regional governments use not only many instruments, but also the same types of instruments. Countries with a fewer number of instruments at the regional level, such as Denmark or Sweden, nevertheless show that all or almost all of those instruments are also used at the national level. In the case of Belgium, where the national level uses fewer instruments than the regional level, several instruments are in common, such as R&D funding and scholarships.

With sharing of roles across governments, the challenge is ensuring that there is complementarity and not wasteful redundancy. Some redundancy across levels is difficult to avoid and may reinforce system stability. When there appears to be duplication of instruments, it may be for a good reason – such as different target actors or co-financing by different levels of government. For example, at the regional level, innovation-support

Figure 4.4. **Number of science, technology and innovation policy instruments used by national and regional governments, 2009**



Notes: National refers to the number of instruments used at national level, regardless of whether they are used at other levels. Regional refers to instruments reported at regional level, regardless of whether they are used at other levels. Common instruments refer to the number of instruments reported at both national and regional level, which includes those instruments reported in the tally of national and regional instruments.

Source: OECD (2011), *Regions and Innovation Policy*, OECD Reviews of Regional Innovation, OECD Publishing, *http://dx.doi.org/10.1787/9789264097803-en*.

StatLink http://dx.doi.org/10.1787/888932520745

services are often targeted to small and medium-sized enterprises (SMEs) that are not in high-tech sectors, while national-level innovation support services are more often intended for high-tech sectors. Excessive redundancy of instruments can be attributed to: a lack of awareness of the instruments developed at another level of government; a failure to distinguish between target groups; and excessive complexity preventing the intended beneficiaries of the policy instrument (*i.e.* firms, research institutions, etc.) from understanding the public offer of support. Instruments at one level may also be developed to address problems created by policy from another level.

A number of challenges in STI policy result from these multi-level governance arrangements, such as whether a regional asset is of national significance. National policies determine significant STI resource flows to actors in regions. Regions are orienting their strategies, at least in part, towards national and supranational objectives for recognition and accompanying resources. The fact that many regions prioritise the same sectors is in part a response to objectives and funding flows from higher levels of government, even if it is not possible for all regions to be strong in the same sectors. Calls for proposals and other competitions to recognise or give a label to regional strengths are one common tool. For example, France's competitiveness poles programme labelled certain clusters of international significance (and hence a priority for the national government) and national significance (a priority for the region). Other examples include the Networks of Competence (Germany), VINNVÄXT clusters (Sweden), or knowledge clusters/industrial clusters (Japan). Such designations also serve to align resources across levels of government around common objectives.

Regions need to map disparate financing sources behind a coherent strategy. Funding for STI-related activities may come from different levels (local, regional, national and supra-national) as well as different sectoral ministries at the same level (science and research, industry and enterprise, regional development, education). Many regions therefore try to fill the gap when resource flows from other levels are not sufficient. Regions with little independent resources or STI policy competences are more dependent on the different national or supranational programme funds. Regions need to pool together the different programmes and instruments into this multi-level policy mix.

Once the particular multi-level governance problem has been diagnosed, there are different co-ordination mechanisms that can help, and countries use many simultaneously. Such mechanisms include dialogue, consultation, contracts, project co-financing, regional development agencies, and national territorial representatives, among others. Almost all countries report using four or more of these tools. One lesson that emerges most clearly from country feedback is that regular dialogue and consultation are generally considered to be the most effective tools for co-ordination in a multi-level governance context. Dialogue can build relationships as well as promote information sharing. It can shed light on the most relevant regional actors in the private and academic sectors, as well as in the public sector, that can be mobilised for improving not only regional, but national performance.

Bringing private actors to the centre of the policy process

Public investment is designed to leverage private sector investment, in the long term if not the short term. A wide range of civil society actors are relevant given the broader approach to innovation, including scientists, academics, training institutions, and labour groups. Studies have shown that when firms are active in the strategy process, regions are better able to address problems as they arise or to increase the utilisation of policy instruments relevant for innovation. The increasingly networked nature of innovation is another rationale to engage a more diverse group of stakeholders for strategy development. The private sector is generally more aware of the global trends and market conditions that will influence their innovation-related investments. Universities and research centres are more attuned to the areas of promise for basic research breakthroughs. And for application of innovation to other areas of public service, civil society at large can play a lead advisory role.

Different institutional forms are used to solicit this private sector and civil society engagement, but there are barriers and risks to bear in mind. In some cases, regional development agencies or regional innovation agencies are by statute entities with a board of directors that includes public and private actors. The same is true of many regional advisory councils, such as the Science and Industry Councils in UK regions or the Growth Fora in Danish regions. There are often a limited number of tireless regional champions who participate in publicly led committees. However, getting fresh perspectives is often more difficult, as is involving SMEs who have more limited time. Business-driven committees have proven more focused on outcomes, as noted in a US-based study. There is also a lack of public sector capacity in providing the right strategic intelligence to such committees. The risks associated with excessive influence of a particular interest group on regional strategies or policies call for balance in the mix of public and private perspectives represented.

Fostering policy learning through better metrics, evaluation and experimentation

New approaches to innovation and metrics to evaluate innovation policies are required to support strategic policy intelligence. Outcome-oriented evaluations require systemic approaches and not simply use-of-funds type audits. Traditional evaluations in the STI field measure the level of outputs (such as new R&D investments, patents and publications), rather than outcomes. Measuring the impact of a change in behaviour of firms serves to inform policy as to its true impact. A narrow view of innovation is reinforced by this lack of metrics. The OECD Innovation Strategy stresses the need to improve the quality of existing metrics and increase the availability of indicators to measure innovation factors that are either not at present measured or whose strategic importance has been underestimated (especially investments in intangible assets). New data, indicators and models for the regional level are needed, in particular for non-R&D-based innovation.

Finally, regions can be relevant laboratories for policy, but this implies a certain tolerance for failure. The diversity of regional situations and the unpredictability of the innovation process generate the need for a certain degree of pragmatic policy experimentation. This requires adequate internal resources (administrative capacity, human resources, political commitment) and external connections to national and international policy-learning networks. Feasibility studies, demonstration and assessment of the impact of new policies or policy mixes can then be made available for adoption by other regions or by higher levels of government.

Regions can and should be agents of change

While regional development paths depend on the past, there are also opportunities to change course. Innovation generation is neither linear nor predetermined, and is subject to uncertainty. Historical accidents, human genius, and long-term concerted action may all support changing regional development paths. A vision for a region's well-being is best grounded in a keen appreciation of its strengths and weaknesses. Regional governments can therefore recognise these opportunities for change and mobilise people as well as public and private resources towards these new goals.

To avoid many common traps, regions need to think global and avoid unproductive forms of competition. Firm co-operation in innovation and S&T networks, extend well beyond regional or even national borders. Even in the largest OECD regions, it is highly unlikely that innovation drivers, barriers and opportunities can be encompassed within

regional administrative boundaries. The globalisation of economic activity, the need to connect to wider knowledge networks and the internationalisation imperative of companies should be recognised in regional strategy documents. In addition, the benefits from public investment for innovation leak across regional boundaries. However, regional innovation policies mostly deploy their tools in the restricted space of administrative regions, rather than functional regions across administrative borders. Policies are implemented "in" regions rather than "for" regions. The answer is to adapt policies to functional regions, beyond administrative borders.

Notes

1. The OECD Innovation Strategy is an OECD-wide initiative requested by member governments to provide policy guidance on boosting innovation performance. The first set of core reports was presented at the OECD Ministerial Meeting in May 2010 and additional research continues. For further information, see *www.oecd.org/innovation/strategy*.
2. A regional connection in this analysis includes at least one co-patent between two regions on average during the three-year period. Region-to-region connections not meeting this threshold were excluded.
3. "Green" patents for this analysis include waste management, air and water pollution reduction, renewable energies, hybrid/electric car technologies and energy efficiency in lighting and building.

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