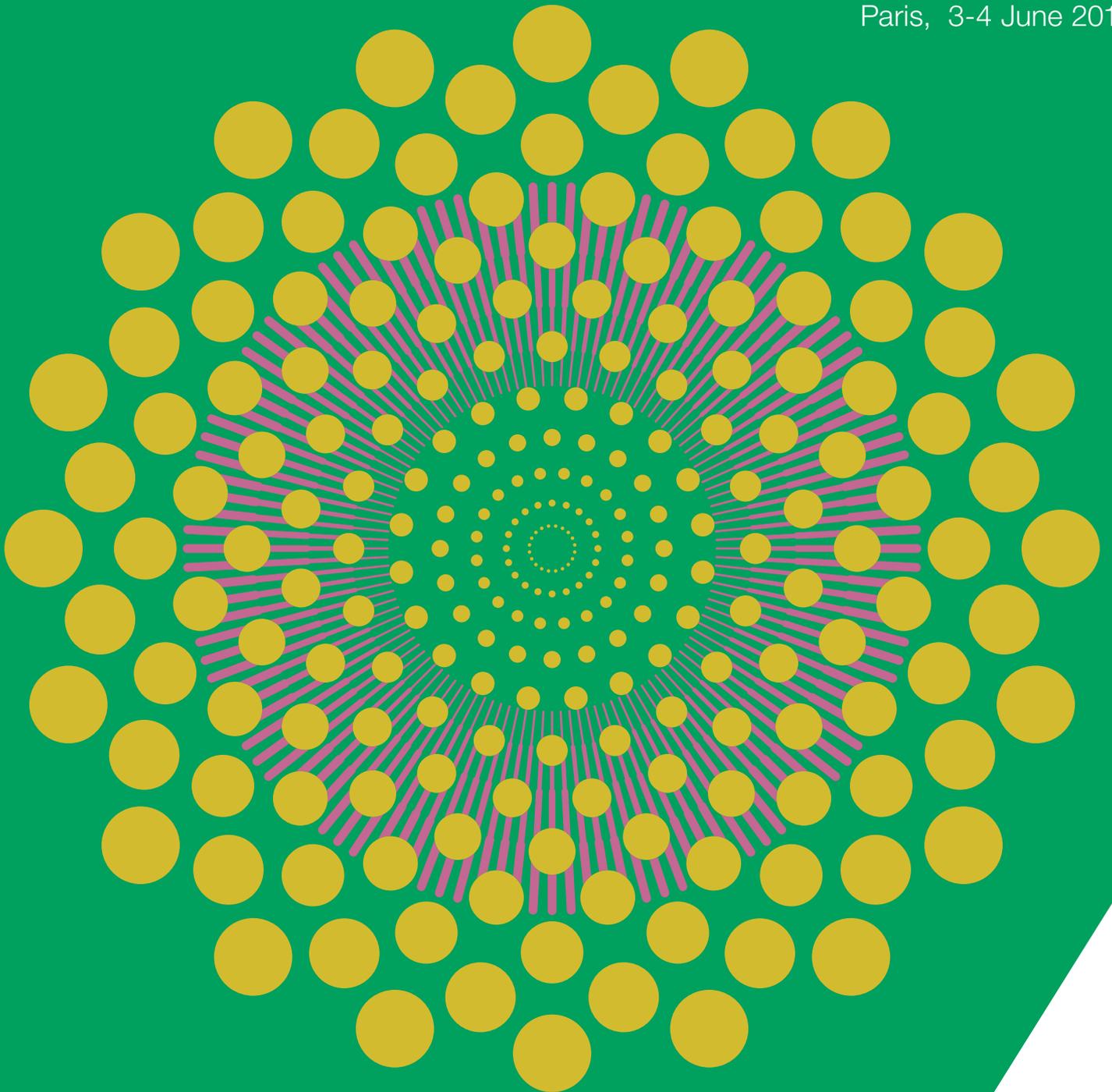


Meeting of the OECD Council at Ministerial Level

Paris, 3-4 June 2015



OECD INNOVATION STRATEGY 2015 AN AGENDA FOR POLICY ACTION

OECD Innovation Strategy 2015

An Agenda for Policy Action



1. The OECD released the Innovation Strategy in 2010. The Strategy was one of the first dedicated horizontal projects in the OECD. Since its launch, it has been well received and affected policy developments in many countries. In his 2013 Strategic Orientations, the Secretary-General pointed to the need to revisit and update the Innovation Strategy and the 2014 OECD Ministerial Council Meeting (MCM) signalled the importance of carrying out such update.

2. The 2015 version of the OECD Innovation Strategy was co-ordinated by STI and draws on the work of 14 OECD Directorates that contributed in areas such as green innovation (ENV, IEA, NEA, STD and STI), public sector innovation (GOV, EDU and STI), health innovation (ELS and STI), inclusive innovation (STI, STD, GOV and EDU), agricultural innovation (TAD), country-specific innovation policies (STI, DEV and ECO), as well as issues such as governance and risk governance (GOV, ENV and STI), skills (EDU, ELS, CFE, ECO and STI), business environment (ECO, DAF, TAD, CFE and STI), knowledge creation and diffusion (STI) and specific innovation policies (CFE, CTPA, GOV and STI). The OECD Committee for Scientific and Technological Policy (CSTP) and the Committee on Industry, Innovation and Entrepreneurship (CIIE) took the lead in developing this update, with other OECD Committees providing substantive input in their respective areas of competence. A synthesis of the work is being delivered to the 2015 MCM, and a longer version of the report will be presented at the meeting of the CSTP at Ministerial level, to be held in Daejeon, Korea, in October 2015.

Executive Summary

3. New sources of growth are urgently needed to help the world move to a stronger, more inclusive and sustainable growth path following the financial crisis. Innovation – which involves the creation and diffusion of new products, processes and methods – can be a critical part of the solution. While not a goal in itself, innovation provides the foundation for new businesses, new jobs and productivity growth and is thus an important driver of economic growth and development. Innovation can help address pressing social and global challenges, including demographic shifts, resource scarcity and the changing climate. Moreover, innovation can help address these challenges at the lowest cost. Innovative economies are more productive, more resilient, more adaptable to change and better able to support higher living standards.

4. Governments play a key role in fostering a sound environment for innovation, in investing in the foundations for innovation, in helping overcome certain barriers to innovation, and in ensuring that innovation contributes to key goals of public policy. The OECD Innovation Strategy 2015 sets out a concrete agenda to strengthen innovation performance and put it to use for stronger, greener and more inclusive growth. The Strategy sets out 5 priorities for policy makers that together provide the basis for a comprehensive and action-oriented approach to innovation, much of which can also be applied in the context of fiscally constrained economies. These priorities are:

- 1. Strengthen investment in innovation and foster business dynamism*
- 2. Invest in and shape an efficient system of knowledge creation and diffusion*
- 3. Seize the benefits of the digital economy*
- 4. Foster talent and skills and optimise their use*
- 5. Improve the governance and implementation of policies for innovation*

5. Implementing an effective government strategy for innovation is particularly important as key trends – the spread of global value chains, the increasing importance and mainstreaming of knowledge-based capital (KBC), and rapid technological progress, including the rise of the digital economy – are

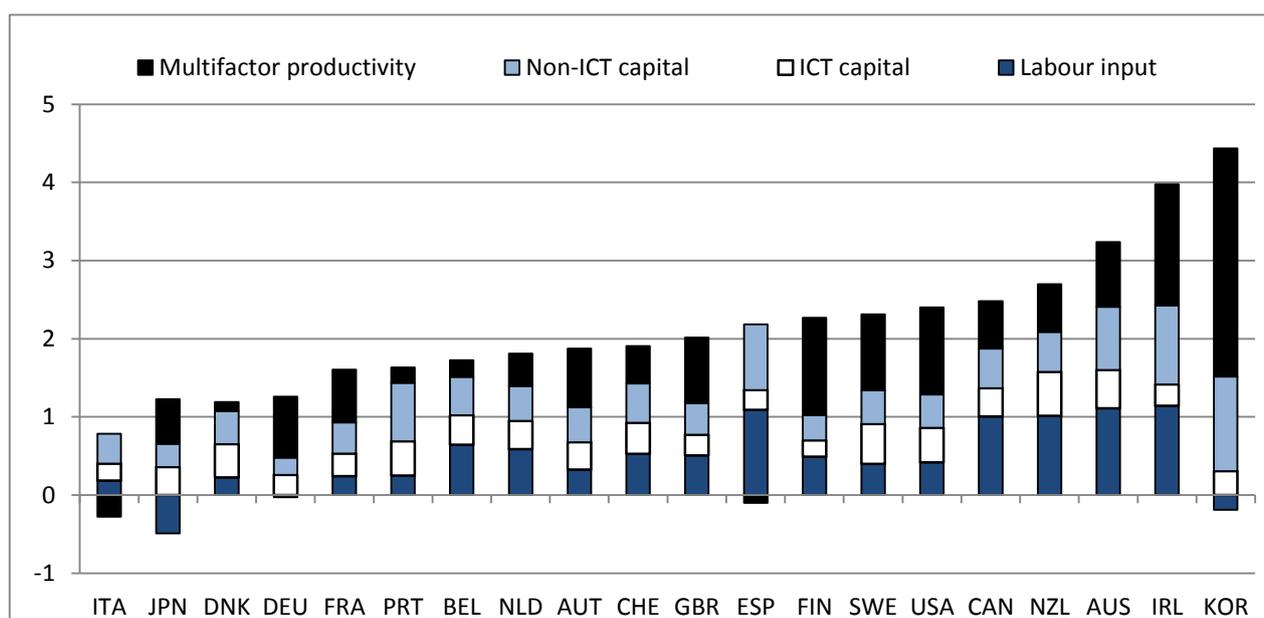
leading to the emergence of a “next production revolution” (OECD, 2015a). In the current context of a weak global recovery, business and policy leaders need to take advantage of these trends to accelerate structural shifts towards a stronger and more sustainable economic future that creates new jobs and opportunities. The remainder of this paper briefly sets out the broader context for innovation and elaborates on the five priorities for policy action.

Why innovation?

6. Innovation underpins the growth and dynamism of all economies. In many OECD countries, firms now invest as much in the knowledge-based assets that drive innovation, such as software, databases, research and development (R&D), firm-specific skills and organisational capital, as they do in physical capital, such as machinery, equipment or buildings. Moreover, billions of people around the world, including in emerging economies, today have access to the Internet and are connected to one another, enabling knowledge diffusion and the creation of further innovations. The proliferation of massive amounts of data (such as geolocation data from mobile phones) is just a hint of what can be expected from the emergence of ubiquitous data generation and computing characterised as the “Internet of Things”. These, and other technological changes in fields like bio- and nano-technology and the associated advanced materials, will lead to ongoing transformations in the nature of production, jobs, the location of economic activity, and the respective roles of different sectors in the economy (OECD, 2015a).

Figure 1. Contributions to GDP growth

Total economy, annual percentage point contribution, 1995-2013



Source: OECD (2015b), OECD Compendium of Productivity Indicators, 2015, based on OECD Productivity Database, January 2015.

7. Such technological changes and related non-technological innovations are an important driver of growth. Empirical analysis shows that innovation, in its various forms, contributes to growth through several channels:

- A contribution resulting from *technological progress embodied in physical capital*. The latest OECD estimates show that about 0.35 percentage points of annual average GDP growth between 1995 and 2013 can be attributed to investment in information and communications technology (ICT) capital alone [Figure 1; OECD, 2015b].

- A contribution resulting from *investment in KBC*, such as R&D, design and other intellectual property, data, firm-specific skills or organisational capital. Recent analysis by Corrado, et al. (2012) found that business investment in KBC accounted for around 0.5 percentage points of annual average GDP growth in EU countries from 1995 to 2007, and 0.9 percentage points in the United States.
- A contribution linked to *increased multi-factor productivity growth*, reflecting increased efficiency in the use of labour and capital, a substantial part of which can be attributed to innovation, including process and organisational innovations. Multi-factor productivity accounted for over 0.7 percentage points of annual average GDP growth between 1995 and 2013 in the countries shown in Figure 1, or about one-third of total GDP growth (OECD, 2015b).
- A contribution resulting from the *creative destruction* that results from innovation, as new firms enter the market, sometimes growing quickly and thus increasing their market share, replacing other firms with low productivity (Andrews and Criscuolo, 2013). Recent OECD work shows how important the resulting reallocation of resources is for driving aggregate productivity growth (OECD, 2015c).

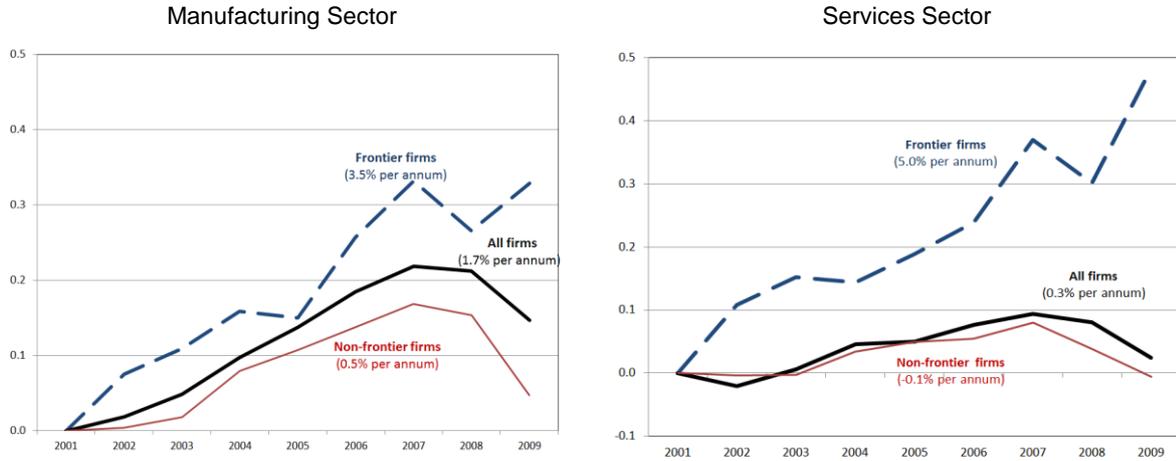
8. Together, these elements can account for a substantial share of economic growth – often around 50% of total GDP growth – depending on the country, the level of economic development and the phase of the economic cycle. Indeed, in the long run, it is difficult to imagine growth without innovation, as it would have to be based mostly on the accumulation of factor inputs, *i.e.* more labour (even if this might involve more qualified labour) or more of the same physical capital.

9. Innovation is particularly important for future growth (Braconier, et al, 2014). Studies of long-term economic development across countries show that multi-factor productivity growth typically becomes a more important driver of growth in relative terms as countries exhaust some of the possibilities for productive investment in tangible capital and as their population ages. Already in many OECD countries and some emerging economies, the contribution of labour input to growth has diminished as a factor of production, as the labour force has started to decline. Moreover, the rate of increase in the human capital stock is expected to slow in the future (OECD, 2015c). For these reasons, many OECD countries are increasingly emphasising innovation-led productivity as the main source of future growth.

10. New OECD work on productivity demonstrates that, despite a slowing in aggregate productivity over the 2000s, productivity growth for firms at the “global productivity frontier” has remained relatively robust (Figure 2), with productivity increasing at an average annual rate of 3.5 per cent in the manufacturing sector, compared to an average growth in labour productivity of just 0.5 per cent for non-frontier firms. The contrast was even greater for firms in the services sector.

Figure 2. Solid growth at the global productivity frontier but spillovers have slowed down

Labour productivity; index 2001=0



Note: "Frontier firms" corresponds to the average labour productivity of the 100 globally most productive firms in each 2-digit sector in the ORBIS database. "Non-frontier firms" is the average of all other firms. "All firms" is the sector total from the OECD Structural Analysis (STAN) database.

Source: OECD (2015c).

11. The strong performance of the global frontier firms is linked to the fact that these firms are typically larger, more profitable, and more likely to patent than other firms. Moreover, they are on average younger, consistent with the idea that young firms possess a comparative advantage in commercialising more radical innovations. They also tend to be large trans-national corporations. These features hint strongly at the importance for these firms of investing in knowledge-based capital and of harnessing competencies across the globe into their value chains. However, the OECD work also shows that the average age of firms at the global frontier is increasing. This may foreshadow a future slowing of growth rates in these firms, bringing into focus the policy factors that shape their performance, such as investment in basic research, intellectual property regimes and other policies that shape productivity at the frontier.

12. Perhaps more important though, is the rising gap in productivity growth between firms at the global frontier and other firms. This has two dimensions: *i*) the extent to which the most productive firms in different countries are able to benefit from advances of those firms at the global frontier; and *ii*) the extent to which lagging firms within all countries are able to benefit from the advances of frontier firms within their domestic economy. In policy terms, the first dimension is largely a function of openness, with exposure to international trade and foreign direct investment and integration in global value chains (GVCs) being key factors allowing firms to benefit from the global frontier. However, this is complicated by the importance of tacit knowledge, which may be less easily absorbed through trade and investment flows. The second dimension is determined in large part by the capacity and incentives for the most dynamic firms in an economy to upscale, and the ease with which resources are reallocated away from less productive firms.

13. While innovation is often mainly a focus of government policies aimed at strengthening productivity and growth, it is also important to support green and inclusive growth and to address global and social challenges more generally. For example, innovation can help to decouple growth from natural capital depletion and make alternative sources of energy and raw materials cheaper and more sustainable. Innovation and the related process of creative destruction lead to new technologies, entrepreneurs and business models, contributing to the establishment of new markets and eventually to the creation of new jobs. Innovation is therefore a key in enabling "green" and "growth" to go hand-in-hand. Areas like

electric and hybrid vehicles as well as renewable energy have seen particularly strong growth in innovation over the past decade.

14. Moreover, as a key driver of productivity growth, innovation leads to value creation that generates the rewards for human, physical and knowledge-based capital. This value creation increases aggregate incomes and has a positive impact on overall living standards. Innovation may contribute to growing income inequality, however, but provided those at the bottom of the income distribution also see significant increases in incomes and well-being, and that appropriate redistributive policies are enacted, these concerns can be alleviated. For example, the growth of the People's Republic of China (China) over the past few decades has lifted millions of people out of poverty, although it was accompanied by an increase in measured inequality.

Innovation today

15. Harnessing innovation requires policies that reflect the realities of innovation as it occurs today. Some of the main features of innovation today include:

- A scope beyond science and technology, involving investments in a wide range of knowledge-based assets that extend beyond R&D. Social and organisational innovations, including new business models, are increasingly important to complement technological innovation.
- Involvement of a wide and expanding range of actors, including firms, entrepreneurs, foundations and non-profit organisations, universities, scientific institutes, public sector agencies, citizens and consumers, often working in close collaboration.
- A strong and ever-expanding basis in the digital economy, facilitated by the growth of mobile telecommunications, the convergence of voice, video and data to the Internet and the rapid uptake of data and sensors (the Internet of Things), in both advanced and emerging economies.
- A growing role of emerging economies, in particular China, which recently passed the European Union in becoming the second largest funder of R&D behind the United States.
- An increasingly global context, with innovation drawing on knowledge and ideas from across the world, though still often rooted in unique local and regional strengths. Production is increasingly occurring in value chains where both production and innovation are fragmented across countries.
- The joining of some of these features – the spread of global value chains, the increasing importance and mainstreaming of knowledge-based capital (KBC), and rapid technological progress, including the rise of the digital economy – that are leading to the emergence of a “next production revolution” (OECD, 2015a). This will not only lead to transformations in the nature of production, but also in the jobs associated with that production, their location in GVCs, their environmental impact, and the respective roles of manufacturing and services in the economy.
- Growing demands on innovation, not only to support growth and job creation, and the efficient delivery of public services, but also to address specific social and global challenges, including green growth, health, food security and the fight against poverty.

Policies for innovation

16. A range of policies affect the various drivers of innovation. Getting the policy mix right can help governments in shaping and strengthening the contribution that innovation makes to economic performance and social welfare. These *policies for innovation* are much broader than the policies that are often seen as “innovation policies” in a narrow sense – such as policies to support business R&D, financing for risk capital, etc. These policies for innovation need to be focused on enhancing the

performance of the system as a whole, as weak links in the system will hinder its performance. The priority assigned to different elements will depend on the nature and state of their system of innovation: one size clearly does not fit all. OECD analysis suggests that innovation thrives in an environment characterised by the following features, all of which are explored in detail in the OECD Innovation Strategy 2015:

- *A skilled workforce* that can generate new ideas and technologies, bring them to the market and implement them in the workplace, and that is able to adapt to technological and structural changes across society.
- A sound *business environment* that encourages investment in technology and in knowledge-based capital, that enables innovative firms to experiment with new ideas, technologies and business models, and that helps them to grow, increase their market share and reach scale.
- *A strong and efficient system for knowledge creation and diffusion*, that invests in the systematic pursuit of fundamental knowledge, and that diffuses this knowledge throughout society through a range of mechanisms, including human resources, technology transfer and the establishment of knowledge markets.
- *Policies that encourage innovation and entrepreneurial activity*. More specific innovation policies are often needed to tackle a range of barriers to innovation. Many of these actions include policies at the regional or local level. Moreover, well-informed, engaged and skilled consumers are increasingly important for innovation.
- *A strong focus on governance and implementation*. The impact of policies for innovation depends heavily on their governance and implementation, including the trust in government action and the commitment to learn from experience. Evaluation of policies needs to be embedded into the process, and should not be an afterthought.

Priorities for policy action

17. In the current context of slow growth and pressing social challenges, five priorities emerge as being particularly important from this broad toolbox of policies for innovation.

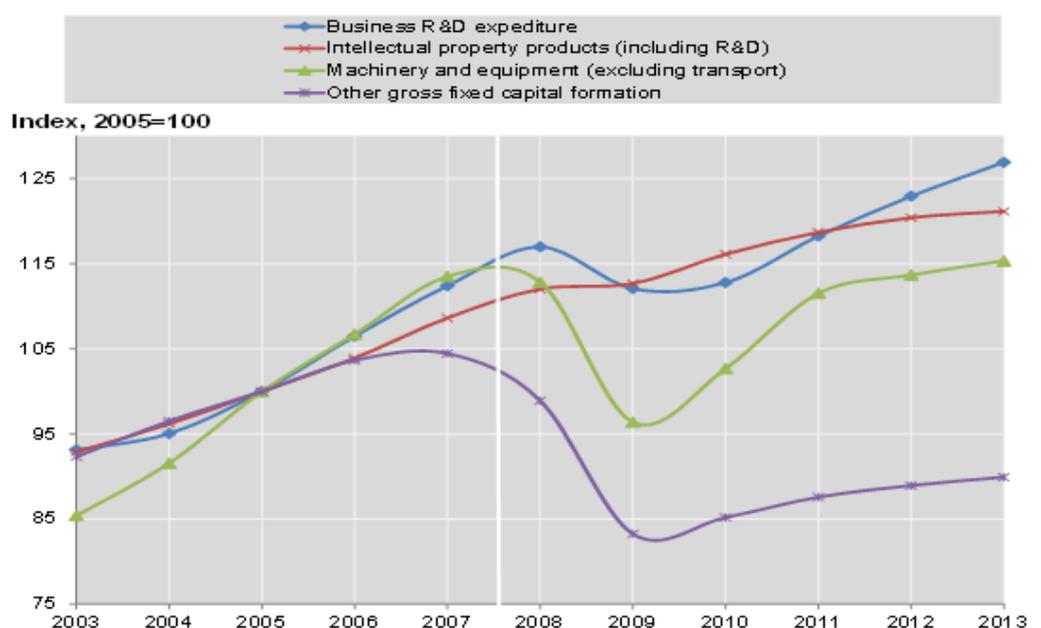
Priority 1: Strengthen investment in innovation and foster business dynamism

18. Strengthening investment is rightly a high priority for policy. In the context of innovation, it is important to note that much business investment today is no longer in physical equipment or buildings – a large share (often more than half) is in KBC. While such investments have grown less rapidly over the crisis years (OECD, 2015a), they have been more resilient than investment in fixed capital (Figure 3).

19. Structural reforms in product, labour, and financial markets are important to get the most out of investment in KBC, by enabling resources – capital and labour – to flow to the most productive, often KBC-intensive, firms, enabling them to achieve a sufficient scale, which can also enable them to enter international markets (Figure 4). This requires that resources can be easily reallocated to their most productive uses. Well-functioning product, labour and risk capital markets as well as policies that do not trap resources in inefficient firms – including bankruptcy laws that do not excessively penalise failure – are central. Open markets and competition are particularly important to diffuse innovations, including to lagging firms. Rising participation in global value chains (GVCs) magnifies the benefits from lifting barriers to international trade and from easing services regulation, given the multiple crossing of borders involved in GVC production and the increasing reliance of GVCs on domestic services.

Figure 3. Investment in knowledge-based capital

Business investment in knowledge assets weathered the crisis better and recovered earlier (Index, 2005=100)



Source: OECD (2015a), Main Science and Technology Indicators, January 2015, OECD National Accounts Database, March 2015, based on OECD (2014e), OECD STI Outlook 2014, Paris (www.oecd.org/sti/outlook)..

20. Policies in OECD countries often also implicitly or explicitly favour incumbents, and do not always enable the experimentation with new ideas, technologies and business models that underpins the success of innovative firms, be they large or small. Subsidies to incumbents and other policy measures that delay the exit of less productive firms can stifle competition and slow the reallocation of resources from less to more productive firms. Examples include fiscal measures that favour well-established firms – such as R&D tax credits which do not have carry forward provisions – or government support measures that are contributing to excess capacity in certain industries.

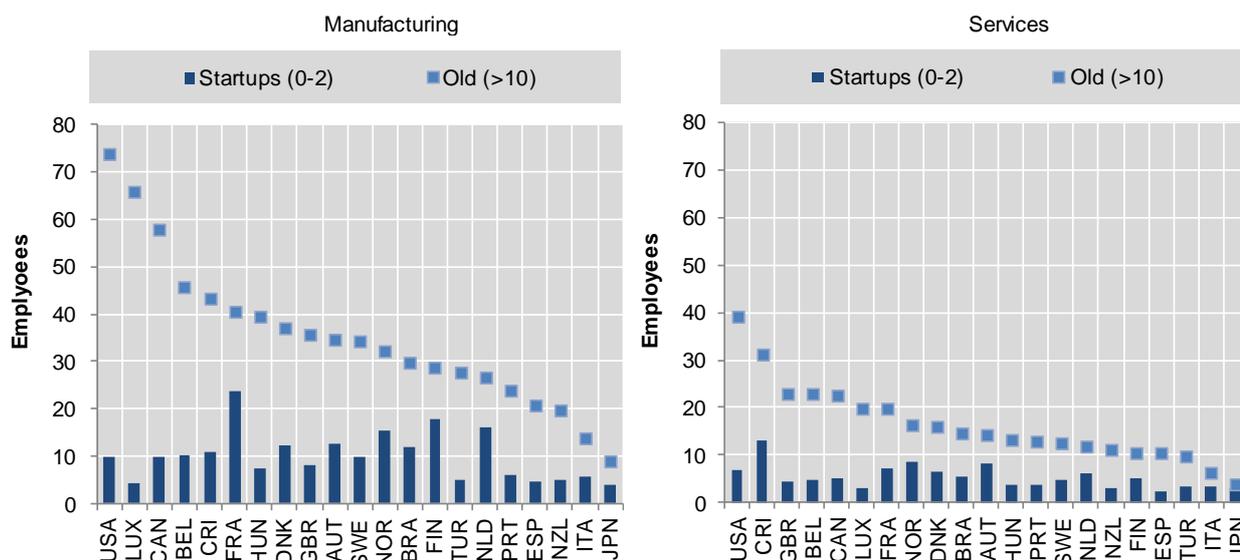
21. Young firms are also important for innovation and play a key role in employment creation, accounting for over 45% of all new jobs created in OECD countries over the past decade. Even if only some of these firms reach a large scale, they help drive renewal and creative destruction in the economy and support the growth of new and emerging areas. However, the average young firm does not scale very well in many OECD countries (Figure 4), and their small size limits their impact on innovation, the economy and society. Policies which (unwittingly) constrain the growth of firms should therefore be assessed with particular care. Examples include both regulations which only affect firms above a certain size, but also rewards, such as support mechanisms for which only smaller firms are eligible).

22. The growing importance of business investment in KBC also highlights the need for sound framework policies in other areas. For example, firms today rely on a wide range of IP rights to protect their investments in KBC, but existing IPR policies are not always well suited to the fast-changing nature of innovation today. Ensuring a well-functioning IPR system is therefore an important priority for policy. Policies that can help unlock the potential associated with big data have also grown in importance as business investment in this area has grown, as further discussed below.

23. Access to finance is another important challenge for innovative, KBC-intensive enterprises. External financing is especially important when innovative firms, particularly young firms, begin to grow. Strengthening seed and early-stage equity finance, including venture capital and angel investment, can

boost the creation and development of innovative ventures. Other mechanisms, such as public listings for SMEs, can provide financial resources for established growth-oriented firms. Along with efforts to boost the supply side of the equity market, demand-side initiatives – e.g. improving investment readiness and improving finance-related skills in new and small firms – should also receive policy attention. A further challenge is to implement policies that lever private resources and help to share risk with the private sector (such as through co-investment schemes for financing seed and early stage ventures).

Figure 4. The average size of start-ups and old firms



Note: The figure reports the average size of start-up firms (from 0 to 2 years old) and firms more than 10 years old, over the available years. See source for country-specific details.

Source: Criscuolo, Gal and Menon (2014) and OECD DynEmp Express Database, April 2015, www.oecd.org/sti/dynemp.htm.

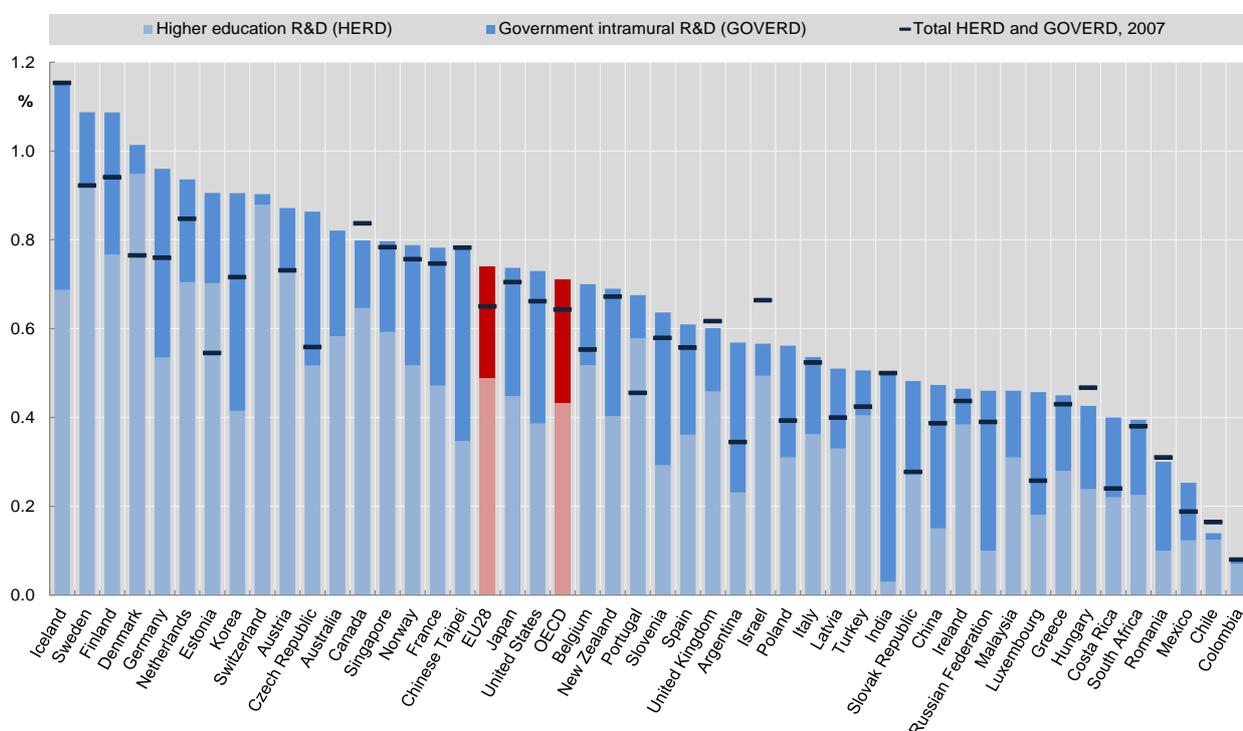
24. Policies aimed at encouraging investment in KBC should also consider the complementarities of public and private investments in these assets. Business investment in KBC goes hand-in-hand with well-designed public investment in areas that have high social returns, e.g. (especially basic) R&D, education and knowledge infrastructure (e.g. broadband networks). These are further discussed below.

Priority 2: Invest in and shape an efficient system of knowledge creation and diffusion

25. Government plays a critical role in providing some of the foundations for innovation. New OECD research shows that basic research, in particular, drives long-run productivity growth by enhancing the mobility of economies to learn from innovations at the global frontier (OECD, 2015c). Public funding is needed to address the inherent under-investment in basic research of private firms, linked to the large knowledge spillovers of such research. Long-term funding for curiosity-driven research must be preserved, as this has been the source of many significant innovations in the past and has high social returns, while project-based funding can allow for more direct steering of public research towards major public policy objectives, complementing private research spending. A long-term and stable perspective for public research funding is essential; focusing too much on short term results will put the future seeds of innovation at risk. While public budgets for R&D have held up reasonably well since the crisis (Figure 5), they are now declining in several countries (OECD, 2014a).

Figure 5. Public R&D expenditure by type of research system

HERD and GOVERD, as a percentage of GDP, 2012, and total HERD and GOVERD in 2007



Source: OECD Main Science and Technology Indicators Database, June 2014, www.oecd.org/sti/msti; Eurostat and UNESCO Institute of Statistics, June 2014.

26. The broader system of knowledge creation and diffusion is equally important for productivity growth; more intensive collaboration between firms and universities is associated with more diffusion of foreign technologies. To foster diffusion and encourage collaboration, policy makers should facilitate knowledge flows and foster the development of networks and markets which enable the efficient creation, circulation and diffusion of knowledge. Policies for commercialisation of public research should go beyond patents and licensing, however, and should also include public-private collaborative research, student and faculty mobility, contract research, faculty consulting and student entrepreneurship. A sound and an effective IPR system is important to foster knowledge creation and diffusion, as is a policy and regulatory environment that manages the risks associated with innovation and enables the responsible development of technologies and their convergence. This is particularly important in the context of the emerging next production revolution (OECD, 2015a).

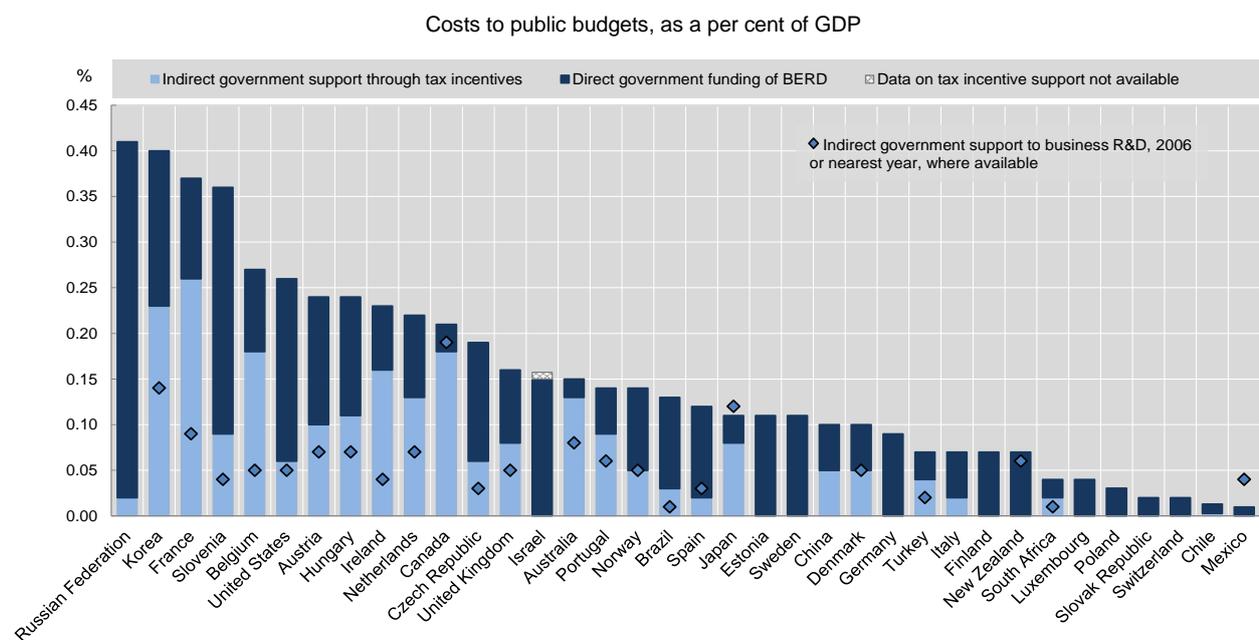
27. Rising international connectedness and the key role of multinational firms in driving frontier R&D imply that the benefits from public basic research and support to private R&D will become more widespread globally. This may weaken incentives for national governments to support these activities (Braconier, et al., 2014) while at the same time pushing them to compete to attract mobile investments by MNEs. Thus, global cooperation on research – *i.e.* joint funding and mechanisms to facilitate cross-border and cross-field collaboration – will become increasingly important. Developing effective science and technology initiatives at the global level requires responsive and adaptable modes of governance, combined with flexible funding and spending mechanisms.

28. In implementing specific innovation policies, governments continue to stimulate R&D either directly through contracts, grants and awards or indirectly through R&D tax credits. The former have declined since the crisis while the latter have grown in popularity. In both cases, governments must have an

eye to effectiveness. In designing such policies, a focus on high social returns and international good practices is essential. R&D tax incentives should be designed to also meet the needs of young, innovative firms and avoid amplifying cross-border tax planning opportunities. Young firms often have not yet generated taxable income, which may prevent them from using (non-refundable) R&D tax incentives. This may inhibit innovation and growth since such firms have particular strengths as R&D performers (e.g. in creating radical innovations) and job creators. Measures such as cash refunds, carry forwards, or the use of payroll withholding tax credits for R&D-related wages can address this problem.

29. Governments should also ensure that R&D tax incentive policies provide value for money and are relatively predictable for firms. In many countries, overall tax relief for business R&D may be greater than governments intended and this may be compounded by the rising generosity of tax relief for R&D over the past decade (Figure 6). The full costs of R&D tax incentives are not always transparent, since they are “off budget”. Governments should systematically evaluate tax relief measures to assess whether their targeting and design remain appropriate. Furthermore, OECD analysis also suggests that in countries that have experienced a large number of R&D tax policy reversals, the impact of such policies on private R&D expenditure is greatly diminished (Westmore, 2013). It is therefore important that governments do not repeatedly tinker with such policies to minimise policy uncertainty for firms.

Figure 6. Direct government funding of business R&D and tax incentives for R&D, 2012 and 2006



Source: OECD R&D Tax Incentive Indicators, www.oecd.org/sti/rd-tax-stats.htm and OECD, National Accounts and Main Science and Technology Indicators, 15 December 2014. Direct funding estimates for Brazil based on national sources.

30. Policymakers should balance indirect support for business R&D (fiscal incentives) with the use of direct support measures to foster innovation. Direct support measures – e.g. contracts, grants, awards for mission-oriented R&D or support for networks – can be particularly effective for young firms that lack the upfront funds or collateral to finance an innovative project. It is important, however, that any allocation of direct support is non-automatic and based on competitive, objective and transparent criteria. Moreover, selection processes must be designed to ensure efficiency (including minimal bureaucracy), avoid rent-seeking activities (especially by vested interests) and support challengers, e.g. young firms and more radical innovation. Non-financial support measures, e.g. training, mentoring and network development, including for SMEs, are an important component of the overall policy mix, as lack of funding is only one

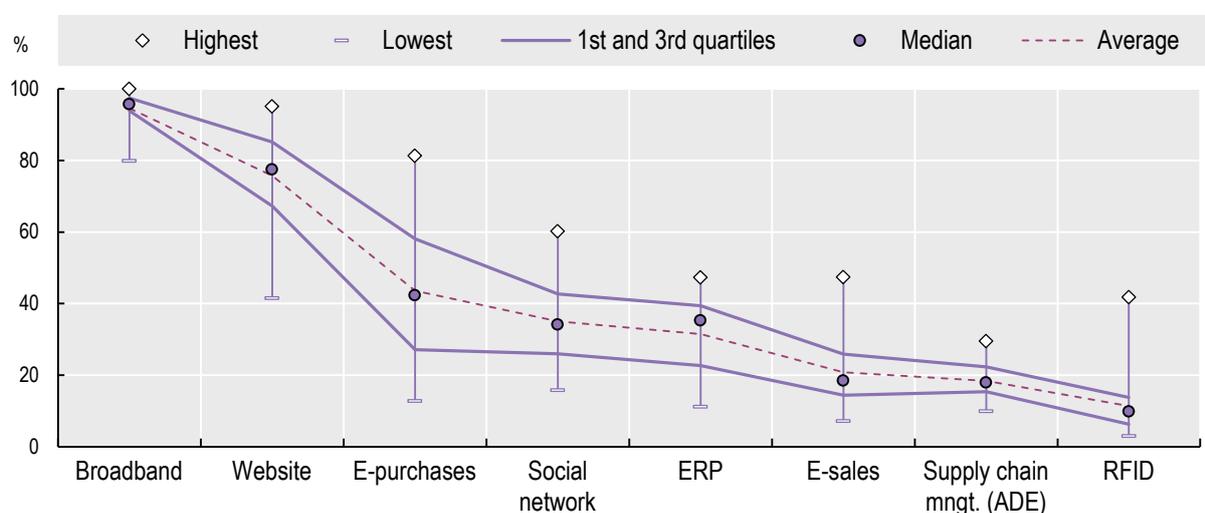
of the barriers that hold back innovation. Across all innovation policies, well-designed public-private partnerships are increasingly important, including at the local and regional level, and can help leverage government funding. Collaborations with new and emerging actors, such as private foundations, also require attention of policy makers.

Priority 3: Seize the benefits of the digital economy

31. Almost no business today is run without the help of ICTs. In 2014, almost 95% of enterprises in OECD had a broadband connection. However, only 21% of firms conduct e-sales and differences among countries in the use of various ICT technologies remain considerable (Figure 7). This is closely, but not exclusively, related to differences in the share of smaller firms across countries.

Figure 7. The diffusion of selected ICT tools and activities in enterprises, 2014

Percentage of enterprises with ten or more persons employed



Source: OECD (2015d, forthcoming), *Digital Economy Outlook 2015*, based on OECD, ICT Database; Eurostat, Information Society Statistics and national sources, March 2015.

32. The growing number of computer mediated transactions and the accelerating migration of social and economic activities to the Internet are contributing to the generation of a huge volume of (digital) data – commonly referred to as *big data*. Big data are now used by organisations, often in highly creative ways, to generate innovations in products, processes, organisational methods and markets.

33. An open and accessible Internet, with high fixed and mobile bandwidth, is essential for innovation in the 21st century. The Internet has become a platform for innovation thanks to its end-to-end connectivity and lack of gatekeepers, providing a place where creativity, the exchange of ideas, entrepreneurship and experimentation can flourish. Furthermore, an open Internet enables the management of global value chains (GVCs), in which companies increasingly spread production internationally.

34. While a source of important innovations, the use of big data brings major economic and societal challenges that governments need to address. These include:

- Fostering investments in broadband, smart infrastructure and the Internet of Things as well as in data and analytics with a strong focus on SMEs and high value added services.
- Promoting skills and competences in data analytics.

- Removing unnecessary barriers to the development of the Internet of Things, such as sector-specific regulations.

35. Governments also need to strike the right balance between the social benefits of openness and private preferences for a less open system. This implies addressing the following challenges:

- Preserving the open Internet and promoting the free flow of data across the global ecosystem.
- Addressing individuals' concerns about harms caused by privacy violations.
- Addressing concerns related to the appropriation of returns on investments in data-driven innovation.
- Assessing market concentration and barriers to competition.
- Promoting a culture of digital risk management across society.

Priority 4: Foster talent and skills and optimise their use

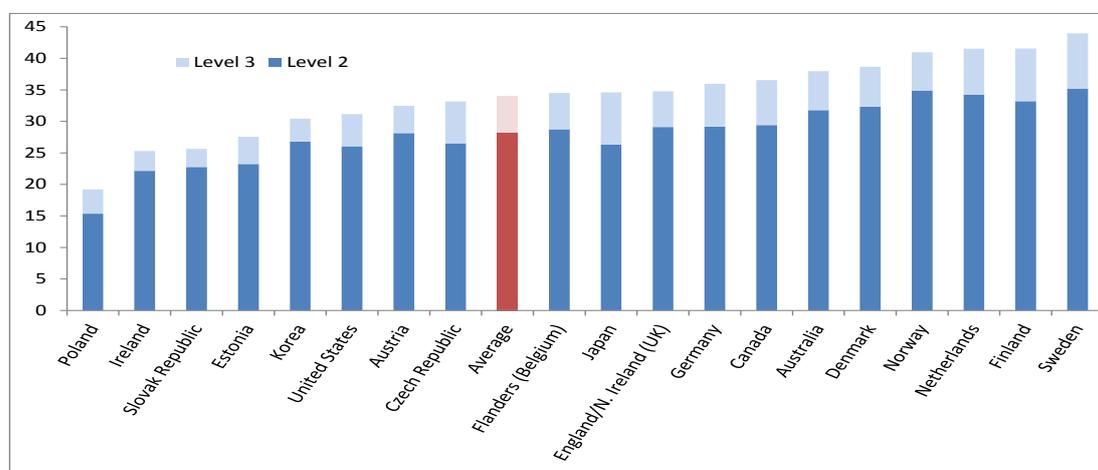
36. Education and training systems are core to innovation and productivity, including in realising the benefits of the next production revolution (OECD, 2015a). However, OECD assessments show that on average, only one-third of all adults have the skills necessary for a technology-rich environment (i.e. levels 2 or 3 in the OECD Survey of Adult Skills, see Figure 8). Many disciplines are relevant, as are broader competences such as creativity and critical thinking. A key principle should be the creation of an environment that enables individuals to choose and acquire appropriate skills and supports the optimal use of these skills at work (the OECD's *Skills Strategy* (OECD, 2013) sets out a comprehensive approach to develop skills and put them to best use in the economy).

37. Broad curricula, updated pedagogical practices and the development of tools to assess innovation-related skills are all important in initial education. Beyond subject-specific expertise, tertiary education should also develop students' creativity, critical thinking, entrepreneurship and communication skills. Doing so ultimately depends on pedagogical approaches and the design of curricula. Because rankings of higher education institutions often emphasise research, countries should also ensure that institutions have incentives to improve the quality and relevance of their teaching.

38. In the workplace, possible policy avenues to support firm-level training include improving information about training opportunities, setting legal frameworks so that private parties can organise and finance their training (e.g. through contracts), and increasing the portability of skills by improving information on the competencies and skills that are gained through various learning channels. Reinforcing public funding of vocational education and training, and tax incentives to promote training, might be supplementary measures. However, policy measures must take into account the implications that the "poaching" of workers subsequent to training has for firms' willingness to undertake such investments. Policy incentives must reconcile firm-level benefits with those of the wider economy.

Figure 8. Proficiency in problem solving in technology-rich environments among adults

Percentage of 16-65 year-olds scoring at proficiency levels 2 and 3



Source: OECD, Survey of Adult Skills (PIAAC) (2012).

39. On average across countries, roughly one-third of workers report a mismatch between their existing skills and those required for their job, implying they are either over- or under-skilled. This high level of skills mismatch also represents a barrier to the growth of innovative firms. Making the most of the available skills in the economy requires reforms to policies that restrict worker mobility, and funding for lifelong learning.

40. Making the most of the available talent pool is also about ensuring that women have equal opportunities to contribute to innovation. Governments should strive to ensure that barriers to women's participation in science, innovation and entrepreneurship are removed. Gender stereotypes and non-transparent nomination and appointment procedures can all hinder female involvement. Awareness programmes showcasing successful women in science and technology, and in high-growth firms, can provide useful role models for young women who may not otherwise consider such fields. More broadly, removing gender biases can improve research and innovation and open up new market opportunities.

41. Policy should also facilitate the development of enduring linkages and networks among researchers and innovators across countries. The knowledge embodied in people is the object of strong global competition. New OECD research (Appelt, et al. 2015) shows that knowledge flows across countries are circular. Policies should therefore not be based on a view that international mobility entails zero-sum competition. Collaboration between countries often results in better outcomes. A key consideration is that migration regimes for the highly skilled should be efficient, transparent and simple, enabling movement on a short-term basis. Removing restrictive recruitment practices in the public research system can facilitate mobility, as can reform of overly restrictive immigration and visa policies.

Priority 5: Improve the governance and implementation of policies for innovation

42. The governance and implementation of national innovation strategies are critical to their success. The process of developing a national strategy requires early and adequate involvement of stakeholders, including business, academia, social partners and key actors. Given the wide range of policies that affect innovation, it is important to ensure that the full set of government policies that affect innovation are well aligned, not only at the level of central government, but also between the central government and regional and local authorities, many of which are actively involved in innovation activities. The development and

implementation of innovation policies also requires strong capabilities within the public sector, including in building trust in government action and ensuring the support of stakeholders for policy actions.

43. The growing importance of governance also reflects a new approach to policies for innovation in many countries, where governments are increasingly acting as a facilitator in the face of complexity and uncertainty, enabling closer co-ordination between individual economic agents as well as fostering greater experimentation in the economy. This includes greater emphasis on building networks, improving co-ordination and regulation, as well as promoting awareness and less reliance on government funding.

44. Establishing a national strategy for innovation is one thing; its implementation is often another matter. The framing of policies for innovation needs to recognise that they operate in a complex, dynamic and uncertain environment, where government action will not always get it right. A commitment to monitoring and evaluation of policies, and on learning from experience and adjusting policies over time, can help ensure that government action is efficient and reaches its objectives at the least possible cost.

45. Policy learning rests on an efficient and well-developed institutional framework, strong capabilities for evaluation and monitoring, applying available good practices, and an efficient and capable government bureaucracy. Incorporating policy monitoring and evaluation at the design stage of policy making will support evidence-based decision making and accountability and enables policy learning over time, as can experimentation with policy measures at a small scale. Better measurement of innovation outcomes and impacts is essential in this context.

46. To be effective, innovation policies and the related governance system need to be adapted to the specific challenges faced by each country. Countries differ considerably in their basic conditions for innovation, such as the level of economic development, the structural make-up and trade specialisation of the economy, as well geography. They also differ in their institutional characteristics and approaches to policy, e.g. as regards the role of government and different private and public actors in the economy. As a result, policy needs and policy agendas will differ across countries and specific challenges.

47. Moreover, the specific choice and combination of innovation policies and related governance need to be aligned with the capabilities of each country in terms of policy making and policy implementation. At the same time, there is much scope for mutual learning and the exchange of experiences and good practices across countries, even though the institutional context for policy making will differ by country. The OECD will continue to provide a platform for such mutual learning, including in measuring and analysing innovation performance, identifying good policy practices through evaluation, and fostering international cooperation.

48. There is no magic bullet to strengthen innovation performance. However, concentrating policies on the five concrete areas for action discussed in this paper will help governments in fostering more innovative, productive and prosperous societies, and strengthen the global economy in the process.

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