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Current challenges in fostering the European innovation ecosystem

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Title: Current challenges in fostering the European innovation ecosystem

This paper analyses key challenges for improving the European innovation ecosystem, notably the need to improve: (i) innovation performance to boost productivity growth, (ii) knowledge-intensive industrial activities, (iii) financing of highly innovative activities, (iv) the role of universities in local innovation ecosystems, (v) the governance of innovation ecosystems and (vi) the role of social sciences and humanities in shaping research and innovation policies.

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Foreword

Innovation will be a key factor in renewing the EU's economic fabric, improving productivity and generating growth, as well as addressing societal challenges in the aftermath of the economic and financial crisis. This paper discusses the main current challenges facing regional, national and EU innovation policies regarding productivity development, knowledge-intensive industrial activities, financing of innovative activities, the role of universities in local innovation ecosystems, governance of innovation ecosystems, and social sciences and humanities as shapers of research and innovation systems. Knowledge and technology diffusion runs through most of these issues and should be considered an overriding challenge.

The paper is not an exhaustive technical report, but rather a policy brief prepared by the JRC staff with a discussion of some of the main current challenges facing the European innovation ecosystem. The paper is a synthesis of analyses carried out by the JRC as a background for some of the discussions of the High-Level Group chaired by Pascal Lamy on maximising the impact of EU research and innovation programmes.

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Executive summary

The political interest in the sluggish European innovation performance is not a new phenomenon as witnessed by the earlier Commission communications on a broad-based innovation strategy (2006) and the 'innovation union' flagship initiative (2010).

In the aftermath of the crisis, European innovation performance has received renewed attention due to its importance in addressing problems related to productivity and competitiveness, as well as societal challenges in areas like energy, transport, climate change, the circular economy, digitalisation and health.

This paper analyses key policy areas for improving the performance of what is often called the European innovation ecosystem. The paper looks in particular at the following issues.

- *The need for an improved innovation performance to boost EU productivity growth.* The observed slack in productivity development in many countries and regions is largely due to too slow a rate of technological progress. There exists a divergence in innovation capabilities between EU regions, economic sectors and firms within sectors, which has contributed to a slow productivity growth.
- *The need to increase knowledge-intensive industrial activities linked to global value chains.* Increasing investment in R & D by firms is key to being able to engage in knowledge-intensive industrial activities. Many Member States and regions suffer from an insufficient number of firms with strong innovation capabilities. Targeted EU interventions can be part of the policy response to this problem.
- *Access to finance: the need to make financial markets more responsive to high-growth opportunities in highly innovative activities.* Europe has a longstanding problem in making sufficient financing available to highly innovative firms. The economic and financial crisis aggravated the problem and saw much liquidity being funnelled to 'zombie' firms. Improving the availability of financing for innovative firms is crucial for improving the EU innovation performance.
- *Universities and skills: the need for higher education institutions to strengthen their role in local innovation ecosystems.* Universities are major contributors to local innovation ecosystems. In order to strengthen this role, changes in incentive systems, educational orientation and university governance are necessary.
- *The governance of research and innovation systems: the need for long-term planning, removal of administrative barriers and increased flexibility.* Bottom-up smart specialisation strategies with their focus on entrepreneurship and regional competitive advantage can provide a good framework for improved governance.
- *Social sciences and humanities (SSH) research: the need for a greater contribution to shaping research and innovation policies.* Despite the high quality of European research in SSH disciplines, research programmes could often be better linked to 'hard science'.

The challenge of improving knowledge and technology diffusion runs through most of these issues and is an overriding challenge.

1 Introduction

The aftermath of the financial and economic crisis has seen capital misallocations, a drop in industrial output, lower investments and subdued growth. At the same time, Europe is facing a number of societal challenges related to energy, transport, climate change, the circular economy, health and digitalisation. Innovation is key to renewing the EU's economic fabric, improving productivity, generating growth and addressing societal challenges after the crisis. This paper discusses the challenges facing regional, national and EU innovation policies.

There has been widespread recognition in the EU of the need to address innovation challenges. This was the subject of a 2016 report by the European Commission's European Political Strategy Centre requested by President Juncker (Madelin, 2016), and it is reflected in various EU policy initiatives as well as in the main EU funding instruments, the framework programme for research (H2020) and the Structural Funds (ESIF). Financing innovation is also an important activity of the European Investment Bank, and the European Fund for Strategic Investments (EFSI) provides important financial guarantees (e.g. to small and medium-sized enterprises (SMEs)).

However, despite these efforts, availability of private funds for innovation has been lacking, while financial markets in the aftermath of the economic and financial crisis have accommodated the survival of 'zombie' companies. Moreover, even though the education sector is an important contributor to the growth of the knowledge economy, the participation of universities in innovation activities and their response to changing labour market demands can be improved. Other issues concern the slowness of diffusion of innovation from leading firms and regions, the increase in interregional and inter-sectoral disparities in innovation capabilities, the inadequate governance of innovation systems and better capitalising on the SSH research strengths in innovation processes.

The paper discusses the following challenges.

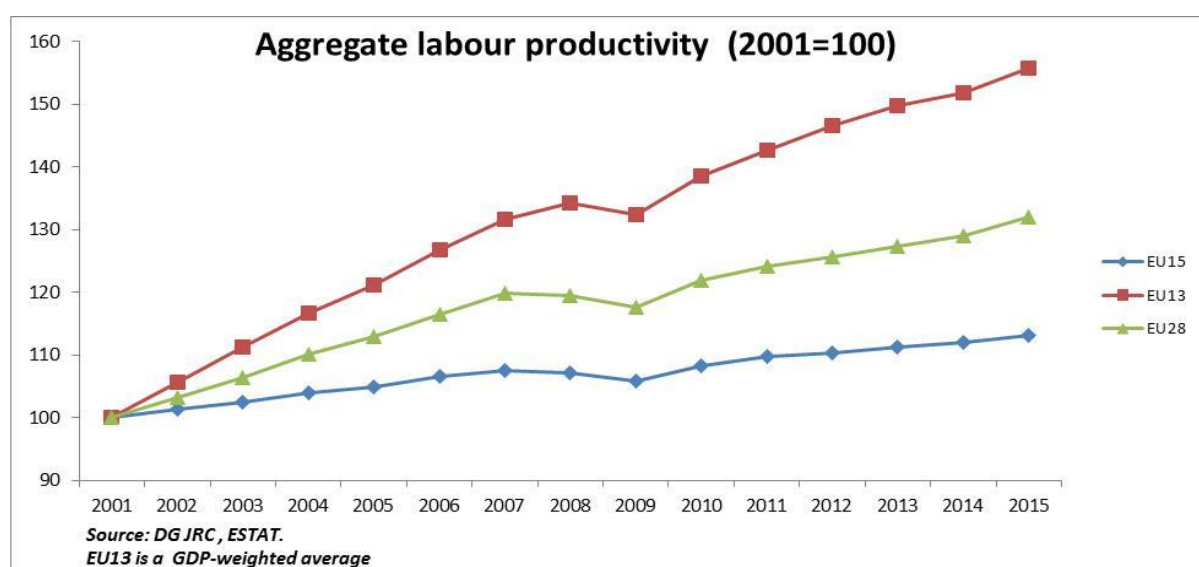
- The need for an improved innovation performance to boost EU productivity growth.
- The need to increase knowledge-intensive industrial activities linked to global value chains.
- Access to finance: the need to make financial markets more responsive to high-growth opportunities in highly innovative activities.
- Universities and skills: the need for higher education institutions to adequately play their role in innovation ecosystems.
- The governance of the research and innovation systems: the need for long-term planning, removal of administrative barriers and increased flexibility.
- SSH research: the need for a greater contribution to shaping research and innovation policies.

This paper is not an exhaustive technical report, but a policy brief with a discussion of some of the current important challenges facing the European innovation ecosystem. The paper is a synthesis of analyses carried out by the JRC as a background for some of the discussions of the High-Level Group chaired by Pascal Lamy on maximising the impact of EU research and innovation programmes.

2 The need for an improved innovation performance to boost EU productivity growth

As can be seen in Figure 1, overall EU labour productivity growth has been relatively modest in the last decade. Moreover, the graph shows that this modest increase was mainly driven by steeper labour productivity growth in the EU-13 group of countries, which partially offset the flat performance observed for the EU-15. It is positive that convergence in labour productivity levels has taken place between the EU-13 and the EU-15. However, productivity levels in absolute value are in general much lower in the EU-13 than in the EU-15, as the former are (still) transition economies, and thus for the time being can continue to reap relatively large productivity gains through capital accumulation. The more important role played by capital deepening rather than by innovation in driving labour productivity growth is confirmed by the analysis in Veugelers (2017), which shows that total-factor productivity (TFP) growth has been rather flat since 2000.

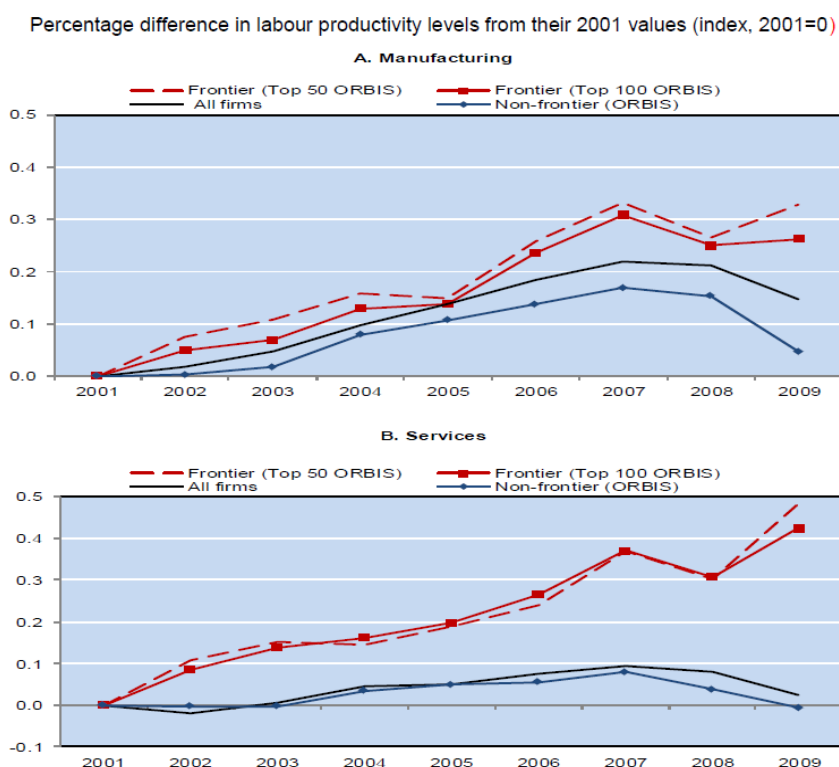
Figure 1. The evolution of labour productivity across Member States is quite heterogeneous, especially after the economic and financial crisis



The disappointing progress on TFP masks a more diverse picture of innovation performance across regions and sectors. Since 2011, innovation performance has increased for all regions in Austria, Belgium, France, the Netherlands, Norway, Slovakia, Switzerland and the United Kingdom, and for more than 50 % of regions in Greece, Italy, Poland and Sweden. Whereas it has decreased for all regions in Romania and for more than 50 % of regions in the Czech Republic, Denmark, Finland, Germany, Hungary, Portugal and Spain (European Commission, 2017).

The observed divergence of innovation performance between countries and regions seems to be mirrored by differences in the evolution of productivity both between sectors and between firms within business sectors. Figure 2 reveals that the overall productivity performance in services has been much lower than in manufacturing. This may to some extent be explained by the fact that services have historically been more labour intensive than manufacturing and more difficult to automate, making it more difficult to achieve sizeable productivity improvements over time. However, this may change with digitalisation. Figure 2 shows that the service firms with the highest labour productivity increases seem to have been performing as well or better than the best performing manufacturing firms.

Figure 2. Firms at the global frontier have become more productive than other firms over time, in both the manufacturing and the services sectors.



Source: OECD (Andrews, D., Criscuolo, C. and Gal, P. N. (2015)).

Importantly, Figure 2 also shows that, over the past decade, large and increasing productivity gaps have built up between the most productive 'frontier' firms and the rest of firms, especially in services. This could indicate a need for further product market reforms to increase competition, which would incentivise firms to innovate and/or adopt new technologies. This gap increased in 2009, the first full year of the economic and financial crisis ⁽¹⁾.

It is neither realistic nor desirable to expect a uniform distribution of innovation across European regions and businesses. However, the disappointing development of TFP and the divergences of innovation and productivity performances between regions and firms are indications that new approaches and reforms of EU and national policies will be necessary to speed up knowledge accumulation as well as knowledge and technology diffusion to support a broader range of regions and firms.

3 The need to increase knowledge-intensive industrial activities linked to global value chains

The importance of R & D for firms varies according to the sector (Moncada-Paternò-Castello, 2016). R & D is a driver of competitiveness in high- and medium-tech sectors, whereas in low-tech sectors it is often observed that different types of 'non-R & D innovation', e.g. in the form of capital investment in equipment (often produced by high-tech sectors), or non-technological innovation (marketing, organisation) are the most important sources of innovation. However, looking across all sectors, striving for strong

⁽¹⁾ The gap is not likely to have narrowed much after the crisis given that 'zombie' firms made up a large share of firms in the aftermath of the crisis (see Section 4 below).

and excellent private research is necessary for a number of reasons. First, private R & D is essential to keep an industrial base in Europe and therefore for the EU's competitiveness. Second, private R & D often also spills over back to higher education and helps maintain a high level of skills as well as the ability to adopt technologies developed elsewhere (Achibugi and Filippetti, 2017). Third, private R & D is necessary to deal with societal challenges in areas such as energy, transport, climate change, the circular economy, health and the digital revolution. Importantly, these challenges also represent industrial opportunities, and therefore they are potential sources of growth and jobs.

In many Member States and regions an insufficient number of firms has been able to accumulate innovation capacities to result in a critical mass of innovators and a boost of the national or regional innovation systems. The absence of a critical mass of innovators in many regions and their weak economic fabric prevents the generation of sizeable externalities thereby impeding knowledge diffusion as well. Additionally, in Member States and regions with less developed innovation systems, the business sector continues to account for a minor share of national or regional R & D, and it has even been declining in some Member States and regions. Slow rates of diffusion of innovation hamper the development of European innovation systems, particularly in lagging regions. The creation of successful domestic and international networks between firms as well as between firms, research performers and governmental actors are key to the generation and diffusion of innovations (Taylor, 2016).

Member States have tried to increase business R & D by providing tax incentives. Currently, 26 Member States provide tax incentives for R & D in some form or another. There are, however, growing doubts about the current extent of reliance on tax instruments (Appelt et al., 2016; D'Andria et al., 2017). Evaluations of the effectiveness of national schemes show wide variance and suggest that they are complements, not substitutes, to direct funding of business R & D through grants (Appelt et al., 2016; CPB, 2014). Furthermore, the impact of R & D tax credits on R & D investment depends on their design and the complementarity with the policy mix of the individual Member States (Ientile and Mairesse, 2009; CPB, 2014). Evidence on R & D input additionality also suggests that the commitment of firms to R & D fades when tax incentives are suppressed (Bravo-Biosca et al., 2013). Thus, R & D tax incentives alone cannot support a virtuous circle of accumulating R & D innovation capabilities within firms.

Income-based incentives ('patent boxes') have in recent years also been taken up by several Member States to incentivise private R & D. The sizeable budgets of favourable intellectual property right (IPR) tax regimes of Belgium, France, the Netherlands and the United Kingdom are equivalent to about one sixth of indirect support to R & D (CPB, 2014). However, an empirical study by Alstadsæter et al. (2015) found that while patent boxes attract high-value patents, they do so with little impact on domestic R & D, suggesting few or no effects on R & D. Stimmelmayer et al. (2016) estimate that 3 % of the profits of multinationals tend to shift to subsidiaries benefitting from the introduction of patent boxes. Furthermore, patent boxes are distortionary, since they only favour successful innovations that can be protected with IPRs, but not others (especially non-R & D innovation).

Targeted EU interventions on some specific technologies can partly tackle the problem of insufficient innovation capacity development within firms (e.g. based on ongoing analysis of key enabling technologies and new technologies as well as in the context of thematic smart specialisation platforms). Existing or new infrastructures for prototyping/testbeds could be exploited by firms (especially SMEs) to simplify access to new technologies. Further opening up of public research programmes and research infrastructures would make research capabilities and knowledge of different types and scale accessible to businesses, in particular to SMEs. The JRC can play an active role by sharing its experience with developing practical access conditions to JRC research infrastructures.

The biggest potential for improvement may lie in better exploiting the synergies between European, national and regional support frameworks. An analysis of support instruments

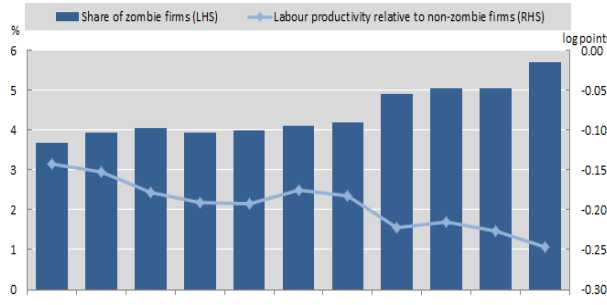
over the period 1990-2013 (Veugelers, 2015) suggests that the innovation policy mix of most EU states is similar, irrespective of the characteristics of their innovation systems. Multiple initiatives at the EU, national and regional levels, together with poor policy monitoring, programming and execution can result in overlaps (e.g. 'too much' support for inefficient SMEs) or leave large gaps in support (e.g. for medium-sized firms with high-growth potential). Initiatives such as smart specialisation strategies and the European Institute of Innovation and Technology have provided a fresh impetus for improvements in programming and coordination. However, there remains much room for further development and addressing the regional differences requires new approaches and actions. The need to strengthen the links of national and regional actors with international innovation networks is especially pressing for the lagging regions.

4 Access to finance: the need to make financial markets more responsive to high-growth opportunities in highly innovative activities

Europe has a long-standing problem of access to finance in the early stages of development for highly innovative companies.

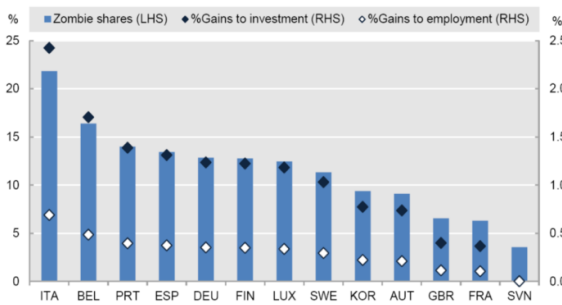
A JRC analysis of high-growth companies finds that financially constrained start-up (small) companies are nearly 25 % less likely to be high-growth companies than other start-ups (Hallak et al., 2017; see also Damioli et al., 2017) and that financial constraints further penalise employment growth in younger companies (more than SMEs in general).

Figure 3. Since the crisis, the shares of zombies firms and the productivity gap relative to non-zombie firms have increased



Source: McGowan-Andrews-Millot, OECD, 2017, Working Paper No. 1372

Figure 4. Potential gains in investment and employment for non-zombie firms by reducing zombie shares to the level of the best performing country.



Source: McGowan-Andrews-Millot, OECD, 2017, Working Paper No. 1372

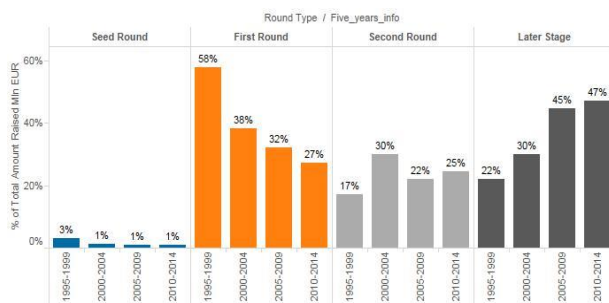
In the aftermath of the economic and financial crisis, an increase in the number of 'zombie' ⁽²⁾ firms took place and the gap in productivity between zombie and non-zombie firms increased (Figure 3). The existence of zombie companies is related to structural problems in market functioning that are unlikely to disappear unless they are tackled through competition-promoting reforms, but maintaining a supportive financing of zombie firms might shield them from competition and crowd out the growth of more productive firms. Significant gains in investment and employment for non-zombie firms would be possible if the share of zombie firms could be reduced to the level of the best performing country (Figure 4) ⁽³⁾.

⁽²⁾ 'Zombie' firms are indebted and loss-making firms for a few consecutive years, but can continue to operate, for example thanks to support from banks.
⁽³⁾ E.g. in Italy, reducing zombie shares would bring around 2.5 % more investment and 0.7 % more employment.

Venture capital (VC) activity in Europe started decreasing after the dot.com bubble burst in 2001, but has decreased further with the economic and financial crisis. Over the last two decades, VC funds have also moved away from seed to later-stage funding and from young to older companies (Figure 5). In 2014, less than 1 000 European companies received EUR 5.8 billion in VC funds ⁽⁴⁾ (Figure 6). In comparison, the annual budget of the current EU research framework programme, H2020, is more than EUR 11 billion ⁽⁵⁾.

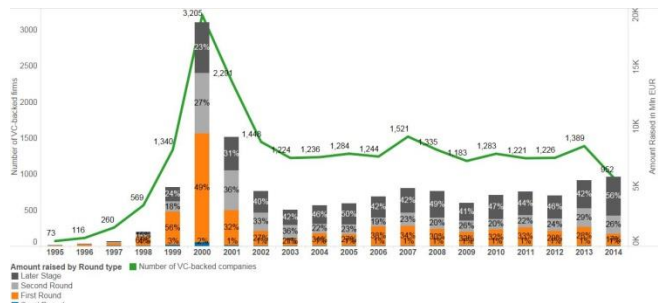
The VC-backed companies are also geographically concentrated in larger cities. The top 20 European cities by number of VC-backed companies accounted for 58 % of all European VC-backed companies, and 69 % of those funds were received by companies located in Paris, London and Berlin. The firms' location has an impact on the probability of receiving VC funding as well as on its volume and continuity. This also explains why European start-ups often migrate to VC hotspots to improve their funding prospects.

Figure 5. VC funding increasingly target mature companies



Source: De Prato, G., Nepelski, D. and Piroli, G. (2015)

Figure 6. VC funding in Europe have decreased significantly after the dot.com bubble burst



Source: De Prato, G., Nepelski, D. and Piroli, G. (2015)

The literature shows that jobs created by high-growth innovative companies tend to require higher human capital levels and are more persistent than in other high-growth firms (Ciriaci et al., 2014). The EU and the United States have economies of a comparable size, but the EU has significantly fewer young innovative companies entering an extended period of high growth. A lack of access to finance for scaling up may be one of the factors preventing a larger proportion of highly innovative firms from entering longer periods of high growth (OECD, 2015; Bravo-Biosca, 2010).

Improving the availability of financing for innovative firms would seem crucial to boost future innovation performance in the EU. The public sector has an important role in supporting early-stage innovative activity by small firms given the often tepid nature of the VC cycle at this stage of firm activity and the scarcity of financial support available in the market (Gampfer et al., 2016).

Recent measures have introduced EU funding schemes supporting innovative ventures through guarantees, loans and direct grants. The 'start-up and scale-up initiative' includes, among others, changes to VC regulations, the creation of a pan-European VC fund of funds, and technical assistance for the Member States in this area. The H2020 SME instrument and the 'Fast track to innovation' pilot are good steps forward to assuring faster access to finance. Furthermore, the EFSI also has the potential to provide financing for key innovating firms, including SMEs, and thus to crowd in private investments.

⁽⁴⁾ In 2000, over 3 200 companies received EUR 19 billion in VC funds.

⁽⁵⁾ See <https://ec.europa.eu/programmes/horizon2020/en>

5 Universities and skills: the need for higher education institutions to adequately play their role in enabling innovation

Universities are major contributors to local innovation ecosystems and economic growth through their research, education and innovative activities. Together with research centres, they are, for example, co-innovators of 70 % of the innovations derived from H2020 projects. However, changes in strategic orientation and university governance are required for universities to realise their potential contribution as enablers of innovation. Excellence in research, high-quality education, entrepreneurship and contributions to innovation all need to be strengthened, while at the same time ensuring synergies between them.

A high quality of education is strongly correlated with R & D performance and economic growth. Some of the strongest research universities are successful in providing their graduates with high levels of transversal skills related to intellectual creativity, analytical capacity and entrepreneurial competences. Most European universities, however, have been less apt in doing so and have been too slow to respond to the changing societal and labour market needs, and technological change in recent decades has disproportionately benefitted those with higher levels of education and skills (Van Reenen, 2011; see also Berman et al., 1998).

Some scholars predict that further automation and increasingly sophisticated forms of artificial intelligence may lead to permanent unemployment of substantial layers of the labour force (Brynjolfsson, E. and McAfee, A., 2014). Current efforts to prepare the workforce for a more knowledge- and innovation-intensive economy via a decisive expansion of tertiary education have produced mixed results. Mismatches between educational supply and demand in the local labour market are particularly prevalent in less developed regions and Member States, but this type of bottleneck is to a varying degree a common problem observed across most Member States.

Inter-sectoral mobility between academic research and industry is insufficiently developed at all levels, while it would foster knowledge exchange and absorptive capacity in industry as well as in the public sector and, at the same time, strengthen the links between universities and society. There is therefore scope to increase the scale and level of ambition of inter-sectoral mobility schemes. Universities could also further mobilise the entrepreneurial potential of students and alumni.

Many European countries have implemented or are experimenting with incentive systems that link research funding allocation decisions to *ex post* evaluations (Jonkers and Zacharewicz, 2016). Research excellence is a central element in most assessment exercises of this kind, but graduate labour market outcomes and societal interaction parameters are also increasingly considered (e.g. Sweden and the United Kingdom). Other countries use alternative incentive mechanisms, including performance contracts (e.g. Austria and Finland) or excellence schemes (e.g. Germany and Spain). A similar approach could be developed whereby institutional funding would be linked with the impact on innovation.

A number of countries have undergone university reforms to adapt their teaching activities to changing labour market demand. Finland is one of the few countries with national guidelines for the provision of entrepreneurship education. Aalto University is one successful example of a university having a greater role as a leader 'orchestrating' its local innovation ecosystem. This enables it to better promote bottom-up entrepreneurial activity from staff and students while forming strategic links with other actors in its environment (Rissola et al., 2017). To promote universities towards exploiting their potential for societal impact through education and research, some governments have also included societal impact considerations in impact assessment-based funding allocation mechanisms.

6 The governance of research and innovation systems: the need for long-term planning, removal of administrative barriers and increased flexibility

The performance of a research and innovation system depends crucially on openness (Wagner and Jonkers, 2017) and the interactions between its actors (individual researchers, universities and public research organisations, as well as SMEs and large companies). Information failures (e.g. 'silo' thinking), administrative barriers or inappropriate regulations hamper the capacity of research and innovation actors to make the most of investments in research and innovation. Appropriate governance involving long-term planning, removal of administrative barriers, increased flexibility, monitoring and evaluation, and stakeholders' involvement is a key factor for achieving a successful implementation of research and innovation policy at regional, national and European level.

Frequent examples of suboptimal governance include the following:

- Public research infrastructures funded by ESIF may not be economically sustainable (Conte and Ozbolat, 2016) and maintained without the support of national public funding coupled with the implementation of effective business models.
- Researchers often make requests for simplification of administrative procedures as cumbersome administrative procedures negatively affect their motivation and reduce their productivity.
- In many countries (especially the EU-13 countries), the low participation in EU competitive programmes may stem from the absence of reward and recognition for international collaboration (Conte and Ozbolat, 2016). National and regional programmes are also often closed to international partners, who could otherwise accelerate the development of innovative solutions.

The smart specialisation strategy approach was developed by the European Commission as a tool to help regions and Member States to address such issues. The focus of smart specialisation is on pursuing entrepreneurial opportunities based on regional competitive advantages through a bottom-up approach involving all relevant stakeholders. The smart specialisation approach was integrated in the reformed cohesion policy for 2014-2020.

Also, to simplify the access to financing and advice, the EU has requested the Member States to establish independent coordination bodies ('one-stop shops'), which can provide assistance and tailored advice to different stakeholders (in particular SMEs and research institutions/universities) in a timely manner, and also help authorities to shape strategies and public interventions.

State aid rules are important to ensure a level playing field across the single market, but they have also often been criticised for being too strict, slow and cumbersome. Therefore, the EU reformed the EU state aid control system in 2014 with, among other things, a new general block exemption regulation, which has exempted many types of aid, in particular for SMEs and innovation from notification. The reform has led to significant simplifications.

Currently, the European Commission offers financial off-the-shelf instruments (EC, 2016) for implementation in the Member States. The terms and conditions are predefined and designed for a swift roll-out (five instruments available). This approach could be further developed on the basis of the experience and good practices in the design of funding instruments. This would simplify the burden on governments and regions when designing such instruments. It would also simplify the work of beneficiaries of regional, national and EU programmes. This could be supplemented by policy experimentation with new instruments at different levels of governance.

Long-term strategic planning is necessary to maximise the socioeconomic impacts of research and innovation investments. Long-term planning should include the

development of a shared vision of research and innovation policies, as well as priority setting. This facilitates strategic business involvement into the wider innovation ecosystems by providing direction and removing uncertainty about objectives, and therefore it helps business actors to plan investment decisions and long-term initiatives.

7 Social sciences and humanities research: the need for a greater contribution to shaping research and innovation policies

Technology-driven innovation, faster market solutions and more interconnectedness cannot alone solve societal challenges related to rising inequalities, political legitimisation problems, climate change, instability and unpredictability of socioeconomic issues. Further interdisciplinary and transdisciplinary research associating SSH to 'hard' sciences and to the most innovative sectors are necessary to address these issues.

SSH helps shaping highly talented cultural and creative professionals (writers, artists, designers, etc.), which are key to growth and innovation in the new digital-sharing economy environment. There are more than 6 million cultural jobs in Europe, of which 19.1 % are under 30 (vs. 18.6 % in the overall employment) and more than 60 % have tertiary education, which is nearly double the share of highly educated people present in total employment (33 %) (Eurostat, 2016).

The Cultural and Creative Cities Monitor developed by the JRC shows that cities that are engaging in the promotion of culture and creativity are more successful in fostering growth and innovation and strengthening resilience compared to European cities with more than 50 000 inhabitants in general. This includes more jobs per capita, a higher proportion of young people and a bigger proportion of people with higher education. The best-performing cultural and creative cities also registered higher GDP growth rates despite the crisis (Montalto et al., 2017).

Despite the importance of SSH and the fact that the EU is a global leader in performing high-quality research in SSH disciplines⁽⁶⁾, opportunities for SSH scholars to participate in thematic EU research programmes have so far been disappointing. The Commission's second monitoring report (Birnbaum et al., 2017) shows that out of the total 2015 H2020 call budget for societal challenges and industrial leadership priorities, only 5 % went to SSH partners. The fact that the digital revolution will transform areas like anthropology, art, communication, history, literature, linguistics, philosophy and political science makes it even more important to better connect SSH with 'hard' sciences.

8 Conclusions

There is evidence of an increasing innovation divide between European regions, and productivity development is lagging in some countries and regions. Also, firms at the global frontier have become more productive than other firms over time, in both the manufacturing and the services sectors. This calls for a greater emphasis on knowledge and technology diffusion on behalf of leading companies and research organisations to less productive companies in both advanced and less-advanced countries and regions.

The lower EU private R & D intensity compared to countries like the United States, South Korea and Japan is largely due to high-tech sectors representing a smaller share of industry in the EU, while the EU is relatively stronger in low- and medium-tech sectors where R & D makes up a smaller share in percent of value added. There is a need to promote investments in private R & D, both to increase the share of high-tech sectors as

⁽⁶⁾ Nearly half of the world's top 100 institutions undertaking scholarship in the humanities are based in the EU.

well as to address societal challenges related to energy, transport, climate change, the circular economy, digitalisation and health.

Europe has a long-standing problem of making finance available at the early and scale-up stages of firm development for highly innovative firms. However, caution is needed when providing financing to less efficient firms as this might shield them from the effects of competition (creating 'zombie' companies) and crowd out the financing of potential high-growth firms, as has been the case in the aftermath of the economic and financial crisis. Without more young innovative companies entering extended periods of higher growth, many regions and Member States will not be able to improve their innovation performance. Access to finance is often one of the factors impeding scaling up by firms.

Universities are major contributors to local innovation ecosystems and economic growth through their research, education and innovative activities. Better linking universities with their local innovation ecosystems, allowing them larger scope to play a leading role as 'orchestrators', would strengthen the performance of the ecosystem. Therefore, universities should have better incentives to offer education with the type of skills demanded in the job market as well as more incentives to produce high-quality research and become more oriented towards entrepreneurship. This will require changes in incentive systems, educational orientation and university governance.

The overall performance of an innovation ecosystem depends on the quality of its governance. Smart specialisation strategies introduced in Europe in recent years in the context of EU ESIF programmes aim at improving the governance of regional innovation ecosystems and increasing the coherence between regional, national and EU innovation policies. From the point of view of governance, the biggest potential may lie in better exploiting the synergies between European, national and regional support frameworks.

EU research in SSH is world class and it is contributing to the design of policies for better addressing the needs of citizens. However, it could be better linked to 'hard' sciences. This will be increasingly important with digitalisation.

The JRC is carrying out analysis and research projects within all of the above areas with the objective to improve EU, national and regional innovation policies.

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