// NO.7 | OCTOBER 2018

ZEW policy brief

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New Perspectives in European Innovation Policy

Essential Issues

Innovation is essential for economic growth, and governments must encourage firms to increase their investments in innovation. Europe is losing ground to its main Asian competitors when it comes to R&D investment, and is barely keeping pace with the U.S. Moreover, the rate of return on innovation has become significantly weaker in Europe. This has been caused by its relative lack of innovative SMEs, the slow diffusion of innovation, and the increasingly competitive innovation marketplace. In this light, scholars and policy makers are arguing for a new approach to European innovation policy that puts more weight on the development of disruptive innovation and on the diffusion of new technologies throughout the market.

KEY MESSAGES //

- More research is needed on the microeconomics of diffusion. Macroeconomic research shows that the diffusion of technologies is a key determinant for international differences in wealth and productivity, but there is still too little knowledge about the drivers and bottlenecks of technology adoption investment. This is caused at least in part by the difficulties of measuring technology adoption.
- Mission-oriented innovation policy is designed to boost the creation of disruptive technologies that can quickly penetrate or generate markets. These policies involve strategic actions in specific areas deemed key for European growth and well-being. Missions combine traditional supply-side measures with market creation and demand generation to maximize impact.
- Technology diffusion could be enhanced through specific policy actions that aim to bring late-stage innovation projects to the market. SMEs could also be supported in their role as disruptive innovators by improving their access to financing across the European Union. A stronger market for patents and licensing would also improve the return to innovation.
- In its ninth Framework Programme, Horizon Europe, the European Commission puts more weight on mission-oriented research and the diffusion of technologies through research & innovation missions and an expanded scope of the European Innovation Council. In Germany, an institute will be founded with the mission of supporting radical innovation with disruptive potential.

THE ECONOMICS OF INNOVATION

Innovation is key for growth

Innovation is the largest single driver of economic growth and human welfare. It generates new, improved, and more cost-effective products and services. Innovation accounted for two-thirds of European economic growth between 1995 and 2007 (Bravo-Biosca et al. 2013). But investment in innovation is subject to market failures, which lead firms to invest less than what would be best for society. Causes include the uncertainty inherent in investing in R&D, high sunk costs, long investment lags, difficulties in attracting funding for innovation, and the limited appropriability of R&D investments (European Commission 2017a). Because of these market failures, governments around the world established large public support programs for fostering the innovation activities of firms.

Most OECD countries support research investment

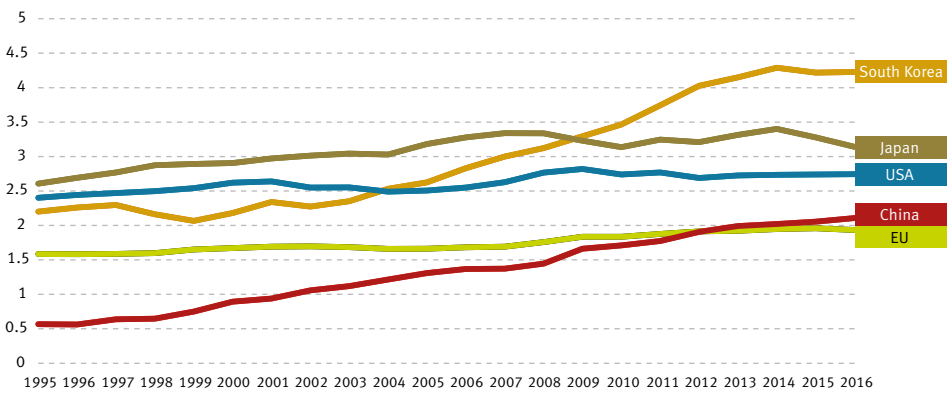
Modern public support for research and innovation (R&I) took off shortly after World War II in the USA, sparked in no small part by the observations by Vannevar Bush (1945) that much of innovation arises from scientific progress, and that the federal government should thus support the advancement of knowledge. Early initiatives funded research directly by establishing public research institutions and encouraged private research investment with tax incentives and subsidy programs. Support for research and innovation was further expanded in the Cold War Era, and has grown more important ever since (David et al. 2000). Nowadays, all OECD countries use R&I policies to boost research investment. Subsidy programs and intellectual property rights are the most common tools. Tax incentives are also increasingly used. Other tools, such as public production, public procurement, and prizes, are used to varying degrees (Takalo 2012).

THE PRODUCTIVITY PUZZLE

EU lags behind when it comes to investment in knowledge generation

The figure shows the international evolution of gross domestic spending on research and development. In 2016, The European Union spent approximately 1.9% of its gross domestic product on research and development. However, the European Union has been losing ground in terms of R&D intensity compared with its main Asian competitors, and has barely kept pace with the U.S. Despite the efforts of recent years to increase R&D investment in the EU, it remains the case that innovations, especially the disruptive kind, have been developed mostly outside of the EU (European Commission, 2017b). In addition, the positive relationship between R&D investment and productivity growth in Europe has become significantly weaker (European Commission 2017a).

EVOLUTION OF R&D EXPENDITURES (% OF GDP)



Source: OECD

Lack of diffusion is a main cause of decreasing productivity gains

There are three main causes for the decreasing impact of R&D investment on productivity growth (European Commission 2017a).

- First, compared with the United States, the EU lacks small firms delivering disruptive innovation – the kind that opens new markets and brings radical change (Cincera and Veugelers 2013). In Germany, the share of innovative firms, particularly among SMEs, is declining (Rammer and Schubert, 2018). Moreover, the innovative SMEs that do exist are having a difficult time expanding to a size where they can have a technological impact. Europe's poorly developed market for technology relative to America's hinders an effective transmission of disruptive ideas to established players with the ability to bring them to the market (Arora et al. 2004).
- Second, the rate of return on innovation seems to have fallen. That may be due to the increasing pace of innovation, which limits firms' ability to reap the rewards from their investment (Jones and Williams 2000). Firms are further driven to race to develop new products by increasingly important scale and network effects, increasing industry concentration and a shift towards 'winner takes most' competition. This further erodes the return on innovation (Autor et al 2017).
- Third, technologies used by the most productive firms take too long to reach the rest of the market. Whereas the productivity of the most productive firms has continued to grow over the past decades, the productivity of 'non-frontier firms' has stagnated (Andrews at al 2013; OECD 2015).

Macroeconomic evidence of the importance of technology diffusion

It is worth taking a closer look at the issue of technology diffusion. Recent macroeconomic research has shown that the speed of diffusion is a critical determinant of international differences in wealth (Comin and Hobijn 2010; Comin and Mestieri 2018) and that it closely correlates with international differences in productivity (Jerzmanowski 2002). An analysis of the diffusion of 15 technologies in 166 countries has found that on average technologies are adopted 45 years after their invention (Comin and Hobijn 2010). Wealthier countries and countries with better-educated workers are able to adopt more quickly, as are countries that are more open to trade and with experience in the preceding technologies (Comin and Hobijn 2004). Countries also adopt technologies faster when their economies are doing well. This is one explanation for the low productivity growth in the sluggish decade since the Great Depression (Anzoategui et al. 2017).

The macroeconomic mechanisms of technology diffusion have received further study as part of the H2020 project FRAME, which relies on DSGE modeling. FRAME is the first program to investigate the economic effects of private-sector investment in technology adoption and of government policies promoting technology diffusion.

Lack of microeconomic understanding

In contrast to innovation investment, there is little understanding of the social returns of technology diffusion. At the micro level, investment in technology adoption is more difficult to measure than investment in innovation, and much work remains to be done. Potentially, economists could approximate adoption investment as the difference between R&D investment and innovation investment, or the gap between R&D- and non-R&D-related innovation expenditures.

Market failure in innovation diffusion

Historically, innovation diffusion has received less public support than innovation investment, even though firms face similar bottlenecks with each. For instance, investment in both innovation and adoption declines in the face of uncertainty. In the case of innovation, the source of uncertainty is the economic success of a new technology. In the case of adoption, managers are often uncertain whether it is better to adopt a given technology now or to wait for future developments. This uncertainty can result in unnecessary delays in adoption. On the other hand, if a firm does adopt a technology early on, some of its experience will spill over to competitors. As with innovation, the possibility of appropriation lowers the incentive of firms to invest.

POLICY MEASURES: MISSION-ORIENTED RESEARCH AND TECHNOLOGY DIFFUSION

Early diffusion policy

In the early '90s, programs emerged in various countries to promote the adoption of new technologies by increasing the availability of information through, say, technology demonstrations, consulting services, science parks, and the publication of technical standards. But most of these programs have since been discontinued. Several countries have established applied research organizations specifically tasked with connecting science and industry and with finding industrial applications for cutting-edge scientific solutions. Examples include the Fraunhofer Society in Germany, VTT in Finland, and TNO in the Netherlands (Comin et al. 2018).

Mission-oriented research

In response to Europe's shortcomings in disruptive innovation, scholars and policy makers have argued for new approaches to European innovation policy. Specifically, they have proposed a mission-oriented approach that enables a closer link between technology generation and diffusion and that incentivizes the rapid expansion of disruptive innovation. Both goals can be achieved by channeling resources into specific directions that are expected to achieve disruptive and impactful innovation and that are critical for European growth and well-being. Traditional supply-side measures can be combined with strategic actions in these key areas to create new markets and generate demand. For instance, policy makers could act as 'lead users' by investing in risky but high-potential technologies, thereby accelerating development in these areas (ESIR 2017; European Commission 2017c, 2018a; Mazzucato 2018).

Encouraging diffusion

Scholars and policy makers have emphasized the importance of allowing the diffusion of disruptive innovations across firms, sectors, and countries (European Commission, 2017a). To achieve this, firms must be encouraged to undertake risky innovation projects with potentially high rewards, while policies need to be put in place that ensure the adoption of new technologies throughout the entire European economy. Diffusion could also be fostered through the implementation of specific support programs and the strengthening of the European market for financing for innovative firms, especially SMEs.

Mission-driven government institutions have played an important role in the creation of key technologies. The Defense Activated Research Project Agency (DARPA) established the basis of the modern internet. GPS was initially developed by the U.S. Navy. The German Fraunhofer society invented the MP3 and MPEG-4 compression technologies. These institutions are all tasked with the generation of new markets through technological breakthroughs (Mazzucato, 2018). One recent analysis showed that German firms that collaborated with the Fraunhofer Society saw more growth and innovation than those that did not (Comin et al. 2018).

Diffusion and classic innovation policy

These activities are minor compared with the extent of classic efforts to foster private-sector research, despite the fact that the latter are not well-suited for supporting technology diffusion. Indeed, some traditional instruments, such as intellectual property rights, achieve their goal by limiting the diffusion of technologies in the short term. Subsidies, tax credits, and direct procurement increase incentives to invest in private-sector research but do nothing to improve technology diffusion (Takalo 2012). Conversely, direct investment in research can support diffusion – such as when policy makers require that the resulting technology be placed in the public domain – but it does little to entice firms to invest in research. In response to these problems, the EU has significantly increased its commitment to mission-oriented policy and innovation diffusion.

LINKING KNOWLEDGE GENERATION WITH TECHNOLOGY DIFFUSION

Programs to encourage disruptive innovation and technology diffusion

The ninth Framework Programme, Horizon Europe, will introduce a limited number of research and innovation missions as part of its Global Challenges and Industrial Competitiveness pillar to foster disruptive innovation. The missions will act as independent programs with specific goals and timeframes. Designed in coordination with citizens and industrial technology users to establish a closer link between innovation and society (European Commission, 2018a), they aim to foster collaborations across sectors and disciplines resulting in more effective actions. Individual member states are taking action as well. In Germany, plans are underway to found an institute with the mission of supporting radical innovation with disruptive potential throughout the market (BMBF, 2018).

A key challenge for mission-oriented policies will be to decide the direction of these programs. Ideally, they should be guided by societal goals that maximize social impact. A promising avenue would be to align the missions with the United Nation's 2030 Agenda for Sustainable Development.

Horizon Europe will also encourage technology diffusion through programs that support the commercialization of high-impact innovation projects. These include the Fast Track to Innovation and the SME instrument. Both will become part of the European Innovation Council for Horizon Europe.

REFERENCES

Andrews, D., Criscuolo, C., Gal, P.N. (2013). Frontier firms, technology diffusion and public policy: micro evidence from OECD countries. The future of productivity: main background papers, OECD.

Anzoategui, D., Comin, D., Gerler, M., Martinez, Joseba (2017). Endogenous technology adoption and R&D as sources of business cycle persistence. NBER working paper no. 22005. Cambrige, MA: NBER.

Arora, A., Fosfuro, A., Gambardella, A. (2004). Markets for technology: the economics of innovation and corporate strategy. The MIT Press, Cambridge, MA.

Autor, D., Dorn, D., Katz, L. F., Patterson, C., Van Reenen, J. (2017). Concentrating on the fall of the labour share. NBER working paper no. 23108. Cambrige, MA: NBER.

Bravo-Biosca, A., Martson, L., Mettler, A., Mulgan, G., Westlake, S. (2013). Plan I – Innovation for Europe. Nesta and the Lisbon Council.

BMBF (2018). Agentur zur Förderung von Sprunginnovationen. BMBF, Berlin.

Bush, V. (1945). Science, the endless frontier: a report to the President. US govt. print off.

Cincera, M., Veugelers, R. (2013). Young leading innovators and the EU's R&D intensity gap. Economics of Innovation and New Technology, 22, 177-198.

Comin, D., Gertler, M. (2006). Medium-term business cycles. American Economic Review, 96, 3, 523-551.

Comin, D., Hobijn, B. (2004). Cross-country technology adoption: making the theories face the facts. Journal of Monetary Economics, 51, 39-83.

Comin, D., Hobijn, B. (2009). The CHAT Dataset. NBER working paper no. 15319. Cambridge, MA: NBER

Comin, D., Hobijn, B. (2010). An exploration of technology diffusion. American Economic Review, 100, 2031-2059.

Comin, D., Hobijn, B., Rovito, E. (2006). Five facts you need to know about technology diffusion. NBER working paper no. 11928. Cambridge, MA: NBER

Comin, D., Licht, G., Pellens, M., Schubert, T. (2018). Do companies benefit from public research organizations? The impact of the Fraunhofer Society in Germany. Scandinavian Working Papers in Economics No. 2018/7.

Comin, D., Mestieri, M. (2018). If technology has arrived everywhere, why has income diverged? American Economic Journal: Macroeconomics, 10, 3, 137-178.

David, P. A., Hall, B. H., Tool, A. A. (2000). Is public R&D a complement or substitute for private R&D? A review of the econometric evidence. Research Policy, 29, 497-529.

ESIR (2017). Towards a mission-oriented research and innovation policy in the European Union: an ESIR memorandum.

European Commission (2017a). The economic rationale for public R&I funding and its impact. Brussels: European Commission.

European Commission (2017b). Open innovation, open science, open to the world – a vision for Europe. European Commission, Brussels.

European Commission (2017c). Lab – Fab – App: investing in the European future we want. Report on the independent High Level Group on maximizing the impact of EU Research and Innovation Programmes. Brussels: European Commission.

European Commission (2018a). A new horizon for Europe. European Commission, Brussels.

European Commission (2018b). EU funding for research and innovation 2021-2027. 7 June 2018. Brussels: European Commission.

Jerzmanowski, M. (2007). Total factor productivity differences: appropriate technology versus efficiency. European Economic Review, 51, 8, 2080-2110.

Jones, C. I., Williams, J. C. (2000). Too much of a good thing? The economics of investment in R&D. Journal of economic growth, 5, 65-85.

Mazzucato, M. (2018). Mission-oriented research & innovation in the European Union. Brussels: European Commission.

Mazzucato, M. (2018). The challenges and opportunities of framing the EC 2020 'challenges' as 'mission-oriented' policies. ISIGrowth policy brief 3/2018.

OECD (2015). The future of productivity. OECD.

Rammer, C., Schubert, T. (2018). Concentration on the few: mechanisms behind a falling share of innovative firms in Germany. Research Policy, 47, 2, 379-389.

Takalo, T. (2012). Rationales and instruments for public innovation policies. Journal of Reviews on Global Economics, 1, 157-167.

FURTHER INFORMATION //

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This project has received funding from
the European Union's Horizon 2020 research and
innovation programme under grant agreement No 727073.

ZEW
Zentrum für Europäische Wirtschaftsforschung GmbH
Centre for European Economic Research

ZEW policy brief series

Publisher: Centre for European Economic Research (ZEW) Mannheim
L 7, 1, 68161 Mannheim · P.O. Box 10 34 43, 68034 Mannheim · Germany · Internet: www.zew.de, www.zew.eu
President: Prof. Achim Wambach, PhD · Director of Business and Administration: Thomas Kohl

Editorial responsibility: Prof. Achim Wambach, PhD