Chapter Five

Rekindling the EU's Economic Growth through Science and Innovation: Can the Europe 2020 Strategy Step Up to the Challenge?

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The Europe 2020 Strategy, which was approved by the European Council in June 2010, proposes a coordinated policy framework to rekindle economic growth in the EU. Its focus is on resolving long-standing structural weaknesses—the innovation gap, skills shortages, long-term unemployment—and prioritizing global public goods linked to climate change.[1] That such a comprehensive agreement could be reached is a remarkable achievement at a time when EU policymakers are confronted with a crisis of confidence in the euro and the specter of sovereign default. It suggests that the Europe 2020's predecessor, the Lisbon Strategy, has helped to construct a common, European agenda for growth—although this consensus did not automatically translate into commitments to reach the agreed targets.

The critical question is whether the Europe 2020 Strategy will remain a call for action, or whether it will develop into an effective action plan that truly contributes to the region's recovery and long-term competitiveness. Serious challenges stand in the way of "operationalizing" the Europe 2020 Strategy. If the decade since the Lisbon Strategy was launched is an indication, there is a serious risk of not meeting the

[1] The long-term growth vision embedded in the EU 2020 Strategy stands on three legs: first, "smart growth," meaning an economy that is based on knowledge and innovation; second; "sustainable growth," by promoting a more resource-efficient, greener, and competitive economy; and third, "inclusive growth," fostering a high-employment economy resulting in social and territorial cohesion. For details, see "Europe 2020. A strategy for smart, sustainable and inclusive growth," Communication from the Commission, Brussels: European Commission, 2010 and http://ec.europa.eu/europe2020/index_en.htm.

targets this time around. Whether this happens will depend on governments making good on their pledges to raise budgetary expenditures, and, just as importantly, on implementing effective partnerships with the private sector. EU funds could play an important complementary role if they are scaled-up, as these resources can target the most pressing market failures and coordination problems. But for this to happen, the institutional failures that have constrained absorption of EU funds would need to be addressed through systemic reforms.

The stakes are high, as there is a continuing productivity gap between the EU and the U.S., and income convergence *within* the EU has stalled as a result of the global financial crisis. Long-term data collected by Madison[2] and analyzed by Gordon[3] reveal that after a century of secular decline, western Europe closed the gap in GDP per capita and labor productivity starting in the 1950s (Figure 1). But from the 1970s, as Europe's "golden growth" era petered out, output per capita stalled at 75% of U.S. levels. And, within the EU, GDP per capita of post-transition economies increased relative to the EU-15 until the hard landing in many of these countries dampened the convergence process (Figure 2).

Multiple ingredients would be needed to reactivate the convergence process, but innovation is likely to be one of the most potent ones if we believe recent studies explaining the factors behind the transatlantic productivity gap as well as that inside Europe. Using a GDP accounting approach, Mourre estimates that two-thirds of the gap in GDP per capita with the U.S. is explained by lower labor utilization in the EU15 and euro area (see Figure 4), whereas hourly labor productivity accounts for the remaining third; when it comes to new member states, 90% of the gap is attributable to labor productivity.[4] What is behind the disparity in labor productivity? The answer

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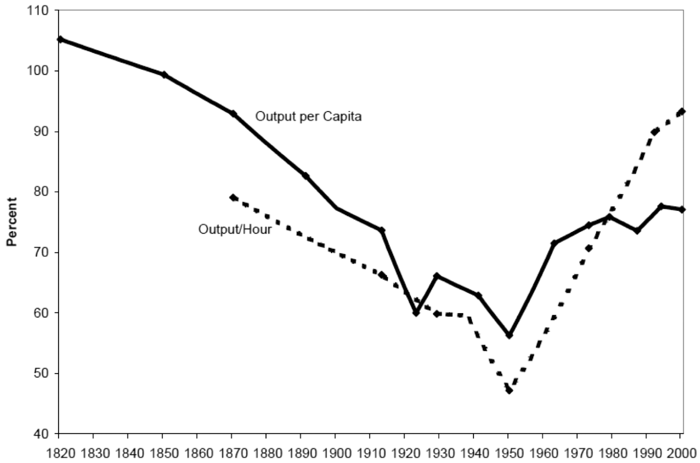
[2] Angus Maddison, *The World Economy. A Millennial Perspective (Vol. 1). Historical Statistics (Vol. 2)* (Paris: OECD, 2006), p. 629.

[3] Robert J. Gordon, "Two Centuries of Economic Growth: Europe Chasing the American Frontier," NBER Working Paper 10662 p. 49 (Cambridge, MA: National Bureau of Economic Research, 2004).

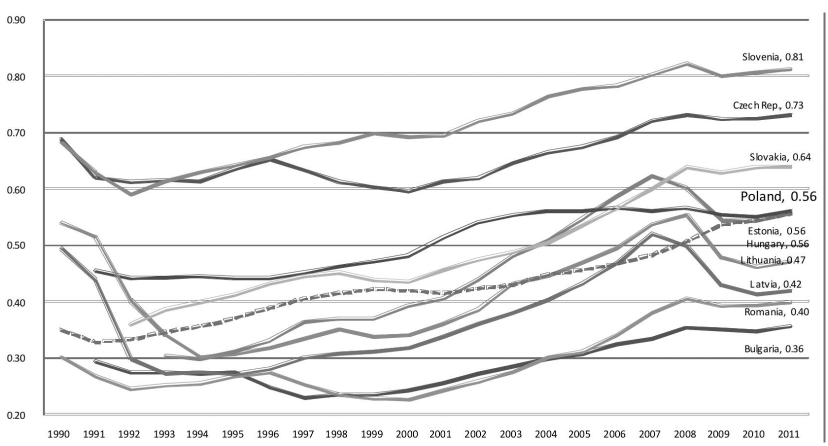
[4] Gilles Mourre, "What explains the differences in income and labour utilisation and drives labour and economic growth in Europe? A GDP accounting perspective," *Economic Papers*, No. 354 (Brussels: European Commission, Directorate-General for Economic and Financial Affairs, 2009).

Figure 1. Ratio of Labor Productivity in Europe Compared to the United States



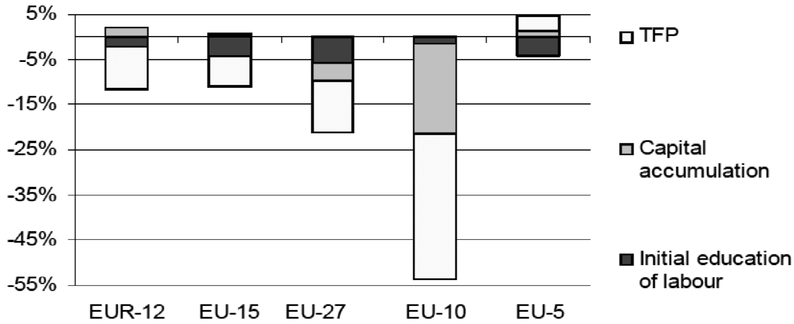
Source: Gordon, op. cit.
Note: This ratio takes Europe to include: Austria, Belgium, Denmark, Finland, France, Germany, Italy, the Netherlands, Norway, Sweden, Switzerland and the United Kingdom.

Figure 2. GDP Per Capita in EU-10 Countries (EU-15 = 100), 1990–2011



Source: World Bank, Europe 2020: The Employment, Skills and Innovation Agenda, p. 9 (Washington, DC: World Bank, 2011).
Note: Eurostat, GDP Per Capita in Purchasing Power Standard.

Figure 3. Driving Forces Behind the EU's Labor Productivity Gap Relative to the U.S.



Source: Mourre, op. cit.

turns out to be much lower total factor productivity (TFP), which is a result of legacy issues such as specialization in low value-added manufacturing, the substantial market share of companies with outdated technologies/products, and weak commercialization of scientific research results.

The developmental experience of knowledge-driven economies like Israel, Finland and Korea has created a global consensus about the importance of innovation as a source of growth. But even those who believe that innovation can solve the long-term growth conundrum facing Europe have a hard time explaining how to do it. This is because innovation is no "silver bullet." It depends on intangible factors, such as getting the incentives right inside scientific organizations. And because it is hard to define and measure innovation in a way that everyone agrees with, it can be difficult for government officials or managers to justify the necessary investment. In addition, even though the private and social rewards of innovation can be huge, they are highly uncertain, making it a hazardous investment, especially for smaller companies that cannot diversify their risks.

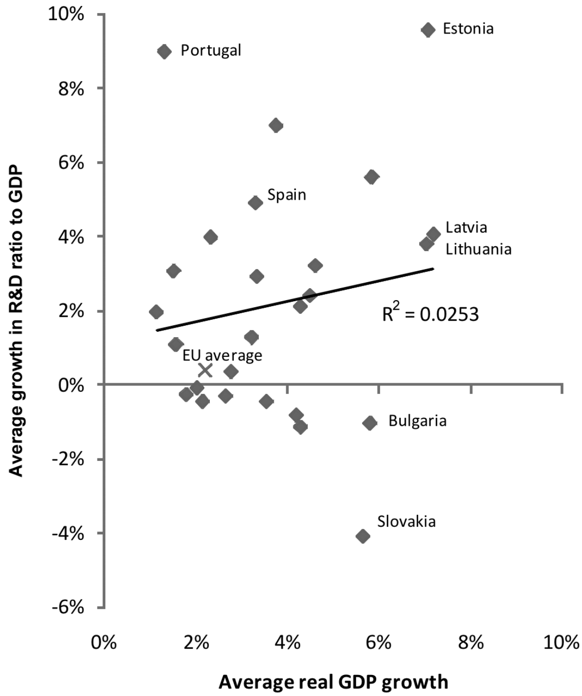
This chapter will argue that the Europe 2020 Strategy (henceforth "Europe 2020") moves the debate about scientific research and innovation policy in the right direction. Nevertheless, to successfully create a *focal point*[5] for multi-national R&D investments that are funded and performed by a variety of public and private actors, there is a need for concrete steps that clarify the "how to." The insights from successful (as well as failed) experiences offer options that can increase the chances of success of Europe 2020. In particular, this will mean efforts to: (i) reinforce the links between the overall R&D targets and national and European innovation policies; (ii) make the most of the tradition of excellence in basic research, by replicating successful institutional and governance models that already operate in the EU; and (iii) greatly stimulate R&D from private sources.

Turning EU-Level Coordination into National and EC Commitments on Research and Innovation Policy

What goals have been formally agreed at the EU level with regard to research and innovation? Most importantly, Europe 2020 reinstates the Lisbon Strategy target to increase R&D from 2% of the EU's GDP in 2010 to 3% by 2020. The track record suggests this announcement, by itself, is unlikely to produce the expected results. From 2000 to 2008, the EU and the U.S. had very similar growth rates in GDP (around 2.2% per year in real terms) and R&D intensity (only 0.4% per year). Growing at this rate, the EU's R&D intensity would barely reach 2.4% in 2050. Within Europe, fast-growing countries in the Baltics and the Iberian Peninsula managed to increase their R&D intensity, but in other new member states (Poland, Bulgaria, Slovakia) the R&D expenditures failed to keep pace with growth (see Figure 4). What this means is that the 2000s were marked not only by de-industrialization, with manufacturing progressively moved to lower cost destinations, but also by "de-R&D-ization." Of Europe's innovation leaders, only Finland and

[5] The description of a *focal point* made by Schelling continues to be relevant: "Once agreement is formally reached, it constitutes the only possible focal point for the necessary subsequent tacit collaboration; no one has a unilateral preference now to do anything but what he is expected to do. In the absence of any other means of enforcement, then, parties might well be advised to try to find agreements that enjoy this property of interdependent expectations." Thomas Schelling, *The Strategy of Conflict* (Cambridge, MA: Harvard University Press, 1960), p. 135.

Figure 4. Growth in GDP and in the R&D to GDP Ratio in the EU (%), 2000-2008



Source: Author's calculations using Eurostat.

Germany saw R&D intensify during the good years, whereas the UK and France actually fell behind.

One drawback of the 3% R&D intensity target agreed in the Lisbon Strategy is that it was irrelevant for well-established knowledge economies like Finland and Sweden (already above 3%) and unrealistic for a majority of countries that started from low levels (below 1%). This made it an implausible focal point. The architects of the Europe 2020 moved in the right direction by recognizing that every country has a different starting point and therefore national governments should set their own targets. Unfortunately, in the midst of a downturn, this choice was conducive to conservatism.[6] First, governments selected targets that are within a close range of their existing R&D levels—for example, Finland set itself a target of 4% by 2020 yet it is already at 3.9% today. Second, the national plans envision a slow (linear) increase in R&D, which will reduce the impact on growth as it takes time for the economic benefits from R&D to materialize.[7]

For Europe 2020 to boost R&D, the national targets need to translate into real—i.e., fiscal—commitments by countries. Even during the time when countries had more fiscal space than they do today, public spending on R&D barely kept up with tax revenue in many EU countries. And during the bad times, the reduction in science and innovation programs proved disproportionate. This has resulted in skepticism by policymakers like Wim Kok, who in a 2011 policy brief stated that "there appears to be a structural lack of connectivity between what is said in Brussels and what is perceived as being urgent in the member states."[8]

What will it take to have adequate follow-through on the national R&D targets? Periodic monitoring of Europe 2020 is an improvement over the Lisbon Strategy, but because the recommendations made by the EC are not binding and carry no penalties, it will only be effective

[6] The European Commission has criticized this in its first progress report on the Europe 2020 Strategy: "there is a risk of relatively low level of ambition in setting national targets and of an excessive focus on the short term... the aggregation of the provisional national targets shows that the EU still has some way to travel to meet the EU headline targets agreed by the European Council." European Commission, "Annual Growth Survey 2011: Advancing the EU's comprehensive response to the crisis," including "Progress Report on Europe 2020 (Annex 1)," Communication from the Commission (Brussels: European Commission, 2011).

[7] A macroeconomic simulation conducted by staff at DG-ECFIN concludes that the policy actions in the innovation area of the Europe 2020 strategy would result in a modest 0.5% increase in GDP by 2025, whereas the long-term impact 20 years later could be 2%. The exact numbers are subject to great uncertainty, but what's clear is that innovation requires a longer time to deliver the benefits. See Alexandr Hobza and Gilles Mourre, "Quantifying the potential macroeconomic effects of the Europe 2020 Strategy: stylised scenarios," *Economic Papers*, No. 424 (Brussels: European Commission, Directorate-General for Economic and Financial Affairs, 2010).

[8] Lisbon Council, *An Action Plan for Europe 2020: Strategic Advice for the Post-Crisis World* (Brussels, 2011).

if it creates an incentive to "move up the scoreboard."[9] Finland's experience suggests that active participation by top policymakers (the Prime Minister, Minister of Finance) in key coordination bodies is critical. This participation is essential for funding needs of scientific institutions and innovation programs to be properly represented in budget appropriation discussions and to motivate action on the reform front.

In the current economic environment, central and eastern European governments have a unique opportunity to assume leadership for the EU's innovation agenda. A major stumbling block is that most member states that increased their R&D intensity in the 2000s have faced a serious downturn that has led to sharp reductions in public spending and private investment. In particular, these include the Baltic states, Ireland, Spain and Portugal. For these countries, just getting to the pre-crisis R&D levels could take several more years. Given this context, Poland, a large and growing economy with a low and declining R&D-to-GDP (0.8%), could play a catalytic role. The Czech Republic, Slovakia and Bulgaria also fared better and could use this opportunity to dramatically narrow their R&D gap, thereby accelerating convergence in productivity and income.

To grasp this opportunity, central and eastern European member states would have to frontload their planned budget increases for scientific research and innovation and, more importantly, start to tackle structural issues that are a legacy of the system that was in place before the transition. Specifically, there are three legacy issues that seriously constrain the performance of the innovation system: first, weak institutional capacity and lack of experience with innovation support programs; second, a low share of private R&D in comparison to OECD and EU standards; third, the isolation of, and outdated governance in, many public research organizations (PROs). A sharp increase in public R&D, without building capacity in the public administration, new measures to stimulate private R&D, or systemic reforms of the PROs, will likely lead to an erosion in the quality of subsidized projects given the low absorption capacity that exists today.

[9] This type of incentive has been created by the World Bank's Doing Business report and the World Economic Forum's Global Competitiveness Index, as countries see that these rankings affect investor perceptions. It is unlikely such competition will be aroused by Europe 2020 because of its regional scope and thematic focus.

The experience in Israel suggests that having a simple institutional set-up with clear leadership for the research and innovation agenda—in the form of the Office of the Chief Scientist—can improve the implementation of innovation support programs, as well as help to mobilize political support and stabilize funding. Having a single ministry or agency that can champion this agenda mitigates cross-ministerial coordination problems that plague many EU countries, in which science and innovation policies take a second place, because the ministry is responsible for other priorities as well—this could be primary and secondary education, energy, foreign investment, and so on.[10]

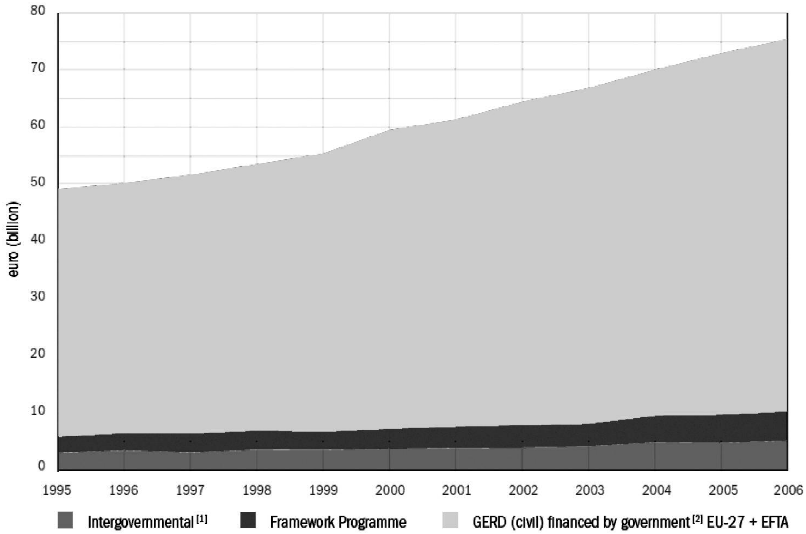
Another lesson from Israel is that it is more likely that policymakers and legislators will see the merits of investing public resources in science and innovation if there is a convincing case about the quality of public R&D expenditures—to put it in American slang, they need to see "bang for the buck." This means much more effective monitoring and evaluation of the results when there is public funding; it also implies taking concrete action so that successful programs are scaled-up, or transferred to the private sector, and failing programs are closed. Serious evaluations of innovation programs simply do not take place in many EU countries, and without them it is impossible to corroborate the direct and indirect impact of the subsidies.

EU funds earmarked to scientific research and innovation could themselves play a central role in achieving the Europe 2020 targets.

Up to now, the EC's Framework Programmes (FP) to support research and technological development have accounted for a relatively small piece of the pie (see figure 5, table 1). Even so, they have been important because FPs are less affected by cyclical ups and downs and they can support long-term R&D projects, as the funding envelope is decided for a multi-year period. FPs have also proved

[10] But it is worth remembering that unlike in other economic policy areas, there is as yet no consensus at the European level about the right institutional and governance model for coordinating/ implementing innovation policy. If the history of central banks is anything to go by, it will take several decades before there is enough accumulated experience by practitioners and academics to arrive at a unique EU model. The fact that *Research Policy*, the first specialized journal for innovation policy, was founded in 1971 is an illustration of how young this branch of social sciences is, as before this time there were only scattered articles on this topic.

Figure 5. Structure of Public Funding of R&D in Europe



Source: Commission of the European Communities, "A more research-intensive and integrated European Research Area: Science, Technology and Competitiveness key figures report 2008/2009," p. 103 (Brussels: European Communities, 2008).

Table 1. The EC Framework Programme for Research and Technological Development

Framework Programme	Period	FP Budget (billion euros)	% of total EU budget[1]
First	1984–1987	3.8	2.9%
Second	1987–1991	5.4	3.3%
Third	1990–1994	6.6	2.7%
Fourth	1994–1998	13.2	4.2%
Fifth	1998–2002	15	4.4%
Sixth[2]	2002–2006	17.5	4.3%
Seventh[2]	2007–2013	53.3	5.5%
Eighth[3]	2014–2020	80	7.8%

[1] This takes account of EU enlargement; the numbers shown are also adjusted for the overlap existing between FPs, but this has a small impact (below 1%).
[2] Includes Euratom.
[3] Estimated.
Source: Author's calculations based on EC financial participations in FPs in the Decisions of the European Parliament and of the Council; and EU budget data in Annex 2 of the EU budget 2008 Financial Report[a]

[a] Commission of the European Communities, *EU Budget 2008 Financial Report* (Luxembourg: European Communities, 2009).

effective at fostering international cooperation, filling a critical gap in the funding space, as national governments are reluctant to cross-subsidize foreign researchers and firms unless there is a clear benefit at the local level.[11] Scaling-up the FP that will cover the period 2014-2020 (this will be called the "Horizon 2020 Programme") is recognized as a priority by the Barroso Commission, which has announced an ambitious proposal to set aside €80 billion for FP8. If approved, it would represent a 46% increase from the current FP7, and it would mean that 7.8% of the total EC budget for 2014-2020 would flow towards research and innovation. The decisions about the EC budget at the European Parliament and the Council will determine the fate of this proposal.

Besides the FPs, the Structural Funds (SFs) have become a major source of EU funds in this area. Whereas the FP focus on research excellence and encouraging mobility of the best researchers, which means that Europe's "innovation periphery" gets only a small fraction of the available resources, the SFs can be designed to respond to national needs, and help raise the average capacity of domestic research organizations and firms. There is room to increase the share of SFs allocated to research and innovation and doing so would catalyze national commitments because the co-financing rules require national beneficiaries to put matching contributions on the table. But there are bottlenecks in absorption capacity that need to be dealt with.[12] Furthermore, there will be a greater long-term impact if additional funds target the demand-side of innovation, encouraging risk-taking by private firms so they undertake breakthrough innovations instead of co-financing run-of-the-mill technology upgrading.

[11] This can seriously undermine cooperation, as the benefits from knowledge and technology transfer tend to be asymmetric: they are greater for the partner that has less to offer, and usually counts with fewer resources.

[12] Recent figures reported in the *Financial Times* indicate that the EU as a whole has spent 21% of the €347 billion in structural funds four years into the seven-year programming cycle, but that several central and eastern European countries have not absorbed even 10% of their quota ("Growth funds fail to reach poor countries," *Financial Times*, Oct. 18, 2011). The take-up rate is lower when it comes to innovation rather than in infrastructure, because projects tend to be smaller and involve multiple beneficiaries.

Making the Most of Europe's Science Base

One of the most resilient strengths of Europe's research and innovation landscape is its science base. A telling statistic is that Europe's total R&D in nominal terms is 71% of the U.S. level and 80% of the level in Asia, yet it produces ⅓ of the world scientific publications, about the same as the U.S., and 1.5 times that in Asia.[13] And the quality of scientific output as measured by citations remains high, although not quite as high as the U.S., and Asia is closing in.

As many innovation scholars based in Europe have pointed out, however, the picture is more complex and challenging than it appears at first blush when looking at the EU's massive production of scientific publications in well-ranked journals.

First, the EU has far fewer "star scientists." While the U.S. accounts for 55% of the papers making it to the top 1 percentile in terms of citations, the EU is responsible for just 29%.[14] It is also reflected in the declining number of Nobel laureates. When it comes to physics, chemistry, physiology or medicine, the leading European countries fell behind the U.S. from the 1950s onwards, but after the 1970s, this margin grew very wide. What is worrying is that this trend has been the result of a failure to retain its emerging stars or attract others from the rest of the world. In the U.S., of the 314 laureates who won the Nobel Prize while working in the U.S., about one-third were foreign-born, including 15 Germans, 12 Canadians and 10 British. By contrast, just 15% of Nobel Prize winners in Germany were born abroad.[15] The challenge is to have more balanced 'brain circulation,' because right now the direction is predominantly from Europe to the U.S.

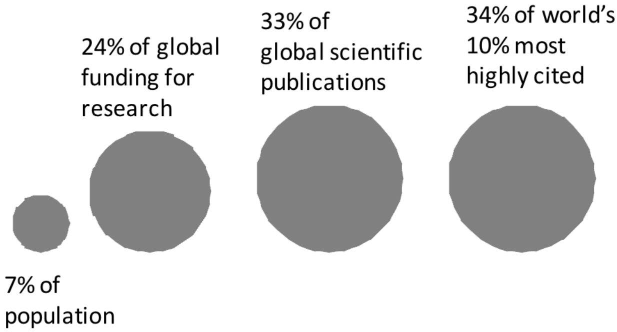
Second, scientific output and patenting are highly concentrated in a minority of research organizations located in a few EU countries. In central and eastern Europe, for example, patenting measures suggest a disproportionate concentration of this inventive activity in more

[13] National Science Board, *Science and Engineering Indicators 2010* (Arlington, VA: National Science Foundation, 2010).

[14] Veugelers, op. cit.

[15] http://www.forbes.com/sites/jonbruner/2011/10/05/nobel-prizes-and-american-leadership-in-science-infographic/. For more details see http://www.nobelprize.org.

Figure 6. The EU and U.S. Share of Global Science



Source: Author's calculations based on Eurostat; NSB (2010), op. cit.; Reinhilde Veugelers (2008), "An evidence-based reform process of EU universities," Presentation at the Third MWP-ACO Conference on University Autonomy and the Globalisation of Academic Careers, http://www.eui.eu/Documents/MWP/Conferences/VeugelersPPP.pdf.

advanced economies like Hungary, the Czech Republic and Poland.[16] Path dependence provides a good explanation for the growing divergence in scientific and technological productivity at the level of research units: initial advantages get bigger over time when funding mechanisms reward performance and researchers have the option to move to the organizations with the best reputation and infrastructure. The challenge is two-fold: to leverage the capabilities that exist in the top scientific institutions by facilitating connections to the second- and third-tier institutions; and to increase the economic impact of scientific results by supporting technology commercialization.

Third, when science leads to inventive activity that has commercial applications, it is likely to be part of an international effort that includes private partners. According to patenting data, international cooperation is one of the most important drivers of inventive activity is, particularly when this cuts across public and private spheres. An example is when scientists become part of a larger project funded by a foreign firm that has its own R&D team. In a recent analysis, we found that fully one-half of all patents granted to inventors based in central and eastern Europe and Russia are a result of multinational teams and

[16] World Bank, *Igniting Innovation: Rethinking the Role of Government in Emerging Europe and Central Asia* (Washington DC: World Bank, 2011).

Table 2. Partners for International Co-Invention with Post-Transition Countries

Country	Percent
Germany	30
United States	13
Switzerland	8
Finland	7
Austria	6
France	6
Sweden	5
Belgium	5
Netherlands	4
Great Britain	4
Canada	3

Source: World Bank (2011).

that multinational enterprises (MNEs) play a key role in these joint efforts.[17] The study also shows that the main partners are in western Europe, and Germany plays an exceptional role in these networks. This is a new trend, as traditionally the most active networks were transatlantic, especially between the U.S. and UK, or connecting advanced European countries.[18] The challenge is facilitating collaboration by establishing the right intellectual property rights (IPR) policies in scientific institutions and by introducing new instruments that can help with transaction costs (e.g., technology transfer offices).

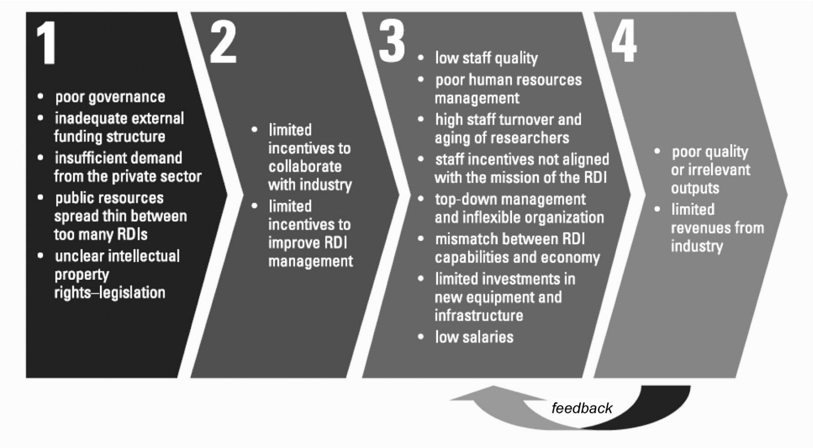
Fourth, the scientific productivity and impact of research organizations is hampered by outdated institutional and governance models, especially in the new member states. In a recent book, we undertook case studies of 21 public R&D institutes (RDIs) in Croatia, Lithuania, Poland, the Russian Federation, Serbia, Turkey, and Ukraine. The main conclusion is that RDIs in these countries have yet to complete

[17] World Bank, "Globalization and Technology Absorption: Role of Trade, FDI and Cross-Border Knowledge Flows," World Bank Working Papers No. 150 (Washington DC: World Bank, 2008).

[18] Royal Society, *Knowledge, Networks and Nations: Global Scientific Collaboration in the 21st Century* (London: Royal Society, 2011).

[19] World Bank, "Restructuring of Research and Development Institutes in Europe and central Asia" (Washington DC: World Bank, 2009); World Bank (2011), op. cit., Figure 7.

Figure 7. Chain of Events Leading to Ineffective R&D Institutes



Source: World Bank (2011).

the transition to the region's new economic realities.[19] Prior to 1990, RDIs were oriented toward the technological needs of large state-owned enterprises. Two different types of RDIs appear to have emerged with different core activities and funding sources. On one hand, there are RDIs that are predominantly funded by public sources and are rather isolated from knowledge commercialization activities, yet at the same time have not shown sufficient results in regards to publications and training. On the other hand, some RDIs are largely financed through the goods and services they offer the private sector, but these goods and services seem to be at the lower-end of the knowledge value chain. The challenge is to reform public research organizations to make them more flexible, refashion internal incentive structures depending on their core mission and improve the connectivity to enterprises.

Reforming the governance of public R&D institutes has proved extremely hard, but at the minimum countries could work on two fronts: helping organizations to better define their missions and operational models according to whether they primarily produce scientific outputs and public goods, or technological services for the business sector; and increasing the share of public funding that is competitive or tied to performance (e.g., in return for specific outputs, or matching external financing from EU sources or commercialization activities).

The final takeaway is that stepping up to these challenges will take much more than a boost in R&D spending and the specific proposals made in Europe 2020—in particular those in the *Innovation Union* flagship initiative—may not go far enough. At the heart of it, the difficulty is balancing the fundamental tension between two priorities: (i) excellence—helping the best scientific institutions to become even better so the EU can maintain a leading place in the global scientific landscape, because if this is not accomplished, Europe may forego making the scientific breakthroughs that will be the basis for the next generation of transformative innovations;[20] (ii) cohesion—constructing a more integrated European Research Area that takes advantage of the full distribution of scientific capabilities, which range from 38,000 researchers in higher education in Poland all the way to Slovenia with 2,000.[21]

To give but one example, the *Innovation Union's* commitment to removing mobility obstacles will most certainly have a positive effect for priority (i) excellence, but will only strengthen (ii) cohesion if there is a simultaneous push to equalize researcher career prospects across countries—without this, the impact will not be healthy brain circulation[22] but additional brain drain from east to west and from

[20] Also called "general purpose technologies" (GPTs) because of their pervasive diffusion into all industries and broad based productivity impact. Besides IT (the computer, the Internet), economists have argued that examples of GPTs include the steam engine, electricity, the railroad, etc.

[21] Eurostat data about total number of researchers, measured in full-time equivalent.

[22] The idea behind brain circulation is that highly-skilled workers who are globally mobile do not just migrate in the direction of OECD economies; they respond to emerging opportunities in different parts of the world. Increasingly, the trend is for younger people to leave their countries to obtain a better graduate education, get some work experience and accumulate capital, and later return home to start a business, work in the subsidiary of a MNE, join a university, and so on. AnnaLee Saxenian provides many examples of scientists and engineers that headed back to China and India in "From Brain Drain to Brain Circulation: Transnational Communities and Regional Upgrading in India and China," *Studies in Comparative International Development*, Volume 40, 2005.

south to north, reinforcing the differences in scientific productivity and impact.

Stimulating Innovation in the Private Sector

In the Lisbon Strategy, besides the 3% R&D-to-GDP target, there was a target to increase the private R&D share to two-thirds. This is no longer an explicit target in the Europe 2020 Strategy, but it is clear that a sustained and concerted effort by public and private actors will be needed to succeed in making innovation the basis for future growth.

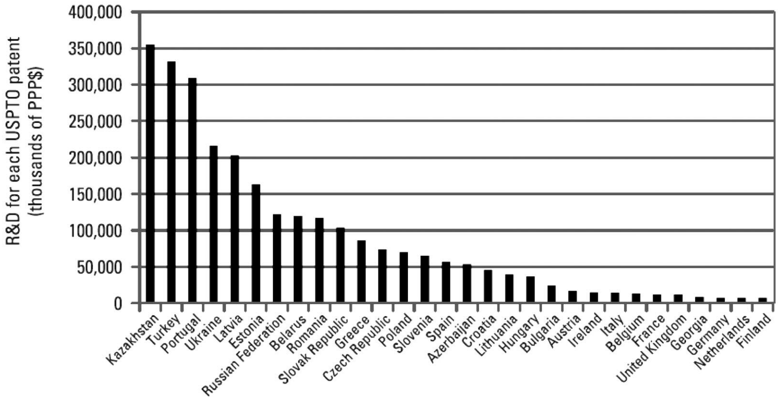
However, the bottom line is that the share of business R&D in total R&D has actually declined in the EU during the last decade—from 56.4% in 2000 to 54.7% in 2008. The new member states lag further behind in this dimension, so not only do they spend less on R&D, but also the private contribution is very weak. The reason is that growth in many of these countries was anchored on business investments in services, financial sector, construction and real estate, which tend to have low R&D intensity. The stubbornly low levels of private R&D have translated into a low effectiveness of R&D spending, as measured by any of the main innovation outputs (patents, publications, citations to patents and publications, high-tech exports, and so on). The R&D "cost" for each patent provides a good illustration of the extent of this structural weakness across Europe (Figure 8).

Meanwhile other countries moved further ahead, including the U.S., where business R&D already accounted for 72% of total R&D in 2000, a ratio that held steady over the last decade. What is remarkable is that this was achieved endogenously, without any big shift in the basic parameters of U.S. research and innovation policy. What is behind this transatlantic divergence? There is no single answer to this question, but the numbers suggest that the incredible growth achieved by U.S. high-tech firms is a central part of the explanation. These com-

[23] NSB (2010), op. cit., provides relevant indicators:

- "Over the past 20 years, growth in [US] R&D spending has averaged 5.6% in current dollars and 3.1% in constant dollars—somewhat ahead of the average pace of GDP growth over the same period (in both current and constant dollars)."
- "Over three-fourths of business R&D is performed in six business sectors. The R&D-to-sales ratio for these sectors as a group was 8.0% in 2007, compared with 1.4% for all other business sectors."

Figure 8. How Much Does a Patent "Cost"? Evidence from the EU and Neighboring Countries



Source: World Bank (2011).

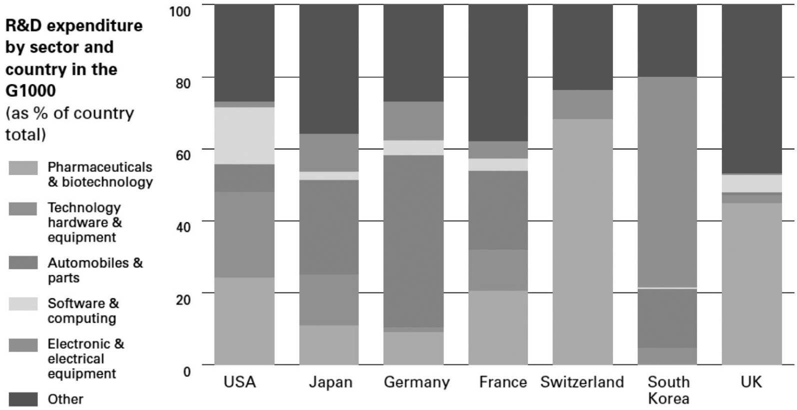
panies have much higher R&D-to-sales ratios than companies in traditional manufacturing or services, and as their weight in the economy is growing, and indeed growing much faster than public R&D expenditures, this has lifted the business R&D share for the U.S. as a whole.[23]

The late start and slow growth of an indigenous Information Technology (IT) sector is probably the Achilles' heel of private innovation in Europe. This structural weakness is noticeable in the *2010 R&D Scoreboard*, which surveyed the top 1,000 UK and the top 1,000 global companies by R&D (see Figure 9). The share of R&D undertaken by the software and computing sector in the U.S. is around 3-4 times that in the UK, Germany and France.

As with scientific productivity, path dependence could reinforce this pattern of R&D specialization as time goes by, making it increasingly difficult for the EU innovation policy to counteract the U.S.

[24] In layman's terms, a patent thicket has been defined as a "dense web of overlapping intellectual property rights that a company must hack its way through in order to actually commercialize new technology." Carl Shapiro, "Navigating the Patent Thicket: Cross Licenses, Patent Pools, and Standard Setting," *Innovation Policy and the Economy*, No. 1 (2000), pp. 119-150.

Figure 9. The Sectoral Breakdown of Business R&D across Countries



Source: UK Department for Business Innovation and Skills, The 2010 R&D Scoreboard (London, 2010).

technological dominance in these sectors. For example, the accretion of "patent thickets"[24] by leading companies will make it much harder for second-movers from the EU (or other regions) to develop a competitive advantage. On account of barriers to market entry related to IPR and marketing, as well as weak initial capabilities, IT companies in Europe that integrated into software development supply chains have generally not managed to develop proprietary technologies and brands. Patent thickets can also interfere with the development of scientific research, as they impose extra search and transaction costs on scientists- such as licenses.[25]

One way to counteract this trend will be to attract global IT leaders to set up large R&D facilities in Europe. Thanks to their lower wages and availability of qualified engineers, central and eastern European countries could be prime locations for these investments—Krakow in Poland is already recognized as an emerging IT hub, with a range of IT services, business process outsourcing (BPO) and R&D labs estab-

[25] Paul David, "The Economic Logic of "Open Science" and the Balance Between Private Property Rights and the Public Domain in Scientific Data and Information: A Primer," Stanford Institute for Economic Policy Research (SIEPR) Discussion Paper No. 02-30 (2003).

lished by, for example, IBM, Motorola, and Google. To stimulate this process, it's important that governments put in place incentives that are tailored to R&D-intensive FDI. How is this different from manufacturing FDI? The key difference is that R&D-intensive FDI is about bringing together a pool of advanced human capital and connecting it at a global level. This has several implications. First, without a pipeline of well-educated graduates, companies will be unwilling to establish a base; daspora programs may be useful in the short term but the quality of domestic education eventually needs to attain global standards. Second, the business environment needs are very specific, including streamlined work permits and a rock-solid IPR framework that facilitates collaboration with public research organizations. Third, scientific institutions need to get the legal and financial support to effectively use R&D contracts, patenting, and licensing when they cooperate with large FDI companies. Fourth, the location needs to be attractive for foreign inventors and developers that will relocate from cities such as Palo Alto or Boston. So if the government is planning a science and technology park, it would need to have excellent access to the main universities, airports and international schools.

In the long term, however, helping indigenous European companies to catch up through activist innovation policies may be less important than understanding the underlying conditions that discourage EU-based entrepreneurs from making the first move or growing as fast as their U.S. peers. It's important to highlight one fundamental difference that has been widely discussed, namely, the different attitudes to risk and entrepreneurship. Outside of Scandinavia, many Europeans seem deeply averse to risk-taking and often have an unfavorable opinion about entrepreneurs. The Flash Eurobarometer[26] conducted annually by Gallup on behalf of the EC's DG Enterprise offers some insightful numbers:

- "The fear of bankruptcy is one of the largest obstacles for many people to start a business. Nevertheless 65% of Europeans

[26] European attitudes to Entrepreneurship, EC MEMO/10/232, Date 04/06/2010, available online at http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/10/232; Flash Eurobarometer Series #283, *Entrepreneurship in the EU and beyond*, Analytic report, 2009.

declare that they are generally willing to take risks. In the US about 82% of those questioned are willing to take risks."

- EU citizens are less likely to say they are risk-takers and liked competition (around 60%) compared to American respondents (around 80%).
- A large majority of Danes and Finns report a positive opinion of entrepreneurs (around 80%), similar to the US—but less than 30% of people in Hungary share this opinion.
- The lack of finances for self-employment is a major obstacle for 24% of EU citizens, compared to 14% in the US.

There are three facets of Europe's aversion to risk and entrepreneurship that the EC and national governments would need to tackle to unleash private innovation. First, there is aversion at the micro level, among potential innovators and entrepreneurs. This has a cultural root that will take time to change—and it's unlikely to happen until there is a large enough number of role models and the education system implant innovation and risk-taking as positive traits. But there is a financial dimension as well. By having a basic universal safety net, countries in Scandinavia mitigated the potential downside of innovating, which makes it easier to take certain risks. There is a danger that the current economic downturn further dampens risk-taking, as the safety nets are cut back.

Second, there is aversion to risk-taking within Europe's financial institutions and investor community. The reason is that when it comes to R&D investments, banks or insurance companies are not in the presence of the standard risks that they can measure and cover. Innovation finance needs to look beyond measurable risks and returns, cashflow and collateral. The US and a few other countries have managed to develop a pool of early stage technology funds and venture capital (VC), and this has been one of the catalysts for the emergence and growth of the IT industry. According to a new report on the VC industry, the supply of VC as a share of GDP is 0.15% in the U.S., six-times larger than in the EU, where it is 0.026%. It's not just a question of size. When it comes to evaluating the potential economic value of innovations, there is no substitute for industry and entrepreneurial experience. The same report points out that the U.S. has 50+ year history of VC against 10+ in the EU, which means that US teams have now managed 6 or more generations of funds. As with entrepreneurs, one of the side effects of the abnormally high volatility experienced since 2008 is that investors are induced into a "flight to safety," and this has a disproportionately strong impact on VC as IPOs constitute the main "exit" mechanism to realize these investments.

Third, there seems to be a low tolerance to risk in the public sector as well. The volumes of early stage funds to co-finance private R&D tend to be smaller. Specifically, a close examination into the use of EU structural funds shows that countries like Poland or Bulgaria have predominantly supported low-risk investments that aim at enhancing productivity—essentially upgrading of machinery and equipment. While upgrading was critical during the transition period, it is now essential to boost real R&D investments. This is not just a question of changing priorities. Administering innovation programs requires specific skill-sets and attitudes, but the public sector focus is often on meeting administrative criteria and tracking the flow of funds, not evaluating the potential or actual results. Moreover, within the European context, the Framework for State Aid for R&D and Innovation has limited the flexibility to formulate innovation policy. While the overall objectives of this framework are sound, the devil is in the details, as highlighted by the comments submitted to the consultation document, which bring to light potential rigidities in the framework.[27]

Final Thoughts

The central question this chapter asked was how much mileage the EU can expect from the Europe 2020 when it comes to innovation. The answer is that having a fully coordinated innovation policy framework at the EU level can be a powerful catalyst, but it is not the fuel, nor is it the engine of growth that will narrow the productivity and income gaps vis-à-vis the U.S.

[27] For example, TEKES, the Finnish Funding Agency for Technology and Innovation which has a global reputation for its innovation programs, commented that because high-tech sectors like biotech have long time-to-market and product development cycles, they should benefit from more favorable treatment. This proposal was not incorporated. http://ec.europa.eu/competition/state_aid/reform/comments_innovation/39632.pdf.

In part, the fuel has to come in the form of firm expenditure commitments by individual countries that turn the Strategy's headline target for R&D-to-GDP into a reality. Given their healthier public finances and the considerable catch-up they still need to make, central and eastern European countries would do well to assume a greater leadership role in this process. EU funds could directly help, provided they are scaled-up drastically and redirected to stimulate frontier innovation.

Europe's science base is an incredibly important asset. A tradition of excellence in basic research has been a bridging point between advanced knowledge economies such as Finland and Germany, and new member states such as Poland and Hungary. International collaboration and public-private collaboration can step up scientific excellence and impact, and simultaneously help to construct an increasingly integrated European Research Area. Reinforcing the performance of the research organizations that have worked in relative isolation so they can start new partnerships will help to fully integrate Europe's research and innovation ecosystem.

But unless the private sector becomes the main funding source and performer of R&D, the outcomes are liable to disappoint. Attracting larger volumes of R&D-intensive FDI could provide a short-term boost. But in the long run, it is more critical to dispel the lingering aversion to risk-taking and entrepreneurship, so future technological opportunities can be grasped. Because the financial crisis will push in the opposite direction, it would help if countries took a much more proactive effort.