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Scarce funds, infinite ideas: choosing the right innovation policies

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Luxembourg faces an innovation puzzle. Despite high income and productivity levels, international firms, strong public research institutions and access to European markets, productivity growth has slowed, while business R&D and firm-level innovation remain modest by international standards. Several explanations are possible, including sectoral specialisation in services, measurement limits, a small domestic market and delayed returns from new technologies. Yet these remain hypotheses, not established facts. This brief reviews key policy instruments to strengthen innovation, including R&D support, public procurement, collaboration schemes and science funding, and argues that they should be designed as a coherent policy portfolio rather than a patchwork of programmes. The priority is not necessarily to spend more on innovation support, but to target the right actors and account for interactions among instruments. Understanding their impact requires linked firm-level and policy data.

Innovation is essential for productivity, competitiveness and long-term growth. But innovation is not just one thing. It can manifest as new products that consumers experience directly, such as smartphones, digital payment systems, on-demand delivery services, and new medical treatments. It can also take the form of new processes, such as better microchips, more efficient batteries, artificial intelligence tools, logistics systems, production methods and organisational routines. Product and process innovations are interconnected. A new consumer product often depends on earlier process innovations in areas such as materials, energy, data, software and manufacturing. Conversely, new products create demand for better processes.

Innovation also varies in scope. Incremental innovation improves existing products, services or processes. It makes them cheaper, faster, greener, safer and/or easier to use. Radical innovation, on the other hand, opens up new technological or market possibilities. It can generate entirely new sectors, transform existing ones or make old technologies obsolete. Both matter. While incremental innovation often raises efficiency and competitiveness in the short term, radical innovation is more uncertain but potentially more important for long-term growth. Incremental and radical innovation are also interconnected. Artificial intelligence is a useful example: as a general-purpose technology, it has radical potential, even if many of its immediate applications take the form of incremental improvements in existing products, services or processes.

This distinction is central to policy. Countries can grow by adopting technologies developed elsewhere, particularly if they are below the technological frontier. However, adoption and innovation require different resources and policies. Adoption requires firms to be able to identify, absorb and implement existing technologies, which depends on having good managers, engineers, IT specialists and skilled workers. Growing through innovation, however, requires the additional capacity to create, adapt and combine knowledge in ways that generate new value and expand the technological frontier. This relies more heavily on investment in R&D, well-trained researchers, connections between science and industry, demanding customers, competitive markets, and public institutions that can take informed risks.

The policy problem is that, although ideas are abundant, private and public resources to transform them into useful innovations are limited. The state cannot fund everything, nor should it. The central question is not whether governments should support innovation, but which instruments work for whom, under what conditions and towards which goals. The economic rationale for government intervention is well established: knowledge generates spillovers (Arrow, 1962; Aghion & Howitt, 1992). Once produced, it can often be reused by others at low cost. While this benefits society, it weakens private incentives to invest in risky research. A sound innovation policy must therefore strike a balance between knowledge creation and knowledge diffusion (Arrow, 1962).

Turning ideas into innovation: what policy can do

R&D support works when it creates additionality

Public R&D support is one of the most common innovation-policy tools. Its success depends on additionality: public money must encourage firms to conduct more, riskier or more socially valuable R&D than they would have done without support (Czarnitzki & Lopes-Bento, 2013; Hottenrott et al., 2017). However, if a firm simply receives a grant for a project that it would have financed anyway, then public money is largely wasted. This is why R&D support can fail. In theory, the support may be captured by firms that are good at applying for grants rather than by those with the best projects, or it may support firms with insufficient absorptive capacity to transform funding into innovation.

Nevertheless, the evidence shows that well-designed R&D grants can work. Studies of firms in Flanders, Belgium, Germany and Switzerland find that public R&D support can increase R&D investment and employment, especially when schemes are targeted and firms have the capacity to use the support effectively (Czarnitzki & Lopes-Bento, 2013; Beck et al., 2016). Importantly, the type of innovation matters. Evidence suggests that public support may be particularly valuable for radical innovation, where uncertainty is greater, returns are more distant and failure is more probable (Hottenrott et al., 2017). Such projects often require resources that are willing to bear risk, which private funders may be reluctant to provide. Incremental innovation is usually closer to existing products and markets, making it less risky and easier for banks or private investors to finance.

R&D tax incentives operate differently. They reduce the cost of R&D for a wide range of firms and are easier

to scale up. However, they are less selective and may support activities that firms would have undertaken anyway. Direct grants are more targeted, but require better selection processes. An effective system typically requires a combination of broad incentives to encourage diffusion and incremental upgrading, as well as selective support for riskier, more ambitious projects.

Public procurement: creating markets for innovation

Innovation does not depend only on supply. New technologies can fail because early markets are missing, users are uncertain, or buyers prefer familiar solutions. This is where demand-side policy matters. Thus, public procurement can create early demand for innovative products and services (Uyarra & Flanagan, 2010). Governments are large buyers in areas such as health, defence, transport, construction, education, energy and digital services. If procurement is designed only to minimise short-term costs, it can reinforce existing suppliers and established technologies. But if tenders specify functional needs rather than predetermined solutions, procurement can encourage firms to develop new approaches (Uyarra & Flanagan, 2010).

Procurement is particularly relevant for radical innovation when firms face market uncertainty. A first public buyer can help validate a technology, reduce commercial risk and attract private investment. For incremental innovation, procurement can also push suppliers to improve quality, energy efficiency, digital performance or service delivery. The key is design. Innovation-oriented procurement requires competent public buyers, clear objectives, openness to new entrants, evaluation criteria that aren't too restrictive and that do not simply reward the cheapest existing solution.

Collaboration helps under the right conditions

Innovation increasingly depends on collaboration between firms, universities, suppliers, customers, public research organisations, start-ups, and users. Such collaboration can provide firms with access to complementary knowledge, reduce costs, and enable risk to be shared. This can be particularly beneficial for small and medium-sized enterprises, which often have limited internal research capacity. However, collaboration is not always beneficial. It can create coordination and search costs, as well as monitoring problems and risks of knowledge leakage. Furthermore, too many collaborations can dilute focus and slow down the decision-making process. Evidence suggests that the benefits of collaboration follow an inverted-U curve: they increase up to a point, after which the costs can outweigh the benefits (Hottenrott & Lopes-Bento, 2016).

Therefore, policy should not promote collaboration for its own sake. Instead, it should only support collaboration when partners bring complementary capabilities, objectives are clear and firms have sufficient absorptive capacity to learn from external knowledge. The distinction between radical and incremental innovation is also important here. Radical innovation often requires a broader combination of knowledge, including links between science and industry and international partnerships. In contrast, incremental innovation may benefit more from collaboration with customers, suppliers or within the same sector, focused on practical improvements.

Public science: the upstream foundation of innovation

Innovation policy should not be limited to support firms. Public science, which is mainly research conducted in universities and public research organisations, is a foundational element of innovation. It generates knowledge that private firms may subsequently utilise in unforeseeable ways. It also generates human capital: PhD graduates, researchers, engineers, and scientifically trained entrepreneurs who move across sectors and carry knowledge with them.

While innovation and science policy overlap in this area, they should not be confused. Industrial policy targets specific sectors, firms, technologies or projects with economic and strategic goals. In contrast, fundamental research policy supports the knowledge base, scientific capabilities and long-term exploration on which future innovation depends. While industrial policy often requires direction, fundamental science also requires openness.

The challenge lies in uncertainty. The most valuable discoveries are often difficult to predict, and funding systems that focus too narrowly on immediate applications may underinvest in the knowledge base from which future breakthroughs emerge. Researchers need time, autonomy and the possibility to pursue risky, long-term questions, while public institutions need mechanisms that preserve strategic ambition without forcing all projects into short-term impact logics.

Models such as the Defense Advanced Research Projects Agency (DARPA) in the United States show how ambitious missions, strong scientific leadership, flexible programme management and tolerance for failure can support projects that are too uncertain for ordinary funding schemes. A complementary approach is provided by excellence-based, multi-year research funding, such as France's LabEx programme, which gives high-performing research teams stable resources and international visibility to develop ambitious scientific projects whose value may only become apparent over time.

However, this does not mean that all science funding should be mission-driven. A healthy system requires curiosity-driven research, interdisciplinary teams, doctoral training, research infrastructure, and channels for knowledge transfer. Science policy supports radical innovation by expanding what is technologically possible. It also supports incremental innovation by improving the skills, methods, and knowledge available to firms. The objective is not to turn universities into short-term service providers for industry, but rather to establish a robust foundation for the entire innovation system.

No silver bullet: build a portfolio, not a patchwork

Innovation instruments work best when used in combination. R&D grants, tax incentives, procurement, collaboration schemes, start-up support, European funding and science policy all interact with each other. While they may reinforce each other, they may also overlap or crowd each other out. A simple example of this is the relationship between supply and demand. R&D grants can help firms generate knowledge. Public procurement can help to commercialise that knowledge by creating early demand. However, if procurement comes first and grants arrive later, the additional effect is limited. Similarly, a firm receiving several forms of support may either increase its total innovation effort or simply reallocate activities across instruments.

This is why policy design should address the bottleneck first. If firms lack the incentive to undertake risky research, grants or tax incentives may be appropriate. If firms have the technology but lack an early market, procurement may be more effective. If firms lack complementary knowledge or absorptive capacity, collaboration schemes can help. If the bottleneck is the creation of long-term knowledge, fundamental science and doctoral training are essential. However, if firms are unable to scale up, then finance, regulation, skills and competition policy may be more important than R&D subsidies.

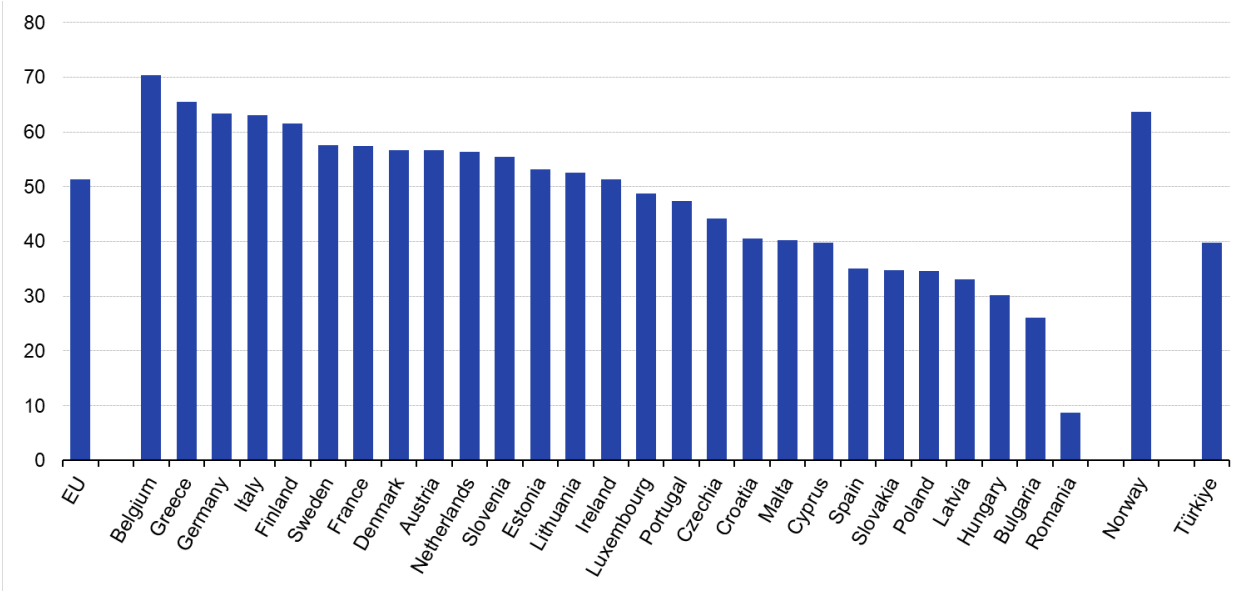
A portfolio approach also requires better data. Governments need to know not only whether a programme works on average, but also which firms use it, whether the support provided is additional, how the various instruments interact and whether the outcomes differ for the type of innovation. This requires linked data on firms, projects, grants, tax incentives, procurement contracts, collaboration partners, scientific outputs, patents, and employment and productivity over time.

Better data are not a technical luxury. They are a prerequisite for better decision-making. Without them, governments risk investing a lot of money in innovation support without knowing whether the support changes behaviour. They cannot identify whether policy combinations create complementarities or cause crowding out. They cannot easily distinguish between successful incremental upgrades and genuinely radical innovations. In a context of scarce public resources, the capacity to evaluate is an integral part of innovation policy.

Luxembourg: high productivity, weak momentum?

Luxembourg faces a specific innovation puzzle. It has high income and productivity levels, many international firms, good research institutions and access to European markets (OECD, 2025; European Commission, 2025). Yet productivity growth has stagnated, and firm-level innovation appears weaker than one might expect for such a rich economy. According to the Eurostat Community Innovation Survey, 48.8 per cent of Luxembourg firms were innovation-active over 2020–2022, slightly below the EU average of 51.4 per cent. This places Luxembourg close to countries such as Lithuania, Ireland, Portugal and Czechia, but well below its neighbours: Belgium, where 70.3 per cent of firms were innovation-active, Germany at 63.4 per cent, and France at 57.4 per cent (see Figure 1).

Figure 1 – Share of innovative-active enterprises, 2020–22 (as percentage)

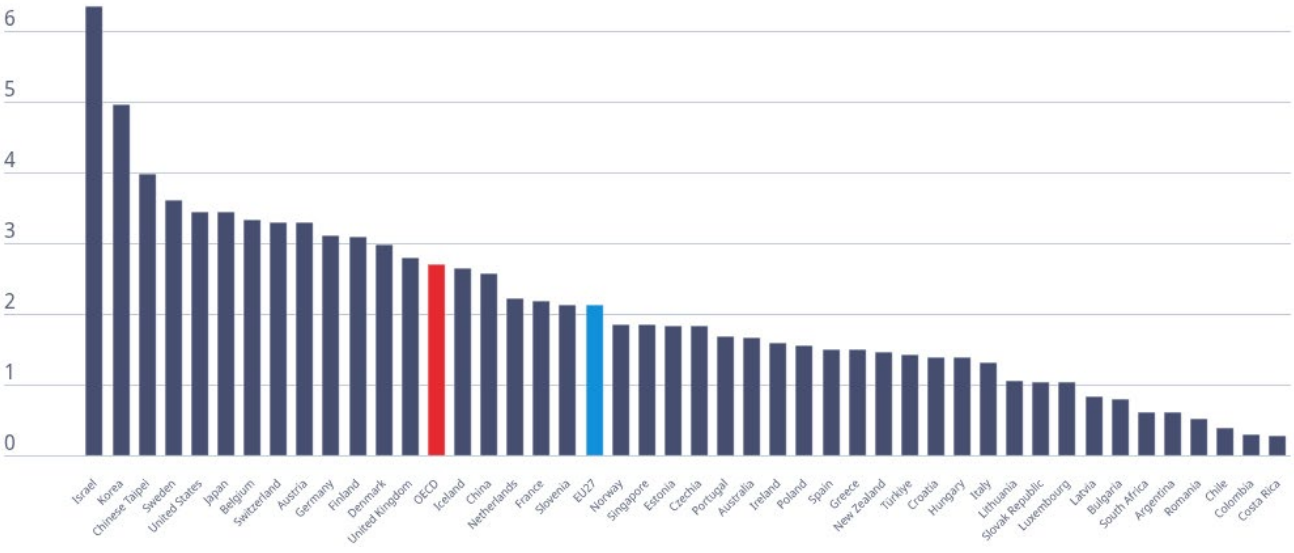


Source: Eurostat Community Innovation Survey

When it comes to innovations with significant environmental benefits, Luxembourg also sits around the middle of the distribution. Finally, Luxembourg's R&D intensity remains low by international standards. In 2023, gross domestic expenditure on R&D represented around 1.0 per cent of GDP, compared with 2.1 per cent in the European Union, 2.7 per cent in China and 3.5 per cent in the United States (Figure 2). The policy question is why these strong structural advantages have not translated into stronger business R&D, broader firm-level innovation and renewed productivity growth.

Several explanations may help account for Luxembourg's innovation puzzle, although the available evidence does not allow for causal conclusions. A first explanation might be sectoral specialisation. Luxembourg is highly specialised in financial and business services, where innovation often takes the form of software, data use, organisational change, compliance systems and new service models rather than formal laboratory R&D or patentable inventions. Standard indicators may therefore underestimate some innovation activity in the economy.

Figure 2 – Gross domestic expenditures on R&D as a percentage of GDP, 2023



Source: OECD (2025): Main Science and Technology Indicators (MSTI) Database.

However, this explanation should not be overstated. OECD comparisons indicate that Luxembourg's low business R&D intensity cannot be attributed solely to its large financial sector, as R&D spending is modest in several other business sectors as well.

A second possibility is that technology adoption does not immediately translate into measured productivity gains. This is particularly relevant for digital and data-intensive services, where productivity improvements depend on complementary investments in software, data infrastructure, cybersecurity, skills, regulation and organisational change. The literature on the productivity paradox suggests that general-purpose technologies such as AI may require substantial intangible investment before their benefits become visible in productivity statistics (Brynjolfsson et al., 2021). For Luxembourg, this should be treated as a hypothesis rather than an established fact, but it is consistent with evidence that technology adoption still lags behind top-performing countries.

These explanations point to a broader policy agenda (OECD, 2025; European Commission, 2025). Luxembourg should be cautious about simply imitating large manufacturing economies. Its innovation strategy should reflect its structural characteristics: a small domestic market, high openness, strong international firms, a service-oriented economy and a relatively young public research system. The objective should be to strengthen the links between public research, business R&D, technology adoption and European market opportunities. However, evidence on the strength of these links, and on where the main bottlenecks lie, remains limited. This makes better data a policy priority. Linked firm-level and policy data would make it possible to assess whether existing instruments reach the right firms, whether they generate additional innovation effort, how different instruments interact, and whether Luxembourg's innovation system is constrained mainly by finance, demand, skills, collaboration, science-industry links or scale-up conditions (OECD, 2025). Without such evidence, policy risks adding instruments without knowing whether they address the binding constraints.

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