Riccardo Crescenzi February 27th, 2025

European Big Science has the potential to drive social and economic transformation

Investment in Big Science projects, such as the Large Hadron Collider at CERN, are often seen as purely scientific ventures. **Riccardo Crescenzi** *argues a more co-ordinated approach to Big Science across the UK and European Union could produce significant social and economic benefits, as well as catalysing innovation and increased competitiveness across the bloc.*

Riccardo Crescenzi and Mark Thomson, the Director-General Designate of CERN, discussed the benefits of Big Science at LSE on 3 March 2025, you can listen to a recording here.

Large-scale scientific endeavours, or "Big Science", are not just about unravelling the mysteries of the universe. They are powerful engines of innovation, economic development, and societal progress.

In this respect, the European Union and United Kingdom face fierce competition from the United States and China. By investing in and coordinating large research infrastructures, both the EU and the UK have an important opportunity to unlock significant socio-economic benefits, spur industrial competitiveness, and foster a more resilient joint research ecosystem.

Big Science and competitiveness in Europe

Recent studies reveal that the Europe's innovation capacity lags that of the US, and that China is rapidly closing the gap. A major part of this challenge stems from the lack of coordinated public research and development (R&D) efforts across European economies. Unlike the US, where investments in large-scale projects are often coordinated at a national level, European nations tend

to fund scientific initiatives independently, even within the EU. This fragmented approach not only increases risks and costs, but also diminishes the collective bargaining power of individual countries when negotiating procurement contracts for sophisticated research equipment.

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For example, Mario Draghi in his Report on "The Future of European Competitiveness" emphasised that "some large-scale innovation projects can only take place at the EU level due to their size and risk profile." When member states work in isolation, they run the risk of duplicating efforts and missing out on economies of scale. By aligning R&D efforts at a European level, policymakers can create a unified strategy that enhances both the quality and impact of research investments. This coordination is essential not only for achieving scientific breakthroughs, but also for boosting industrial competitiveness and creating sustainable economic growth.

The benefits of Big Science

Beyond enhancing competitiveness, Big Science projects generate a range of industry benefits. These ripple through the economy in several ways:

- **Scientific production:** Large research infrastructures produce high-impact scientific outputs that feed into broader innovation ecosystems. When cutting-edge discoveries are made, they often lead to the development of new technologies and methodologies that can be commercialised.
- **Training and skill development:** Big Science projects serve as advanced training grounds for the next generation of scientists, engineers, and technicians. The hands-on experience provided by these initiatives not only improves technical expertise, but also fosters a culture of innovation and collaboration. As researchers work with state-of-the-art equipment, they acquire skills that are directly transferable to industry.
- **Industrial collaboration:** The procurement processes associated with Big Science projects engage thousands of firms across multiple countries. For instance, during the 1995-2015 period,

approximately 4,200 firms in 47 countries collaborated with CERN on the Large Hadron Collider project. Such collaborations enable companies to upgrade their technological capabilities, expand their production processes, and enter new markets.

- **Cultural and societal impact:** Big Science initiatives do more than just generate economic value; they also inspire public interest in science and technology. The cultural benefits include enhanced public engagement, educational outreach, and the promotion of a broader scientific literacy that can help drive future innovation.
- **Advancements in data and ICT:** The large volumes of data produced by these projects spur advancements in information and communication technologies (ICT). This progress not only benefits scientific research but also has wide-reaching applications across various sectors, from healthcare to finance.
- **Environmental benefits:** Some technological innovations emerging from Big Science have the potential to improve energy efficiency and contribute to environmental sustainability. These advancements can lead to greener industrial processes and help reduce the overall carbon footprint of technological production.

In essence, Big Science serves as a multidimensional tool for economic and social advancement. It has the potential to create a virtuous cycle where scientific discovery fuels technological innovation, which in turn drives industrial growth and societal benefits. However, a growing body of research has shown that supportive 'eco-system', regulatory and policy conditions need to be in aligned for these benefits to materialise.

Maximising and spreading benefits

While the potential benefits of Big Science are significant, realising them requires a proactive approach. A central challenge is ensuring that the economic and technological gains do not remain confined to host regions and countries.

To avoid this localism requires robust technology transfer mechanisms. By facilitating the movement of knowledge and innovations from research institutions to industry, policymakers can ensure that the breakthroughs achieved through Big Science lead to tangible economic improvements. This involves creating frameworks and platforms that encourage collaboration between universities, research institutions, and private companies.

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Procurement activities associated with large research infrastructures can also serve as engines for local economic growth. Recent evidence shows that high-tech procurement contracts not only benefit the contracting firm, but also generate multiplier effects throughout the local economy. With policies like SME-targeted assistance, value chain embedding, and effective matchmaking, these procurement activities can diffuse economic benefits widely, ensuring that firms across various countries and innovation systems benefit from investments.

Another important aspect is improving the coordination of public R&D funding. As highlighted by multiple studies, lack of coordination in public R&D investments is a major hurdle. When member states collaborate on large-scale projects, they not only share the financial burden, but also enhance the overall quality and impact of the research. Coordinated R&D efforts can prevent duplication, reduce costs, and ensure cross border benefits.

Furthermore, there is a need for robust evaluation mechanisms to assess the socio-economic impacts of Big Science investments. Strengthening the evidence base on what works in practice is crucial. Policymakers need reliable data and rigorous analysis to make informed decisions about future investments in research infrastructures and suitable policy to maximise their socio-economic returns. This evidence-based approach will help justify and guide the use of public funds, especially in an era of high inflation and budget austerity.

The future for European Big Science

Big Science is not merely an academic or scientific pursuit—it is a strategic asset that has far-reaching implications for innovation and national competitiveness. For Europe to regain its innovative edge, there must be a concerted effort to foster EU-wide collaboration in large research infrastructures. This means not only pooling financial resources but also aligning national policies to support shared scientific goals as well as the generation and diffusion of socio-economic benefits. When countries work together, they can create a more resilient and dynamic innovation ecosystem that benefits all economies.

Moreover, Big Science must be seen as a long-term investment. Not all economic returns from these projects materialise in the short to medium-run, but they lay the foundation for sustained technological progress and economic growth. The success of (and support for) such initiatives depends on robust evidence-based policies to ensure that the benefits of scientific progress are widely shared.

Riccardo Crescenzi and Mark Thomson, the Director-General Designate of CERN, will discuss the benefits of Big Science at LSE on 3 March 2025.

About the author

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Riccardo Crescenzi is a Professor of Economic Geography and Deputy Head of Department for Research at the London School of Economics. His research explores the economics of innovation, public policy, and the socio-economic impacts of large research infrastructures.

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