

# Bocconi

## THE TECHNOLOGICAL PARADIGM, STUPID

GIORGIO PRESIDENTE

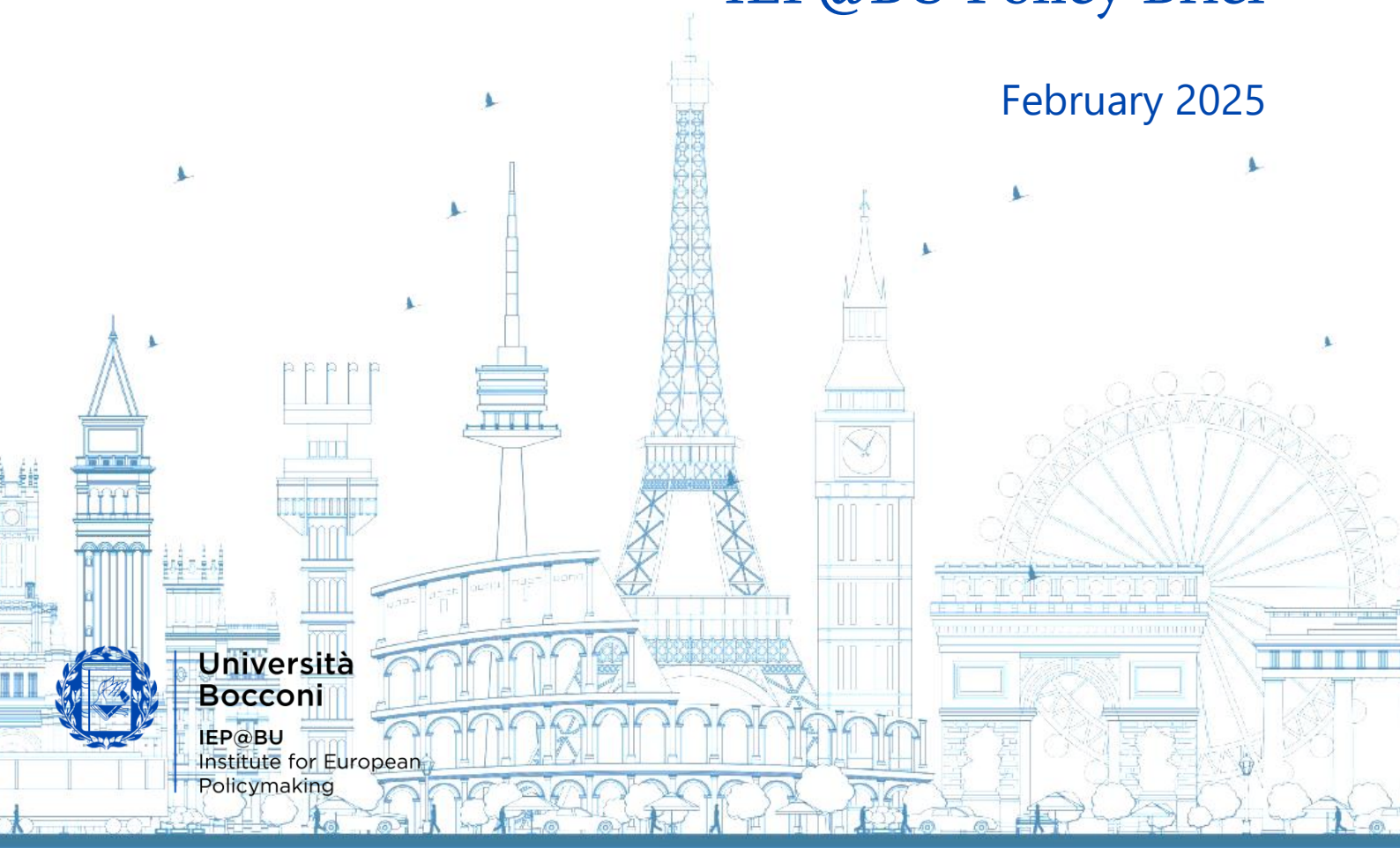
IEP@BU Policy Brief

February 2025



Università  
Bocconi

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Institute for European  
Policymaking



## Executive Summary

European policymakers keep pushing the narrative that boosting AI development is key to European competitiveness. But stakes are much higher, because super-intelligent AI will confer enormous geopolitical leverage to those who control it.

Europe has three options. The first is accepting the dominance of US incumbents in frontier AI development, and instead specialize in AI applications.

The second option is forming a joint venture under EU governance, which would allow European firms to compete with the incumbent tech giants, and at the same time mitigate the geopolitical risk involved in having frontier AI controlled by a few private citizens.

The third option is to develop a different kind of AI. The current vintage of frontier models relies on huge amounts of data for training. Due to market forces and political constraints, it is unlikely that European firms will ever be able to compete in “data-intensive” AI.

Thus, the best chance for Europe is to develop systems that are less subject to such a comparative disadvantage. But radical innovation requires risky experimentation. Cutting red tape and re-directing public support to high-risk-high-reward projects is what it will take.

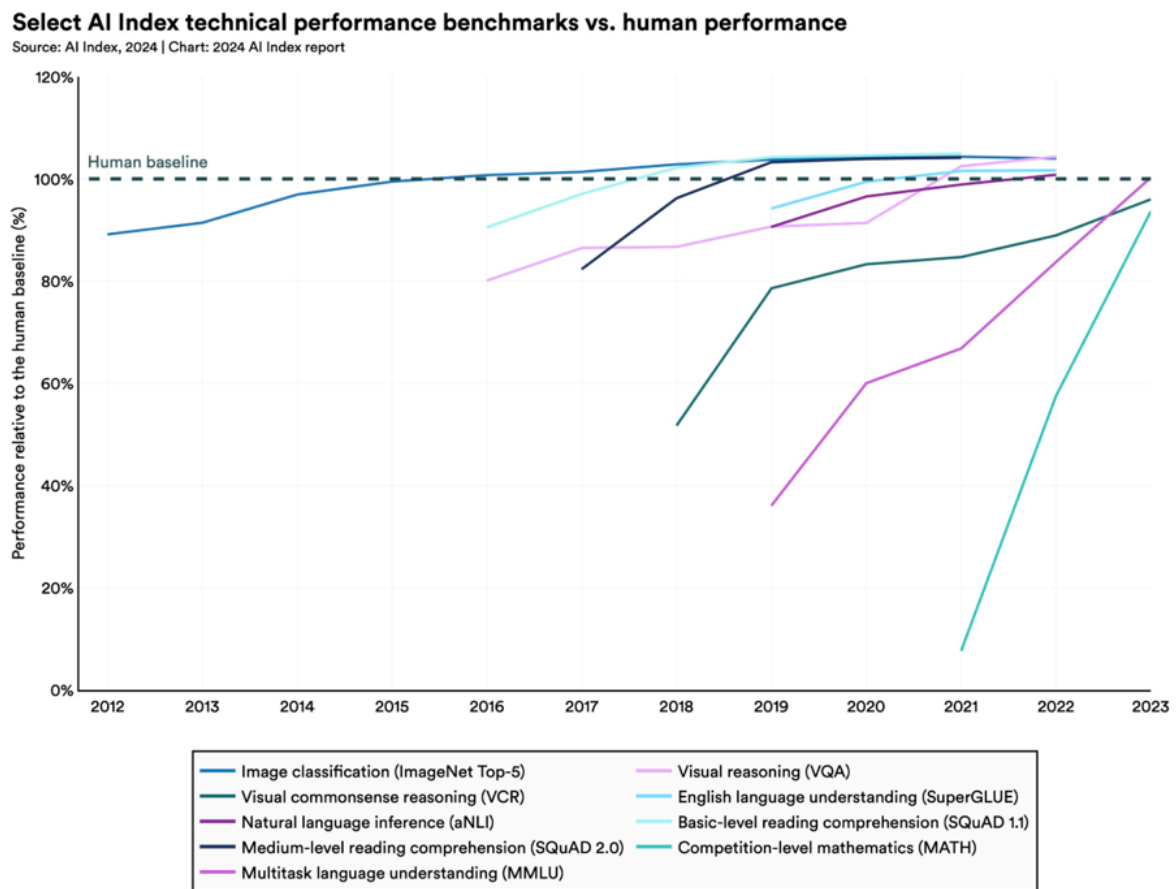


## Concentration of Power, Not Market Shares

If “frontier models” – the state of the art in Artificial Intelligence (AI) – keep improving at the current rate, there is little doubt that in a few years from now they will outsmart humans in many applications (Figure 1).

It stands to reason that the owners of super-intelligent AI systems will acquire an enormous amount of power in the near future.

Figure 1. Source: AI Index Report 2024: <https://aiindex.stanford.edu/report/>



Currently, the best-performing AI systems are all owned by companies headquartered in the United States:

- GPT-4 – OpenAI (Altman, Musk, Sutskever, Brockman)
- PaLM 2 – Google (Page and Brin)
- Gemini – Google DeepMind (Page and Brin)
- LLaMA 2 – Meta (Zuckerberg)
- Grok – xAI (Musk)



Frontier AI companies have a cumulative annual revenue of more than \$500 billion. For comparison, two of the best-performing European AI systems are Mistral 7B/11B, from the French company Mistral and Luminous, from the German Aleph Alpha. They have a combined annual revenue of less than €100 million.

The list does not include R1 by the Chinese DeepSeek (Wenfeng), as it is still [not clear](#) whether its performance is actually as good as its developers claim to be.

Boosting frontier-AI development in Europe is not just a matter of competitiveness. A super-intelligent AI gives geopolitical leverage to those who control it. It is thus mainly a security issue, stemming from the concentration of power that AI confers to a handful of private citizens.

Governments are [exposed too](#), and Trump seems aware of it. One of the first announcements he made is the [Stargate Project](#), a \$500 billion joint venture in AI infrastructure with participants of the caliber of OpenAI, SoftBank, Oracle, Nvidia and Microsoft.

The inauguration ceremony of his new mandate was prominently [attended](#) by Musk, Brin, and Zuckerberg – among the leading entrepreneurs behind frontier models. He also reversed an [executive order](#) passed by former President Joe Biden in 2023 that aimed to monitor and regulate AI risks.

The Chinese government seems aware of it too. Back in 2017, the State Council published a [document](#) describing its ambition to become the world leader in AI by 2025. Today, China pours massive [public investment](#) in the industry and in STEM education, supplying almost half of the best AI researchers.

## AI Policy in the European Union

Meanwhile, on the other side of the Atlantic European policymakers focus on “Trustworthiness Principles”. The [European AI Act](#), introduced in 2024, sets transparency standards and prohibits illiberal uses of AI in critical sectors like education and law enforcement, which seems sensible.

Unfortunately, the Act also imposes heavy administrative and personnel requirements that are [likely](#) to put at disadvantage European AI companies. A comprehensive analysis of digital regulation in the EU is provided in [De Gregorio et al. \(2025\)](#).

Moreover, the burden imposed by the AI Act supplements the legal requirements associated to the [General Data Protection Regulation](#) (GDPR) – in place since 2018 – which has been shown to have an adverse effect of firm performance ([Frey and Presidente 2024](#)).

Financial support to AI in the European Union is provided in part through existing instruments, such as the flagship program for research and innovation, [Horizon Europe](#) and in particular the [European Innovation Council](#) (EIC) – the main program dedicated to innovation. However, the sums involved are at best limited. Fuest et al. (2024) estimates that the annual funding reserved to disruptive innovation is less than €1 billion.



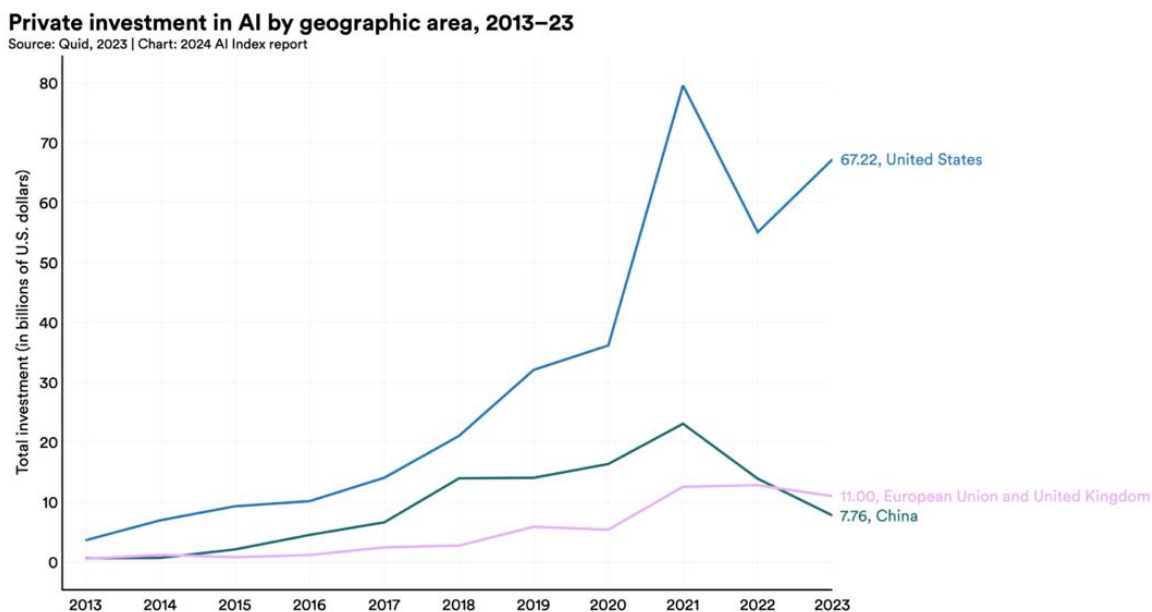
More relevant is the support by the Recovery and Resilience Facility, which [dedicates](#) around 20 % or €134 billion to “digital objectives” (not only AI). The Facility runs between 2021 and 2026, thus corresponding to over twenty billion in annual spending. Until now, however, only around €15 billion or €4 billion per year [have been spent](#) on “digital”. These sums are close to the United States, where annual public spending is estimated just above \$3 billion ([AI Index Report 2024](#)).

The real gap between the EU and the United States is in private AI investment (Figure 2). The key issue with European AI – and the high-tech industry more broadly – is that it attracts little private investment ([Fuest et al. 2024](#)). In this respect, the European Union looks more like China, although the latter has already undertaken it in these terms.

This is problematic, because EU-level funding for AI development accounts for a tiny fraction of the resources available to the US (private) incumbents. Mobilizing private investment is thus a necessary prerequisite for any successful AI policy.

In the context of the [Artificial Intelligence Action Summit](#) in France, President Macron [announced](#) plans for a joint venture of more than €100 billions in private investment for AI development, akin the US Stargate project mentioned above. Similarly, the President of the European Commission Ursula von der Leyen announced [InvestAI](#), a public-private partnership expected to mobilize €200 billions (with a EU contribution of €50 billions) of investment in AI. How successful these initiatives will be remains to be seen, but they certainly welcome in light of the gap in private investment with the United States and China.

Figure 2. Source: AI Index Report 2024: <https://aiindex.stanford.edu/report/>



## European AI – A Lost Cause?

Given the enormous gap in existing and potential AI innovation across the two sides of the Atlantic, a natural question is whether there is any reasonable hope to ever compete with firms in the United States. The dominance of the US incumbents is due in large part to their early entry into the digital services market – an industry characterized by large economies of scale making them similar to natural monopolists in their respective niche.

Moreover, digital services thrive on data. Early entry allowed companies to accumulate vast amounts of user data, which they leverage to train their AI models. More on this point further below.

Training large-scale AI models is expensive. For example, OpenAI's GPT-4 used an estimated \$78 million worth of compute to train, while Google's Gemini Ultra cost \$191 million for compute ([AI Index Report, 2024](#)). But computes can be rented from frontier companies simply by paying a subscription fee. For instance, OpenAI provides access to its GPT models via a cloud-based API. Thus, incentives to develop new frontier models are weak in Europe. Rather than competing with US firms in developing frontier AI, European companies will tend to specialize in AI applications.

Things are different in China. The [export restrictions](#) imposed in previous years by the US on chips considered essential to AI development, might have spurred innovation leading to substantial productivity gains. For instance, DeepSeek has announced that training their R1 model has costed only \$6 million – a fraction of what it takes to train the state of the art. The accuracy of R1's cost figures, is still being [debated](#), but what is certain that Europe would have to compete not only with the United States.

Among the initiatives of the AI Act, the creation of "[AI Factories](#)" seems to go in the right direction. The instrument builds on the Union's [EuroHPC](#) supercomputing facilities to train large-scale AI models. [According](#) to the Commission, the supercomputing facilities can speed up the process from six to nine months to just a few weeks, and allow European companies to save on cloud services that would otherwise be provided by the US incumbents.

Unfortunately, AI Factories alone is unlikely to solve the problem. European companies would have to catch up with two-decades of data collection, model training and know-how. There is thus little hope to compete *within the current AI paradigm*.

## Needed: A Paradigm Shift

Because they thrived in the digital services market – a goldmine of data – the US tech giants have developed AI systems that are extremely data-intensive, such as those based on Deep Learning. Given that big tech control most of these data, and given the constraints imposed by the GDPR – it seems unlikely that EU companies could ever succeed in developing better data-intensive AI.



European companies need to compete with China too. [Frey et al. \(2025\)](#) show that Chinese companies and universities are world leaders in the number – not necessarily the value – of patent applications in Deep Learning, possibly due to the very large pool of user data available and less stringent privacy regulations in the country.

What is needed is thus a *paradigm shift*. Rather than trying to imitate an existing technology, European firms should be after disrupting the state of the art in AI by thinking outside the box. After all, this is what “breakthrough innovation” is – a longstanding [mantra](#) for European policymakers.

Alternatives to data-intensive approaches do exist, but they are currently underexplored ([Klinger et al. 2022](#)). Available evidence does suggest that in line with the literature on directed technical change ([Acemoglu 2002](#)), the trajectory of AI is sensitive to the institutional environment.

[Frey et al. \(2025\)](#) show that the stringent privacy regulation in Europe led European AI developers to experiment outside the leading paradigm. For instance, rules-based systems and transfer learning are AI approaches attempting to minimize the reliance on data.

Data-intensity is also related to energy consumption. Existing models [vary substantially](#) in the resources needed to operate. Developing energy-efficient AI systems could be an additional source of competitiveness.

Another distinction is between open-source and closed AI systems. The current frontier models developed in the United States are closed, while DeepSeek’s R1 is open, meaning that anyone can download it and run it locally. This approach [might generate](#) larger technological spillovers, for instance through research institutions that otherwise could not be able to afford costly closed models.

It is impossible to predict what the next AI paradigm will be. What is certain is that radical innovation requires a lot of risky experimentation.

Thus, the key issue with the regulatory burden imposed by the AI Act, as well as with previous regulations targeting the collection and processing of personal data, is that they reduce the expected returns of projects for start-ups, and so they discourage experimentation. Regulatory sandboxes for start-ups, mentioned in the AI Act, are in principle a good idea. It remains to be seen how successful these programs will be.

## Three Possible Ways Forwards

There are three possible ways forward for Europe. The first is the least glamorous: accepting the dominance of US incumbents in frontier AI development. This is a perfectly viable alternative, since EU companies can profitably specialize in cutting-edge AI applications. For example, IBM’s Watson excels in many fields, [including biotechnology](#) – a key strategic industry in which Europe can still compete globally

The problem with this solution is that it would increase even further the European reliance on the United States, and more specifically – and worryingly – on a few private citizens owners of the frontier AI systems.

The second option involves a real intergovernmental venture [akin CERN](#). This would confer the scaling



possibilities required to compete with transatlantic tech giants under EU-wide governance, which seems a desirable solution in light of the security concerns related to AI. The [InvestAI](#) initiative announced recently by the European Commission seems a step in this direction.

The security threats involved could even justify considering AI development a matter for a [common EU defense policy](#). Admittedly, however, there are frictions involved, as Member States are reluctant in ceding sovereignty.

Finally, the third (not mutually-exclusive) option is better exploiting the existing resources available to the European Union to fund truly radical innovation. Currently, most of the EU-level support for R&D is far from involving cutting edge technologies ([Fuest et al. 2024](#)). Redirecting these resources and eliminating unnecessary regulatory burden to incentivize the undertaking of high-risk-high-reward projects would constitute the best chance for European companies to lead a paradigm shift in AI.





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