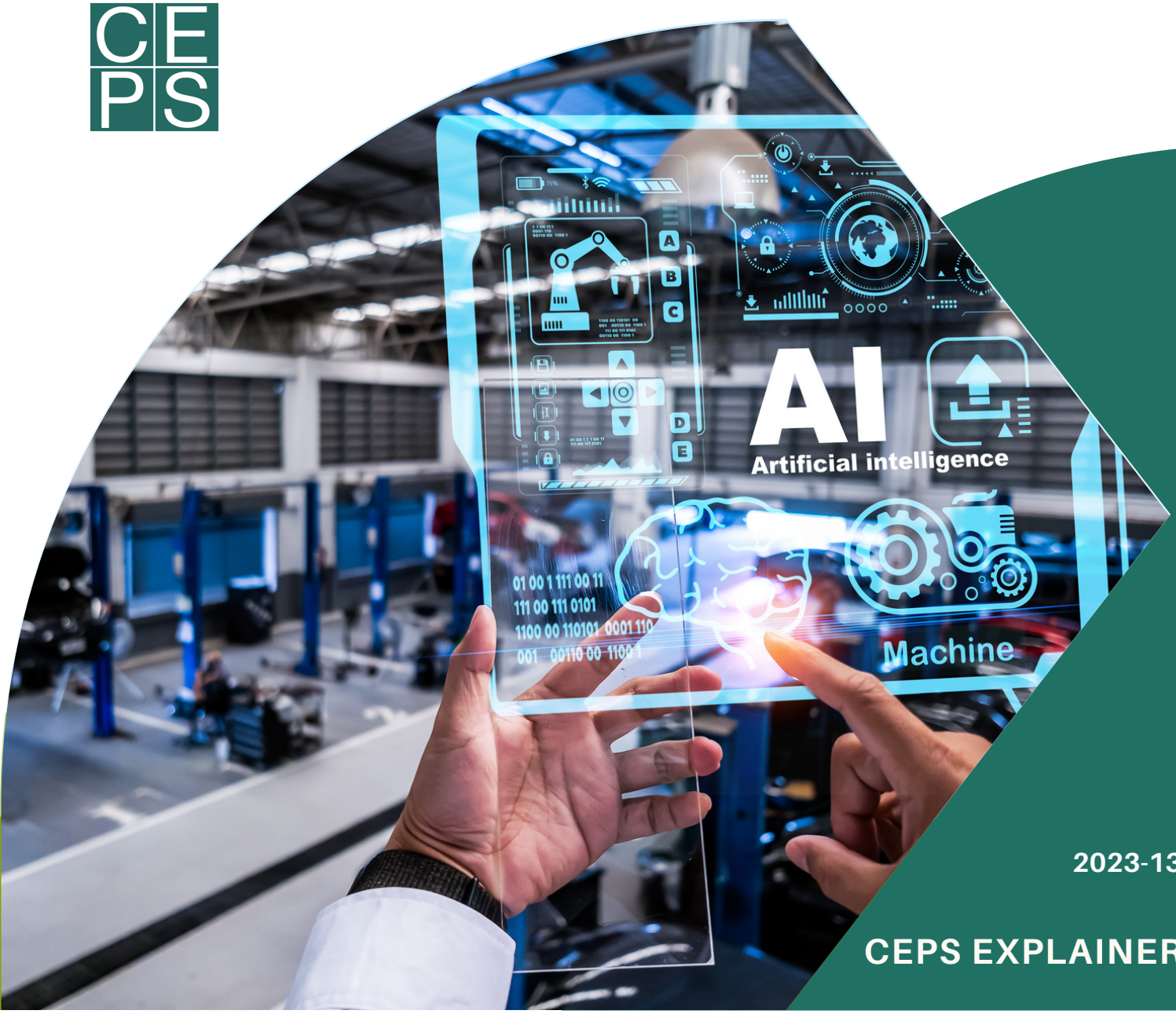

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CEPS EXPLAINER

FORGE AHEAD OR FALL BEHIND

Why we need a United Europe of Artificial Intelligence

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SUMMARY

Europe has been at the forefront of every industrial revolution, including the digital one up to the emergence of the internet. Past decades of European ingenuity and industrial policy have brought us Airbus, Ariane, pressurised nuclear reactors, complex medical imaging devices. But when it comes to AI, Europe is not leading the charge. This is a serious problem, since by not having viable European AI solutions, Europe will be forced to accept cultural and ethical embedding from AI developed in other parts of the world.

Whilst it's true that the US and China dominate the global AI marketplace, Europe definitely shouldn't be counted out yet. Europe's current position should not be mistaken for a lack of talent or a lack of technological potential. Several European hubs based in cities across the continent do indeed harbour a rich pool of AI talent, scientific excellence, and commitment to responsible AI development, which can forge a path towards trustworthy AI, rooted in humanitarian and democratic values.

What's key is that Europe doubles down on investments in these hubs and helps them to become better connected to each other. On top of this, there are many other policy ingredients missing that Europe needs to address before it can become a true AI competitor. After a look at some key figures and data, this CEPS Explainer outlines some broader policy suggestions on how Europe can start to get its feet truly into the AI game.

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Europe has been at the forefront of every industrial revolution and has consistently delivered the most complex products and technologies to the world. There's no need to go back to the steam engine, the dynamo, or wireless communications. Just a few decades ago, CERN was busy developing no less than the World Wide Web while European countries and companies were coming together in an unprecedented way to create the Global System for Mobile Communications (GSM).

Collaborations between different European ecosystems have also brought us Airbus, Ariane, pressurised nuclear reactors and complex medical imaging devices. Today, with the rise of Artificial Intelligence (AI), we are witnessing a revolution that will drastically transform the way we live and the way we work. In fact, AI will re-distribute power at a global scale and pretty much transform everything.

However, to say the least, Europe is not leading the charge. The world is not using 'Made in Europe' AI products or infrastructure. We lack a united and ambitious AI initiative on an EU scale. This needs to change, and the recent State of the Union address delivered by President von der Leyen calls for such a bold action. Europe cannot afford to sit on the sidelines of what might be the most disruptive technological revolution in human history. AI is also a domain where ethics and technology need to go hand-in-hand as it pretty much impacts the entire fabric of our society. The clock is ticking and we need to massively invest to support a truly pan-European ecosystem that encourages AI innovation while safeguarding fundamental rights.

EUROPE CANNOT AFFORD TO SIT ON THE SIDELINES OF WHAT MIGHT BE THE MOST DISRUPTIVE TECHNOLOGICAL REVOLUTION IN HUMAN HISTORY.

AI itself is not such a young field. It has actually fluctuated between periods of fervent enthusiasm and relative dormancy since its inception in the 1950s. But with the advent of the World Wide Web, the development of high-speed broadband and the rise of large-scale online intermediaries, the combination of massive data and computing power has triggered an equally massive AI revolution, based on data-hungry machine learning systems, all of this about a decade ago. In short, AI finally went beyond proofs of concept and reached mass usage, mostly by the tech giants.

Despite having significant talent and capabilities, Europe missed this first phase, partly because of the lack of a unified digital market, and delays in the emergence of the internet economy. Access to a large pool of internet users granted a massive comparative advantage to the United States and China. Via positive reinforcement feedback loops, platforms such as Amazon, Facebook, Tencent, Google, and Alibaba attracted users by offering free or quasi-free services and *in exchang*e gathered massive amounts of data.

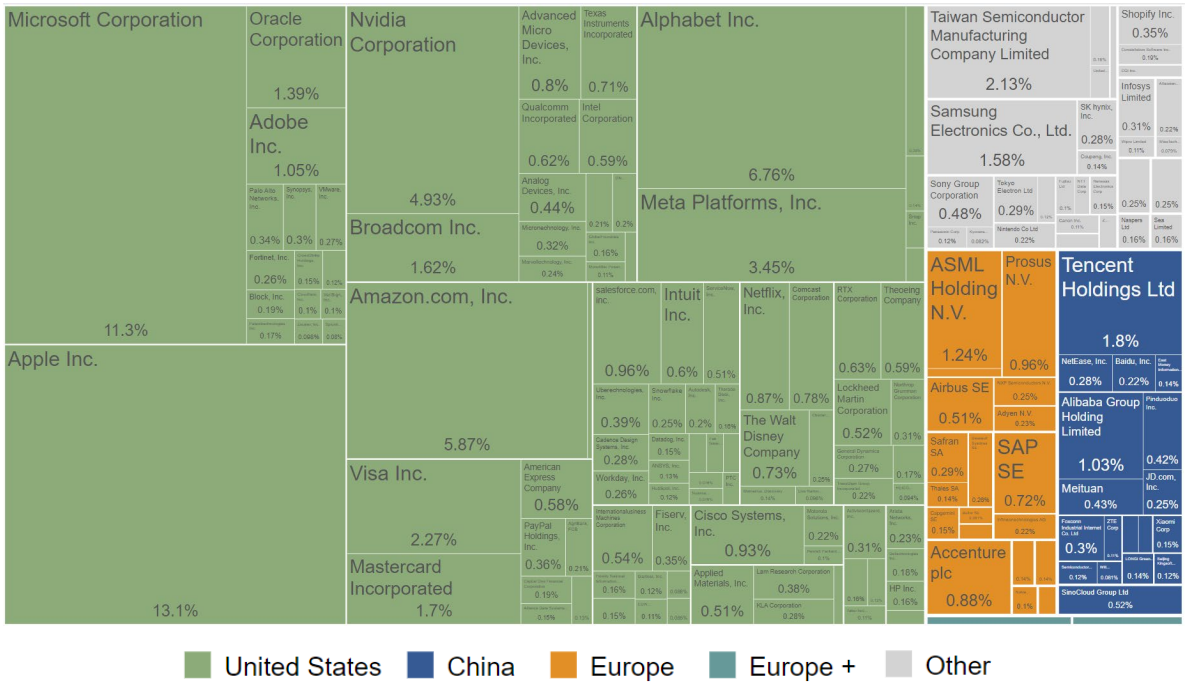
This data, often spontaneously or unintentionally contributed by European users, was then used to train AI recommender systems and other machine learning tools to increase scrolling time, search and engagement. This is how 'big techs' became even bigger, and unavoidably AI-driven. Be it in search, e-marketplaces, or content moderation, the sheer size of data to be processed has made AI use an imperative, and an attractive opportunity.

Against this backdrop, Europe had immense talent, technology and ideas that it failed to exploit and nurture. For example, iWiW (*International Who is Who*) was a Hungarian social networking web service that started almost two years before Facebook. It grew to 4 million – almost all internet users in Hungary – before dying off when Facebook finally entered the market, sweeping away existing alternatives. E-commerce platforms or streaming services existed in Europe but were so divided and siloed that American and Chinese companies easily gained a competitive edge, taking over the European digital market.

And when companies did manage to reach sufficient scale, they were either acquired by the tech giants (Skype), or ended up facing uphill battles in competing against them (Spotify).

Figure 1 (which is fully interactive, along with all other figures in this Explainer, just click on the link) shows the world's largest publicly listed companies in AI-relevant technology sectors by market capitalisation[1]. The sheer dominance of the big US and Chinese AI companies is staggering.

Figure 1. The world's largest tech companies by market capitalisation



[1] Data source: Disfold, 5 September 2023. We selected the top 1 000 largest companies in the world by market cap as of 1 July 2023 and kept the ones operating in software infrastructure, consumer electronics, internet content & information, internet retail, semiconductor equipment & materials, software\x97Application, entertainment, semiconductors, components, auto manufacturers, credit services, computer hardware, electronic gaming & multimedia, aerospace & defense, information technology services, and communications equipment. Figure 2 shows data from 170 publicly listed companies in AI-relevant technology sectors.

Missing this first wave has an obvious economic impact – but it also removes the ability to shape the development of AI towards desirable societal goals. A good example is the rise of recommender systems, which are very powerful engines in a complex world. They became necessary as there is now so much content on the internet that we need systems to search, select, and match users to content. AI recommender systems function by analysing a user's past behaviour, preferences, and interactions to suggest content, products, or services. So in simple terms, what Amazon, Meta, or TikTok recommender systems do is essentially personalise content and decide what users see. This is usually based on a technology called collaborative filtering. So this is what these systems do, they filter.

This act of filtering information is by nature not neutral and the design and implementation of these systems can create inequality through the mechanism of preferential attachment, but also polarising echo chambers. Echo chambers form when users are disproportionally exposed to information and opinions similar to their own, thereby reinforcing their existing beliefs and shielding them from diverse perspectives.

Over the past two decades, European users have been exposed to content on the Web in a way that was largely decided by non-European companies through AI-powered recommender systems. By not having viable European AI platforms, European users have had to accept cultural and ethical embedding from AI developed in other parts of the world. The EU has institutions that are comparatively well aligned with citizens' interests but this does not mean that ethical AI will automatically emerge. It is the outcome of a complex process that will require new and carefully designed research and innovation (R&I) policies and instruments.

BY NOT HAVING VIABLE EUROPEAN AI PLATFORMS, EUROPEAN USERS HAVE HAD TO ACCEPT CULTURAL AND ETHICAL EMBEDDING FROM AI DEVELOPED IN OTHER PARTS OF THE WORLD.

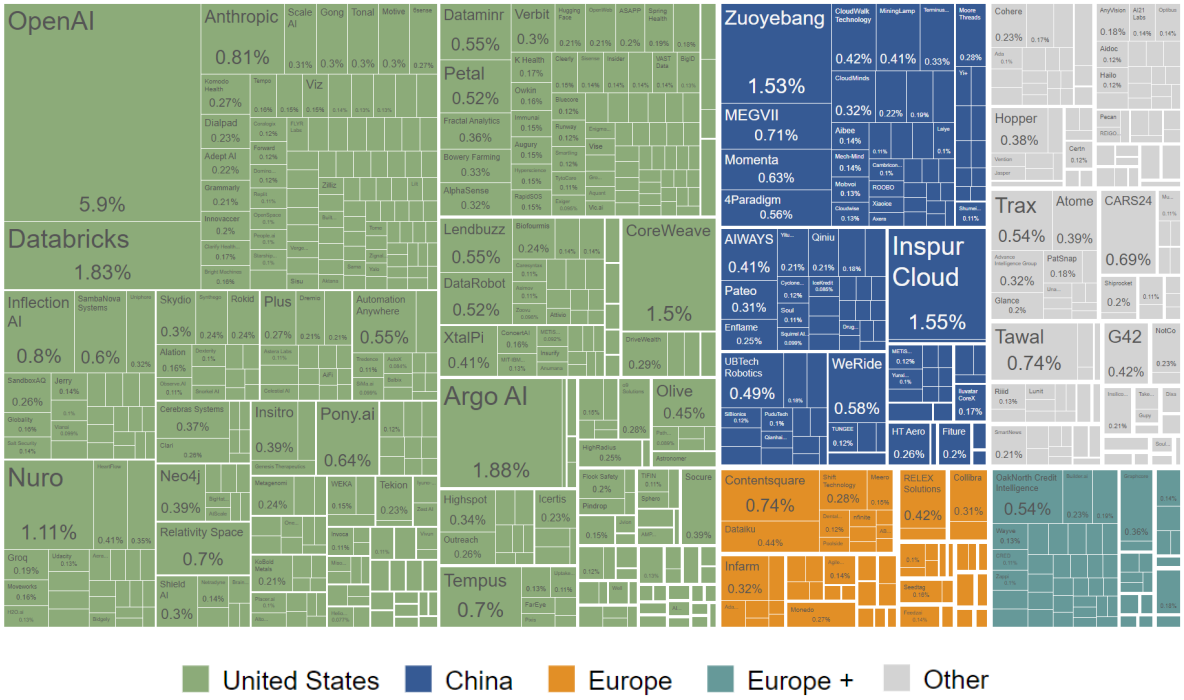
So where are we now? This first phase is not over and will continue to develop. Yet since November 2022 a second phase of the AI revolution has come of age. It really started with the rise of Large Language Models (LLMs) such as OpenAI's ChatGPT, which reached hundreds of millions of users in about two months, becoming the fastest-growing application in the history of the Web. ChatGPT is just one LLM, but other models such as LLaMA2, Claude or PaLM demonstrated outstanding capabilities. And in China, homologous models quickly appeared on the market, giving rise to what Tencent's CEO defined as a 'war of a hundred models'.

The economic and social impact of LLMs might be even larger than the first phase of AI. Recommender systems, for instance, might dictate which parts of the internet world users are allowed to see, but it does not seem to massively replace humans. LLMs, on the contrary, have the potential to do exactly that, in a growing array of tasks and activities that were previously thought to be inaccessible to machines.

And even more importantly, the two phases of the AI revolution are intimately linked – in other words, those that successfully mastered the first phase, building a customer base, and massive data and computing infrastructure, also have an advantage in embracing the second one. Not surprisingly, ChatGPT, Claude, and the upcoming Gemini with their billion – sometimes even a trillion – of parameters, do not come from France, Hungary or Sweden. The few companies that try to build similar models in Europe, such as Aleph Alpha or OpenGPT-X, struggle to raise sufficient funds, find the right skills, utilise data in less widely used languages, and gain access to sufficient computing infrastructure.

If such a situation continues, we might end up in a situation where LLMs trained (also) with European data are designed, developed and deployed by US-based companies and end up replacing jobs in Europe. This does not sound like a win-win. If we look at the top AI startups in the world (Figure 2 below[2]) to get a glance at the burgeoning ecosystem of this second AI phase, the situation looks worrying for Europe to say the least. About 61 % of global AI funding is going to US companies and 17 % to Chinese ones. Only 6 % of the funding goes to EU27 start-ups. Patent applications over the past seven years depict a similar picture. 34 % of patents come from inventors based in the US, 22 % from inventors based in China and only 11 % from inventors based in EU27 countries.

Figure 2. The share of venture capital (VC) funding received by AI startups

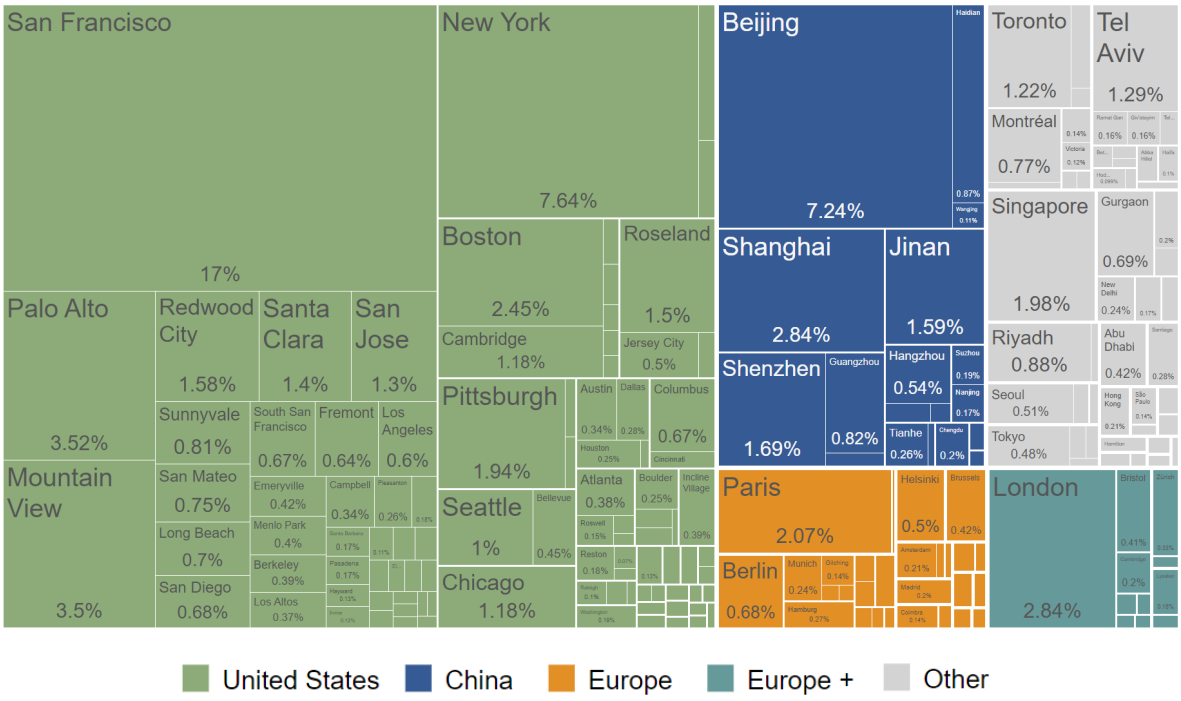


[2] Data source: Crunchbase, 5 September 2023. We selected the top 1 000 global startups with an 'Artificial Intelligence' industry tag and removed the ones that have exited (Acquisitions, mergers or IPOs). Figure 2 shows data from 822 AI startups.

Europe's current position should not be mistaken for a lack of talent or a lack of technological potential. Several European hubs do indeed harbour a rich pool of AI talent, scientific excellence, and commitment to responsible AI development, which can forge a path towards trustworthy AI, rooted in humanitarian and democratic values.

Looking at cities and regions, the picture looks much less alarming than at the country scale (see Figure 3[3]). We see that at the time of writing, the top AI startups in Paris are receiving similar funding to those in Boston, and more than those based in Pittsburgh, Seattle, Chicago, Shenzhen, Guangzhou, or Hangzhou. The gap with the US and China is mainly explained by Silicon Valley, as well as Beijing. But London, Berlin, Helsinki and Munich are also strong poles for AI startups. Europe needs to double down on investments in these hubs and scale them up from regional or European hubs into real worldwide success stories.

Figure 3. The share of AI VC funding at the city level



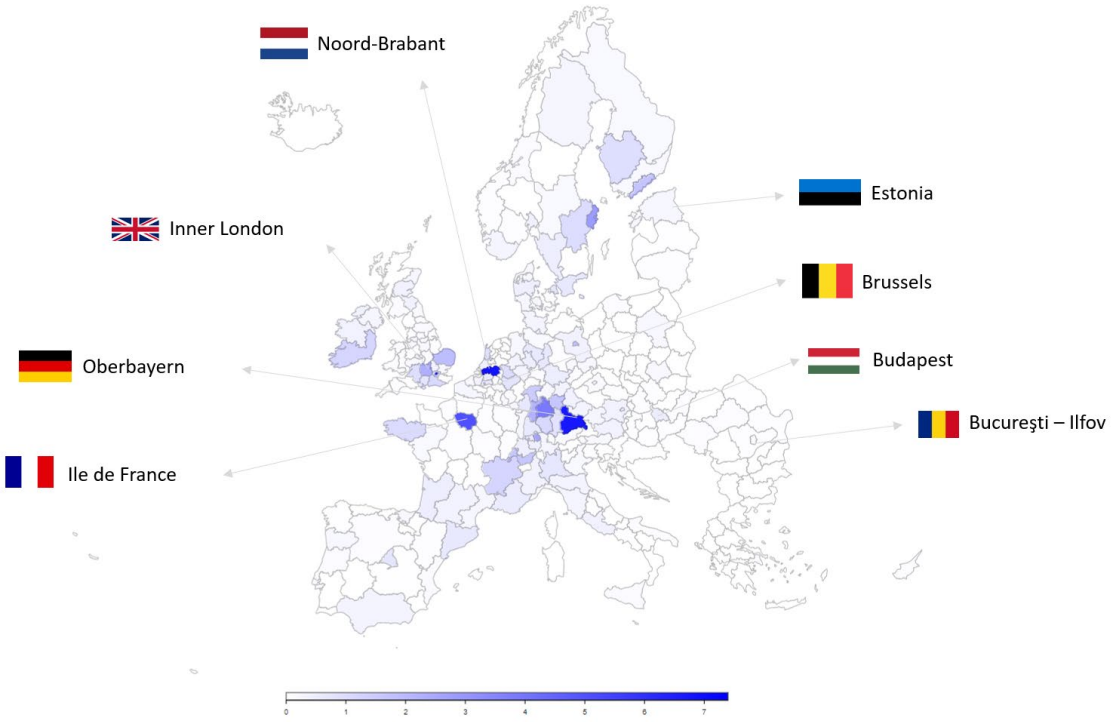
[3] Same data as figure 2, but grouped at the city level.

When we look at patents[4] over the past eight years (Figure 4), it is clear that, as with startups, AI innovation is very concentrated. Four European regions account for more than 25 % of all European AI patent applications, namely inner London, Île-de-France (the Paris region), Noord-Brabant (the Dutch region centred on Eindhoven) and Oberbayern (the German region centred on Munich).

THERE EXISTS A PRESSING NEED FOR SUBSTANTIAL INVESTMENTS IN AI RESEARCH AND DEVELOPMENT, WITH A KEEN FOCUS ON NURTURING THESE HUBS AND ENCOURAGING INNOVATION TO FOSTER AN ENVIRONMENT WHERE EUROPEAN ENTITIES CAN THRIVE AND COMPETE GLOBALLY.

We also find that, in relative terms (as measured by the revealed comparative advantage), the Bucharest region, Estonia, the Budapest region and Brussels significantly punch above their weight in AI. The takeaway message here is that there is a significant concentration of AI talent and innovation potential in some European cities and regions. There exists a pressing need for substantial investments in AI research and development, with a keen focus on nurturing these hubs and encouraging innovation to foster an environment where European entities can thrive and compete globally.

Figure 4. Share of AI patents in European regions



[4] Data source: Google Patents Public Datasets on BigQuery. Patents are assigned to countries based on inventors' residence information. We only focus on PCT (Patent Cooperation Treaty) patents to avoid home bias and missing information. Figure 4 is built using patents published by the World Intellectual Property Organization from 2016 to 2023.

Based on this evidence, Europe urgently needs to invest in select AI hubs and make sure they grow as funding and talent magnets at a worldwide scale. But if Europe truly has the ambition to forge ahead and not fall behind, it needs to go one step further. These hubs must be strongly connected to each other.

Today, this is sadly not the case. When we analyse inter-regional AI patents between European regions, the vast majority of connections remain within the same country (see Figure 5[5]). But as we have discussed before, EU AI hubs are rarely within the same countries. Île-de-France, for instance, is more connected in terms of AI patent collaborations to Rhone-Alpes than to London. Upper Bavaria is more connected to Mittelfranken than to any other major AI hubs. Noord-Brabant tends to be more connected with other AI hubs. Strong connections exist between Brussels and Zurich, Trier and Luxembourg, and the Prague region and Stockholm. We can also see this fragmentation when it comes to AI policy and initiatives – they tend to be led by EU Member States and often lack a European component.

As a result, the EU system of AI innovation is therefore not as efficient as it could be. Promoting an 'ecosystem of excellence' in AI is essential to ensure the EU does not replicate the mistakes of the past. Europe needs much more inter-hub connectivity to produce the complex AI technologies the world needs.

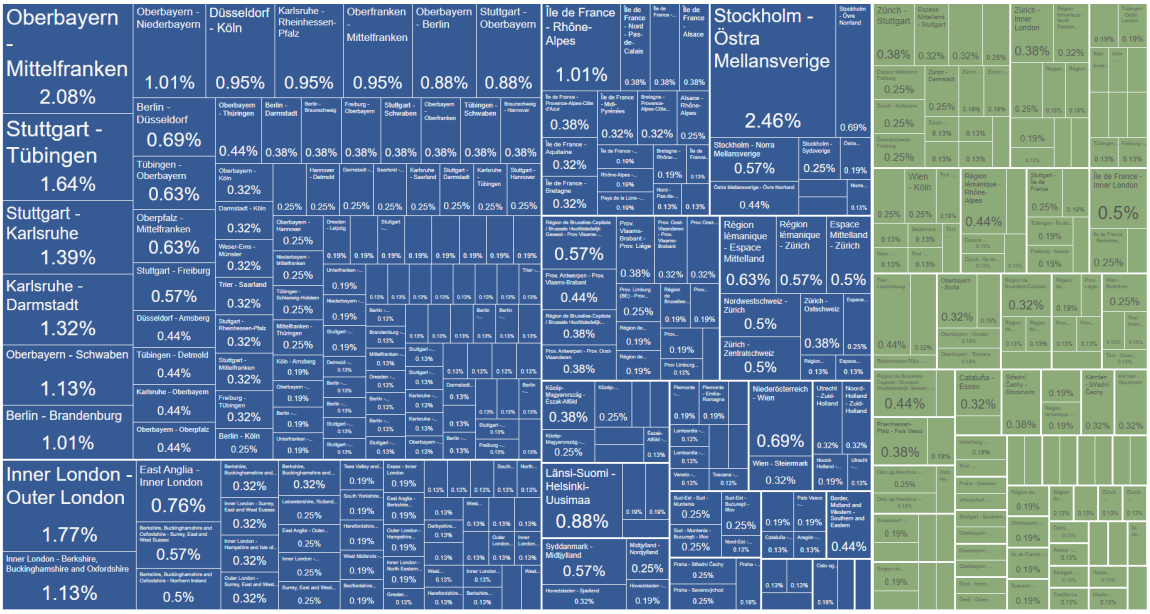
IN SHORT, THE FUTURE OF AI MUST BE TRULY PAN-EUROPEAN OR IT WON'T BE EUROPEAN AT ALL.

In short, the future of AI must be truly pan-European or it won't be European at all. Disconnected initiatives by Member States will not work. Rather, a coordinated industrial policy must be put in place to ensure that the comparative advantages of different AI hubs are merged into a consistent picture, supporting systemic industrial transformation in Europe. This essentially means ensuring that computing infrastructure, adequate data, skills, and research and innovation efforts are promoted in the right places, and with a systemic, mission-oriented approach.

In other words, we need an Airbus moment to foster European excellence in AI.

[5] Data source: OECD RegPat dataset, August 2022 edition. Patents are assigned to NUTS2 regions based on inventors residence information. We only focus on PCT (Patent Cooperation Treaty) patents to avoid home bias and missing information. Figure 5 is built using patents published by the World Intellectual Property Organization from 2016 to 2022.

Figure 5. Share of inter-regional AI collaboration in Europe (patents)



A first, important step towards creating a more conducive environment for European AI excellence was announced by Ursula von der Leyen in the State of the Union address on 13 September – making supercomputing infrastructure available to European SMEs, so that they can train their models more effectively. Yet while this would reduce one of the clear gaps experienced by European AI developers, many other ingredients are missing for the policy recipe to be effective. They include:

- *Mapping, connecting and funding AI hubs.* This implies identifying and analysing specialisations in existing AI hubs and matching them with areas of EU industrial competitiveness; connecting AI hubs to form a coordinated European AI ecosystem; and selectively directing R&I funding towards the hubs, matching their specialisations, as well as to the sectors and use cases where their regions excel[6].

- *Making European AI a cross-cutting enabler of systemic industrial transformation*, by connecting AI hubs to industrial ecosystems. In this respect, in her State of the Union address, von der Leyen announced the launch of 'clean transition dialogues' (which might build on the existing transition pathways for industrial ecosystems). In an earlier ESIR paper, we recommended that these pathways should also be linked to formulating sustainable policies and investments, which account not only for the decarbonisation element but also for the need to create 'good jobs'.

[6] For more on this, see Renda, A., Balland, P. A., & Bosoer, L. (2023), 'The Technology/jobs Puzzle: a European Perspective.' Available at SSRN 4372626.

- *Making larger swaths of data available to AI startups and SMEs*. This can occur in many ways: for example, sectoral and horizontal data spaces, still in the making, could be further pushed to enable the aggregation of interoperable data for specific purposes and uses, and ensure that they're readily available for SMEs. Public institutions can also use the B2G data sharing provisions included in Chapter 5 of the Data Act, and be helped by independent data intermediaries as introduced by the EU Data Governance Act, to then make them available to SMEs (through a GaaP, or 'government as a Platform' approach); and the same could be done by statistical institutes (see Soete 2023). Other recent policy measures that could make more data available to AI developers include the unbundling provisions contained in the Digital Markets Act, and the combination of the digital identity ones in EIDAS 2.0, and the still pending Interoperable Europe Act.

- *Investing in skills, and making them available to EU startups*. The EU should develop a tailored approach to developing the skills needed to transform industrial ecosystems. Such an approach could be made dependent on the specialisation of select AI hubs, with a view to building both AI-specific and complementary skills. More generally, the education system should be revamped to nurture a future workforce skilled in AI technologies and critical thinking.

- *The EU's vanguard position in human-centric GovTech.* The EU stands at the forefront of championing an AI regulatory framework that takes into account the planet, the people and prosperity. Such proactive measures could significantly advance human-centric GovTech, placing the needs and rights of citizens above all else. This highlights an area where further strategic support and empowerment for smaller business entities are essential, but also a new governance model with better public-private goal alignment.

This way, Europe can lead rather than follow. It can shape a future where technology serves humanity and not the other way around. Regulating is not enough – we need European AI innovation that the world subsequently adopts to really carve a pathway that aligns technological advancement with humanitarian principles, establishing a blueprint for the world to follow.

The road ahead is indeed challenging, but is there another one worth pursuing?

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