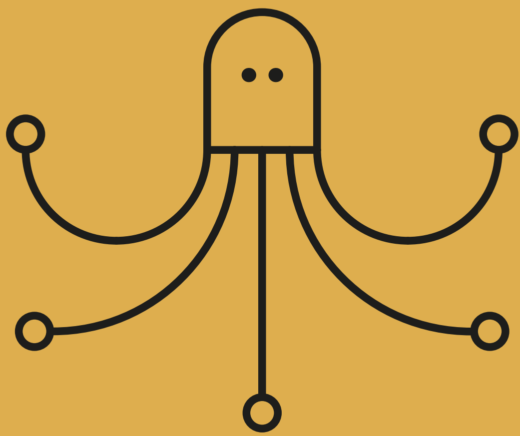
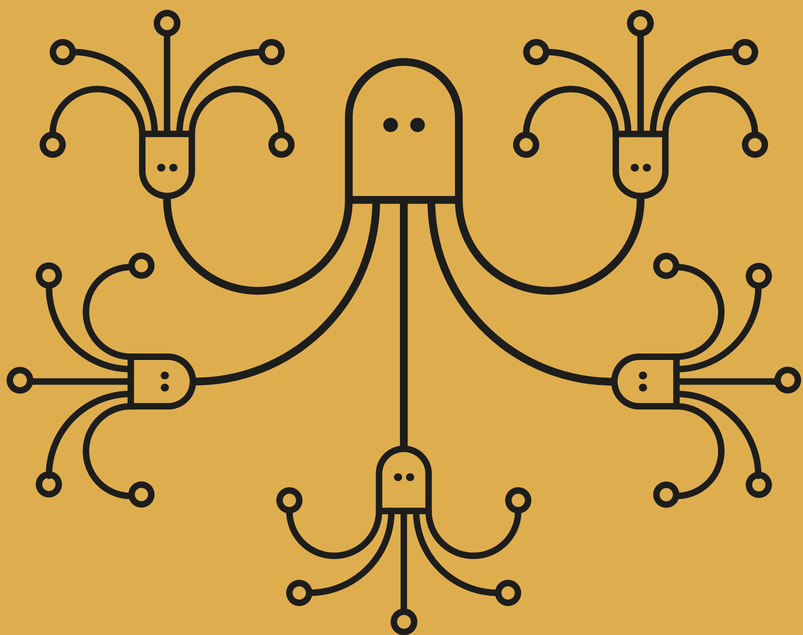
DIGITAL
markets



COMPETITION *in* A.I. MARKETS

FULL VERSION

A.I.
markets



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COMPETITION *in* A.I. MARKETS

EXECUTIVE SUMMARY

The present Research Report examines Generative Artificial Intelligence markets along the following dimensions: their current competitive dynamics; the existence of entry barriers related to access to computational power, data, and expertise; the presence or absence of structural features considered drivers of economic concentration in digital services; and the factors that have positioned Brazil as a regional leader in this sector within Latin America.

Building on the findings concerning markets involved with these technologies, the Report advances recommendations regarding antitrust enforcement and regulatory policies related to competition in so-called digital markets, as well as the regulation of AI in general, but particularly with respect to incentives for investments and development of this sector in Brazil.

Note: "AI markets", "digital markets" and "digital platforms" are vague expressions used in the field that incapsulate markets, services and companies, with different characteristics, involved in the development and application of digital technologies.

"AI markets": the term is used as an abbreviation referring to the sector of AI services and products, such as foundational models, Generative AI (GenAI) and predictive AI, encompassing several markets across the AI stack. Special attention is given throughout the Report to GenAI and Foundation Models, to dialogue with Joint Statement by authorities (see below).

"Digital markets": colloquial term widely used by the literature discussing competition in many markets involving digital products and services. Actually, there is no single relevant market encompassing all the main digital services, which may present different characteristics that are relevant to the antitrust analysis. In this sense, the term encompasses markets for different digital services, such as search engines, social media, online marketplaces, etc.

"Digital platforms": colloquial term used to refer to different firms providing various "digital markets services", which aims at pointing to common organizational characteristics (such as multi-sided interactions linking users and service or product providers, and certain architecture and governance properties), but encompasses different business models. It may nonetheless be used throughout the Report to dialogue with existing debates

1. The fierce dynamic of competition in GenAI Markets

Generative AI (GenAI) – has been at the center of antitrust authorities' scrutiny and concerns, but the market supported by such technology presents significant evidence of thriving competition. First, when analyzing GenAI through the division into AI Assistants and Content Generators, it is noted that neither category has shown concentration in the hands of a few leading companies. On the contrary, there is a flow of new entries and increasing investments. Many new players are rapidly entering this space at different layers, and with clear product differentiation.

Second, a tendency is observed where players who initially provided products and services in one mode (e.g. voice generators) become multimodal and develop more complete service offerings (e.g. end-to-end pipelines to write lyrics, compose melodies, synthesize vocals, and master tracks). This tendency blurs the boundaries between AI Assistants and Content Generators, given mutual competitive pressures of firms exploring these segments.

The scenario remains competitive and complex when it comes to attracting users and obtaining revenue. Users show low fidelity and are prone to experimentation and multi-homing. AI Assistants are more popular, but this is not translated into revenue, as Content Generators are more able to specialize in niches and capture paying users. Capital requirements for entry are lower than often expected, especially considering the development of AI products for specific markets or using open-source models and data. Under these circumstances, even leading players, like OpenAI, are constantly threatened by new entrants – such as demonstrated by the rapid rise of DeepSeek – and pushed to constantly innovate and invest to add improvements and new features.

Lastly, the corporate market of GenAI has attracted significant investment but remains largely underexplored across several sectors of economic activity, with only 5% of projects having successfully adopted corporate solutions and generated revenues. This creates opportunities for market entry and prompts extensive experimentation with new solutions.

In this context, partnerships between AI companies – often leading digital companies and AI startups – emerged as a prominent competitive strategy aimed at achieving differentiation, enhancing technical capabilities, and expanding the functionalscope of products and services. These partnerships tend to preserve the independence and strategic autonomy of the firms involved and foster competition.

This scenario of rivalry and competition may be further enhanced by the availability of open-source AI models. New entrants, such as HuggingFace, offer access to over a million models under various open-source licenses that individuals and organizations can tailor to their purposes, and almost half a million datasets that can be used to train AI systems. These "innovation commons" allow smaller players to benefit from AI capabilities even if they do not have the resources needed to train cutting-edge models.

2. Infrastructure is sufficiently accessible to allow market entry

This highly competitive market dynamic suggests that AI infrastructure (computing power, data and expertise) does not constitute insurmountable barriers to entry.

Computing power is necessary to develop, train and run AI models. However, it does not require building in-house infrastructure, as cloud computing services are available and have been powering many startups. Besides, important technological breakthroughs reduce the need for computing power, and therefore the costs to develop, train and run AI models (with DeepSeek as a landmark example). Furthermore, the development of competitive AI products for particular markets is possible at a fraction of the costs typically associated with GenAI. Many downstream applications are better served by smaller models. Organizations might also develop their own, smaller models that meet their needs, or rely on open-source models. At such smaller scales, the use of cloud computing solutions becomes more feasible and makes AI more accessible.

Access to data does not bar entry either. Current evidence suggests that access to private data does not confer much leverage. Leading players in high-end AI development have not benefited from extensive use of private data, but they have rather established partnerships with sources of high-quality data through often non-exclusive licenses – which means competitors can pursue those data sources as well. Meanwhile, some actors who are best known for their wealth of data from their services in other markets supported by digital technologies, such as Meta and X, have so far failed to transpose that abundance of data into dominant GenAI models. Second, AI scholarship foresees diminishing returns of data, which would mean quality becoming more important than quantity, allowing new firms to gain efficiency from exploiting smaller, high-quality or even specialized datasets that might be advantageous for downstream applications. Lastly, developments in synthetic data generation might also enable new firms to secure the data they need for competing with established players, even if by combining synthetic datasets with real-world data.

Expertise is also not concentrated to the point of barring entry. First, because small players do not require as many professionals as larger ones and even if their expansion would require more talent, there is little reason to believe supply and demand dynamics could not ensure the redistribution of talent towards growing businesses. AI experts and talent move between companies, thereby contributing to the GenAI inventions show that expertise is not concentrated in US companies, even though they lead in marketing AI solutions. Instead, Chinese companies and universities lead in GenAI patents, with research organizations from other Asian countries (Japan and South Korea) playing important roles as well.

3. Market foreclosure strategies by leading firms in infrastructure or foundational models is unlikely

AI markets not only appear free from significant infrastructural barriers to access, but they also lack strong incentives for foreclosure.

Infrastructure suppliers earn high margins and benefit from "growing demand" driven by downstream experimentation by many independent AI Assistants and AI Content Generators, which increases aggregate compute consumption. Excluding downstream rivals would risk slowing the expansion of total demand, especially where multihoming by users and rapid product churn limit the prospect of durable downstream dominance. Besides, product differentiation and uncertainty about which use-case niches will prove most monetizable reduce the option value of committing to a narrow, vertically integrated pathway, making quite uncertain the gains of risky strategies of anticompetitive conducts.

There is a complex and layered structure in the GenAI markets where companies may develop foundational models in different levels of generality from scratch or fine-tuning general ones. This scenario generates both competition and interdependencies, as innovations and applications at higher levels of specificity may create significant spillovers and new opportunities for more general models. While providers of foundational models may indeed develop their own fine-tuned systems at relatively lower cost to appropriate the gains of successful refinements, downstream developers can nonetheless retain competitive advantages derived from domain-specific expertise and know-how. This layered structure,in addition to the uncertainty about the profitability of specific niches, also makes foreclosure practices unlikely. The existence of an open-source AI ecosystem also reduces the hold of large AI providers on downstream markets.

The more plausible equilibrium, therefore, is for infrastructure suppliers to fucus on the upstream – competing via capacity, performance, and reliability advantages—while permitting vigorous downstream competition that expands the market frontier for compute and model services.

4. AI markets do not share the features of digital markets that raised concerns about concentration

AI markets do not pose the same purported concerns that many have with markets supported by digital technologies. AI markets have considerable marginal costs, an absence of network effects, limited data feedback loops, and a different structure than the "ecosystem architecture" attributed to some digital markets.

Near-zero marginal cost of serving additional users is an element for economies of scale. This element is not present at all in AI. Inference (the phase where a model will serve users) may be less costly than training, but it also presents costs. Each request requires computational resources, meaning that marginal costs increase with each additional user or query processed. In fact, the aggregate computational demand (and, consequently, energy consumption) of inference often exceeds the original costs of training. Additionally, increasing societal and regulatory demand for investments in clean energy to address the environmental impact of data centers tend to further increase marginal costs for AI deployment.

Network effects are not present in AI since there is no immediate gain for a user of an AI system with the increase of users of that same system. Another related factor, **switching costs**, are unlikely to take place in AI. That is because users (especially business users) are able to switch between different model providers without significant data migration costs, as there are multiple providers offering comparable services through similar interfaces, to the point that the industry claims AI models are becoming commoditized. Moreover, interoperability and data portability solutions are advancing, which mitigates risks of lock-in.

Data feedback loops (i.e. when feedback data from users is used to refine digital products or services, contributing to attract new users) are not strong in AI. GenAI products are more quality sensitive, and data quality is not strongly influenced by quantity of users generating feedback. For general purpose foundation models feedback loops do not automatically and continuously generate adaptation to specific user preferences, like recommender systems in some digital services do. Most importantly, the competitive effects of data feedback loops in digital markets are largely based on advertising revenues of exploring the economic value of personal data generated in the usage of their services. GenAI providers, on the other hand, base their gains fundamentally on licensing, subscription fees, or enterprise integration instead of user data to refine recommendation systems for targeted marketing.

Ecosystem architectures are also not manifest in AI. AI Foundation model providers cannot be properly regarded as “orchestrators”, with fine-tuned applications being “complementors”., as First, because there is no relation of dependency linked to traffic generation from orchestrator to complementor and vice-versa. Second, there is no genuine joint value proposition to end users. Consequently, increasing the number of active complementors within a foundation model’s structure would not necessarily boost overall demand. But, fundamentally, competition in AI markets is converging, as the distinction between AI assistants and AI generators becomes increasingly blurred and providers move toward multimodal offerings. Unlike the “ecosystem” structure attributed by scholars to digital markets—where an orchestrator controls a particular core service (search, or social networks, or private messaging) and integrates complementary services—Generative AI markets exhibit the opposite pattern. Here, multiple suppliers compete directly within the same broad GenAI market, seeking to differentiate themselves. Solutions such as ChatGPT, Gemini, Meta-AI, Copilot, Claude, and DeepSeek all operate within this shared competitive space, but pursue strategic differentiation through their integration with adjacent digital services, such as search engines, private messaging, office productivity suites, or cloud infrastructures.

5. A different perspective on competition in AI and digital markets

The evidence of competition in AI markets summarized above puts into question the thesis presented by competition authorities’ studies, encapsulated by the Joint Statement on Competition in GenAI, which claims that AI markets would tend to concentrate in the hands of currently leading technology companies. Those studies were premised on the belief that infrastructure would pose insurmountable barriers to competition in AI, and on analogies with the structure of so-called digital markets – both of which are disproved in this Report.

Moreover, the evidence allows an opposite hypothesis: that AI markets actually enhances competition in digital markets and threatens current leaders.

First, an assessment of the integration of AI into digital technologies shows that AI became a significant tool for improving existing digital services. Companies are incorporating AI functionalities in their digital services or using them to improve quality and become more competitive, which has enhanced competition by stimulating investments and differentiation.

Second, besides enabling improvement in services AI systems became a disruptive force that challenges previously well-established markets. An example of such disruptive potential is the multiplication of AI-powered search engines that aimed to disrupt the market dominated by Google, which prompted Google to accelerate its AI products and to enhance its services with embedded GenAI tools. AI also poses serious threats to other traditional digital services, such as image editing tools and marketplaces.

After weighing concerns from scholars and antitrust authorities about potential anticompetitive practices in AI markets against the innovations and efficiencies that AI integration offers, current evidence does not support claims of competitive harm. In fact, AI adoption appears to be intensifying competition in the digital space, leading to greater market disruption and dynamism. Rather than stifling competition, AI integration is emerging as a catalyst for increased rivalry and innovation across so-called digital markets.

6. Effects of Findings for Brazil: AI Innovation Policy

Brazil is a leader in startup development in Latin America, including in AI-first startups, which had a surge of investment in 2024. The State plays a significant role in promoting innovation and market entries in Brazil through a diverse set of public policies. Considering the lack of sufficient grounds for antitrust intervention in highly competitive AI markets, a more fruitful road to promote market entry, innovation and competitiveness for AI in Brazil would be to improve national policies for both enabling and promoting innovation.

Given that startups in emerging economies like Brazil struggle with access to capital and need incentives to scale, partnerships between more established companies and AI startups may be particularly important to stimulate the domestic market for AI development. Therefore, there is a risk that measures like CADE's inquiries into AI partnerships may create a chilling effect on partnerships in general, considering that this is a nascent market in dynamic competition, or postpone procompetitive effects that the partnerships under scrutiny could generate. The disrupting impact of AI should inform proposals of regulation of competition in digital markets regulation (Bill nº 2768/2022 and Bill nº 4675/2025, proposed by the Ministry of Finance). If not rediscussed with a proper view of competitive pressures imposed on digital markets by AI, the proposals may risk becoming inadequate to tackle relevant conducts, or to promote fairness and innovation in digital markets.

7. Policy recommendations

Based on the findings summarized above, the report provides five policy recommendations:

i. **Avoiding analogies with digital markets** when enforcing antitrust in AI markets;
ii. **Monitoring the evolution of AI markets**, seeking concrete evidence of the level of competition and conditions of access to computing, quality data, and expertise, as well as empirical data on key competitive variables;
iii. **Not undermining partnerships between AI companies unnecessarily**, or carrying investigations swiftly when necessary, so as to not stifle efficiencies that these arrangements bring to AI markets;
iv. **Beware of the disruptive impact of AI on "digital markets"**, especially when discussing regulating digital markets, since this reveals the inadequacy of adopting per se prohibitions on vertical practices, and the need for case-by-case and prospective analyses of competition in markets involving digital and AI technologies; and

v. **Fomenting market entries**, through State incentives on both the supply and demand sides. These measures should be discussed and implemented within the scope of bills discussing AI regulation.

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1. INTRODUCTION

Artificial Intelligence (AI), as a domain within computer science, has existed since the mid-20th century.[1] The subarea of generative AI (GenAI) has been prominent in corporate research at least since the publication of Google's "Attention is All You Need" paper in 2017,[2] which introduced the transformer architecture that underpins many GenAI models today. However, it was only in 2022, with the public launch of OpenAI's ChatGPT, that GenAI became regarded as a commercial and societal phenomenon.

Although different types of applications have long been underpinning modern life technologies[3] and been hailed as drivers of economic transformation,[4] it is the rapid and widespread adoption of GenAI that has compelled policymakers to address AI technologies. In this context, competition authorities globally have begun scrutinizing AI markets for AI technologies with a focus on GenAI, motivated especially by the presence of leading tech companies in this subarea.

Competition authorities' analysis of AI markets[5] therefore developed as a continuation of the debates around antitrust in so-called "digital markets"[6], where authorities had already launched landmark investigations and enforcement actions against leading companies.[7]

Enforcement actions against anti-competitive conduct by leading tech companies were initiated in a context of criticism directed at antitrust authorities for an alleged underenforcement in merger control in the sector. Critics considered digital services to be excessively concentrated in a handful of players, and attributed this largely to a permissive merger control in the last two decades.[8] Authorities therefore deal with this impression of a past failure – an error type 2 in digital markets – and may seek to avoid this alleged mistake in relation to AI-related markets,[9] as expressed by former U.S. FTC Chair Lina Khan.[10]

Antitrust authorities are therefore concerned that the shortcomings of competition law enforcement in digital markets may be replicated in the context of AI. In particular, there is apprehension that leading technology firms—by allegedly exercising control over critical inputs such as data, computational infrastructure, and specialized AI talent—could leverage their positions to emerging markets.

In this context, authorities and organizations began examining the competitive dynamics of AI, resulting in the following studies:

- September 2023: the United Kingdom's Competition and Markets Authority (CMA) initiated a review of foundation models and raised concerns about vertically integrated firms with both infrastructure and application-level capabilities dominating markets.[11] In 2024, the CMA published an update of the report, where it expressed renewed concerns that the foundation models sector would be developing in ways that risk negative market outcomes.[12]

- May 2024: the OECD published the working paper "Artificial Intelligence, Data and Competition", raising concerns that control over key assets—particularly data, computing infrastructure, and large-scale AI models—

may enable incumbent firms to reinforce their positions across adjacent markets.[13]

- June 2024: the French Autorité de la Concurrence issued a sectoral opinion on GenAI, pointing to structural risks to competition. The report expressed concern over the concentration of computing power, the role of vertical integration, and the emergence of high entry barriers for smaller AI firms. It also called for vigilance regarding partnerships between large digital platforms and AI startups, which it fears may restrict access or foreclose rivals.[14]

These concerns culminated in the "Joint Statement on Competition in GenAI" (hereafter Joint Statement) issued on July 23, 2024, by the CMA, the U.S. DoJ and FTC, and the European Commission's Directorate-General for Competition. The statement purported three risks to competition in AI: (i) concentrated control of key inputs could "potentially put a small number of companies in a position to exploit existing or emerging bottlenecks across the AI stack and to have outsized influence over the future development of these tools"; (ii) incumbent companies could entrench or extend market power from other markets to AI-related markets; and (iii) arrangements involving key players could amplify those risks in some cases.[15]

These studies influence competition authorities in other jurisdictions. For instance, the Brazilian competition authority (CADE) opened proceedings to investigate leading tech companies' partnerships with AI startups,[16] aiming to verify whether merger control has been bypassed, but also demonstrating concerns – like those from the authorities above – that such partnerships could have anticompetitive effects on Brazilian markets. Although these proceedings are still under analysis, they signal the authority's concerns to the markets and may cause chilling effects on AI partnerships. Therefore, critically analyzing those conclusions is essential to foster qualified debates about competition policy for AI in Brazil.

In addition to CADE's investigations, the AI sector in Brazil is also subject to regulatory uncertainty, as bills looking to regulate AI (Bill nº 2338/2023) and commercial conducts by digital platforms (Bill nº 2768/2022 and Bill 4675/2025, proposed by the Ministry of Finance[17]) are currently under debate. Both bills should be discussed with an accurate view of competition in AI-related markets, rather than based on assumptions or on outdated analyses of digital services before the competitive pressures imposed by AI.

In this context, the goal of this Report is to provide a close scrutiny on the premises of the argument made in those studies, which lead to the conclusion that there would be an inexorable concentration in the emerging markets based on AI in the hands of leading companies. As we shall see, some of its key premises are questionable and either include presumptions that are unlikely to hold true, or that have already been contradicted in recent developments of the technology and the market. Those arguments are also enshrined in analogies with characteristics of digital markets that are unconvincing and do not hold if we consider carefully the chain of production of AI systems and the characteristics of the markets involved.

REPORT STRUCTURE

Drawing from the context above of antitrust authorities' scrutiny of competition on AI, we examine their arguments (see Section 2) and proceed to critically assess them, as well as the blind spots in authorities' outlook of AI.

The first critical assessment tackles the presumption that AI would be destined to strong concentration (see Section 3). First, we highlight the evidence that markets for GenAI are in strong competitive dynamics characterized by new entries, substantial investments and rivalry. Then, we analyze AI infrastructures which were considered as barriers to entry in authorities' outlook – that is, computing power, data and expertise – and conclude that, contrary to authorities' findings, those infrastructures do not seem to impair market entry. Importantly, regarding computing power, we find that there are no incentives for incumbents to foreclose access to compute for companies acting downstream in the AI stack, since the provision of compute (e.g. through cloud computing services) is profitable, while many activities downstream in the AI stack (e.g. developing and launching GenAI chatbots) are not yet profitable.

Another important point investigated in Section 3 is the role of fine-tuning in competitive dynamics. We find that some of the authorities' studies are based on a simplified and inaccurate categorization between markets for foundation models and for fine-tuned applications, when, in reality, there are gradations of refinement that blur those lines. Authorities also failed to consider that, contrary to traditional settings that generally lack competition between suppliers and buyers (except for vertically integrated firms), in AI-related markets that competition is intrinsic: generalist models inevitably compete with more specialized variants, yet they also benefit from downstream fine tuning. In this context, the general model provider is not necessarily incentivized to exclude downstream refiners, rivalry coexists with complementarities, and value appropriation occurs across multiple layers of technological development. Therefore, fine-tuning creates uncertainties that undermine any straightforward prediction of market power leverage strategies by upstream developers.

Further, the report analyses the structural characteristics attributed to digital markets, which competition authorities transpose to AI (see Section 4). We therefore examine whether network effects, economies of scale, feedback loops and lock-in effects would be present in AI, and find that either they are not strong (such as economies of scale and data feedback loops), or are not present at all (such as near-zero marginal costs and lock-in).

Therefore, AI shall not be seen as a factor continuing or reinforcing concentration in digital services. In fact, we argue that AI introduces competitive pressures on digital services (see Section 5). In addition to the factors outlined in Section 4, we also analyze ecosystem architectures and find that AI is likely to disrupt the functioning of ecosystems identified in digital services.

Lastly, we assess the impact of those findings in Brazil, considering the state of the art in AI innovation in the country, as well as regulatory debates. We highlight the shortcomings of competition policy trends tackling AI partnerships and of the discussed regulation of digital markets, and suggest that a better strategy to foster innovation and competitiveness would be not focusing on competition interventions in AI-related markets (whether ex ante or ex post), but rather on public policy promoting technological development – which, in Brazil, should leverage unexplored mechanisms such as public procurement.

2. ARGUMENTS UNDERPINNING THE JOINT STATEMENT BY COMPETITION AUTHORITIES

As above mentioned, the Joint Statement drew the following conclusions from the studies supporting the positions of the CMA, FTC and European Commission about the fate of AI-related markets. Their view is summarized in the table below:

Table 1: The fate of AI-related markets according to the Joint Statement

Joint Statement's expectations for AI-related markets
Probable Leveraging: concentrated control of key inputs could "potentially put a small number of companies in a position to exploit existing or emerging bottlenecks across the AI stack and to have outsized influence over the future development of these tools
Control by leading tech companies: incumbent companies could entrench or extend their market power from digital markets to AI-related markets
Incentives for anticompetitive practices: arrangements involving key players could amplify those risks in some cases

In summary, these conclusions from the Joint Statement are based on the three following main arguments, made by the authorities' studies mentioned above.

1. After the uptake of GenAI, those authorities consider as if AI were inexorably destined to strong market concentration due to high barriers to entry such as computing power, access to data expertise

• Computing power
Access to sufficient computing power is essential for developing foundational models. This power relies heavily on specialized IT components like Graphics Processing Units (GPUs) and AI accelerators, which are expensive and have experienced shortages due to exploding demand. According to the authorities, building in-house infrastructure for this compute would be exceptionally costly and difficult for new entrants, making cloud computing the primary alternative, but also costly. The costs for training state-of-the-art models can run into tens or hundreds of millions of dollars.

• Access to data
Training large GenAI models demands vast quantities of high-quality and diverse data. While much data is publicly accessible, authorities pose that uncertainties regarding the lawfulness of using public data are rising, partly due to content publishers asserting intellectual property rights. They also contend that proprietary data may become important for training foundation models, which would raise barriers to entry and expansion of smaller organizations.[18]

• Expertise
Authoroities describe that the developing foundation models requires scarce, highly advanced technical skills in areas like machine learning and deep learning. They also point to a significant shift of talent from academia to industry, as larger firms can offer more attractive salaries, job prospects, and resources, making it harder for smaller organizations to compete for skilled employees.

2. Incumbents would have leverage in relation to the infrastructure

According to those authorities, leading digital companies possess significant advantages over the essential infrastructure needed for GenAI due to their existing market positions and vertical or conglomerate integration.

• Preferential access to computing power
Those companies can purchase GPUs in large quantities and negotiate preferential agreements with suppliers like Nvidia. Many also develop their own in-house AI accelerators (e.g., Google's TPUs, AWS' Trainium, Microsoft's Maia), reducing dependence on external suppliers. Leading cloud service providers, or "hyperscalers" (AWS, Google Cloud, Microsoft Azure), are the most important among few key players able to provide the necessary computing resources for AI development.

• Preferential access to data
These companies could enjoy preferential access to vast volumes of data from their existing services (e.g., YouTube for Alphabet, Facebook/Instagram/WhatsApp for Meta) and user interactions. They also have the financial power to enter into agreements with third-party data owners for exclusive or difficult-to-replicate access to content, further solidifying their data advantage (e.g., Google's agreement with Reddit, OpenAI's deals with news publishers).

• Ability to attract talent
Their financial capabilities, global reputation for innovation, and wide service catalogues allow them to attract and retain top technical talent, sometimes even by recruiting entire teams from startups.

• Strategic partnerships and investments
The sector is characterized by numerous agreements and minority investments by leading companies in GenAI model developers (e.g., Microsoft's partnership and investment in OpenAI, Amazon and Google's investments in Anthropic). These partnerships could grant exclusive access to models or influence their development.

3. Features observed in the past decades by competition authorities on digital markets are assumed to be equally present in AI

The authorities' competitive analysis of GenAI draws parallels with the dynamics of established digital services, where certain structural features could lead to consolidation and "winner-takes-most" outcomes. Such features include economies of scale with zero marginal costs, network effects, data feedback loops, and ecosystem architectures.

However, as will be demonstrated throughout this report, the three arguments above make assumptions that at close scrutiny are at least questionable, either conceptually or on empirical grounds. Particular attention will be given to the analogies with digital markets structure and characteristics, as AI products or the chain of their production are not prone to zero marginal costs, nor to network effects. Although some attention must be given to data feedback loops, the ecosystem effects observed in the AI markets are more likely to foster competition than to undermine it. These procompetitive effects, which are already noticeable in AI markets, may also bring competitive pressure on digital markets themselves.

Hereinafter, this report will question those assumptions in three main aspects:

i. whether those "infrastructure" costs have an inexorable leveraging effect from digital markets into the markets of foundational models and fine-tuned models;
ii. whether the analogies with the features of so-called digital markets really hold; and
iii. whether ecosystem structures are present in AI and if they could foster inter-ecosystem competition instead of bringing anticompetitive incentives.

Since we do not assume the burden of demonstrating that AI-related markets are inherently competitive, our critique of the assumptions underpinning the Joint Statement suffice to illustrate that its conclusions are speculative. Accordingly, enforcement actions grounded in such conclusions risk being not only premature but also potentially detrimental to fostering the very innovation that is desirable for fostering competition in this field.

3. INEXORABLE HIGH CONCENTRATIONS IN AI MARKETS?

Before questioning and discussing the premises and assumptions underlying the studies that informed the Joint Statement of those antitrust authorities, it is worth noting that there currently exists a strong competitive dynamic characterized by new entries, substantial investments, and significant rivalry in the GenAI sector. Such observation already casts doubt on the thesis that markets for the development and application of AI are destined to become concentrated in the hands of a few companies.

Just to mention an emblematic instance, OpenAI, the leading company in the field of GenAI, was not part of the group of incumbent tech firms, which immediately seems to be uncongenial to the claims of leading tech firms' uncontested dominance.

And a closer look to the market in recent years shows that the GenAI landscape has indeed evolved rapidly, with outstanding features that show fierce and increasing competition.

First, there are several new and competitive entries in the markets related to AI-native products (distinguished from those markets where existent products or services incorporate AI). Besides, the initial divisions in the GenAI sector, first between AI-Content Generators and AI-Assistants and, second between image, video, audio and text generators were completely blurred, with many AI-Assistants adding features of content generation and the rise of multi-modal generators, therefore increasing rivalry by native AI-assistants access to broader audiences but still facing specialized capacities of niche content generators, which, in their turn, are obtaining higher margins and revenues.

Second, given the substitution threat posed by GenAI on digital services and the ability of AI systems to boost and increase the efficiency of digital products, leading digital companies are strongly investing and developing their own GenAI products, which has enticed rivalry and differentiation, given that leading providers of different digital services are coupling their products with AI launchings, either independently or through partnerships with AI-native companies.

Third, as we shall discuss in Section 5, the disruption caused by the launch of AI Assistants that are rapidly overlapping with digital services, like web search, has brought new competitive pressures on digital services, not only by stimulating investments and differentiation, but also by coupling digital services with GenAI technology.

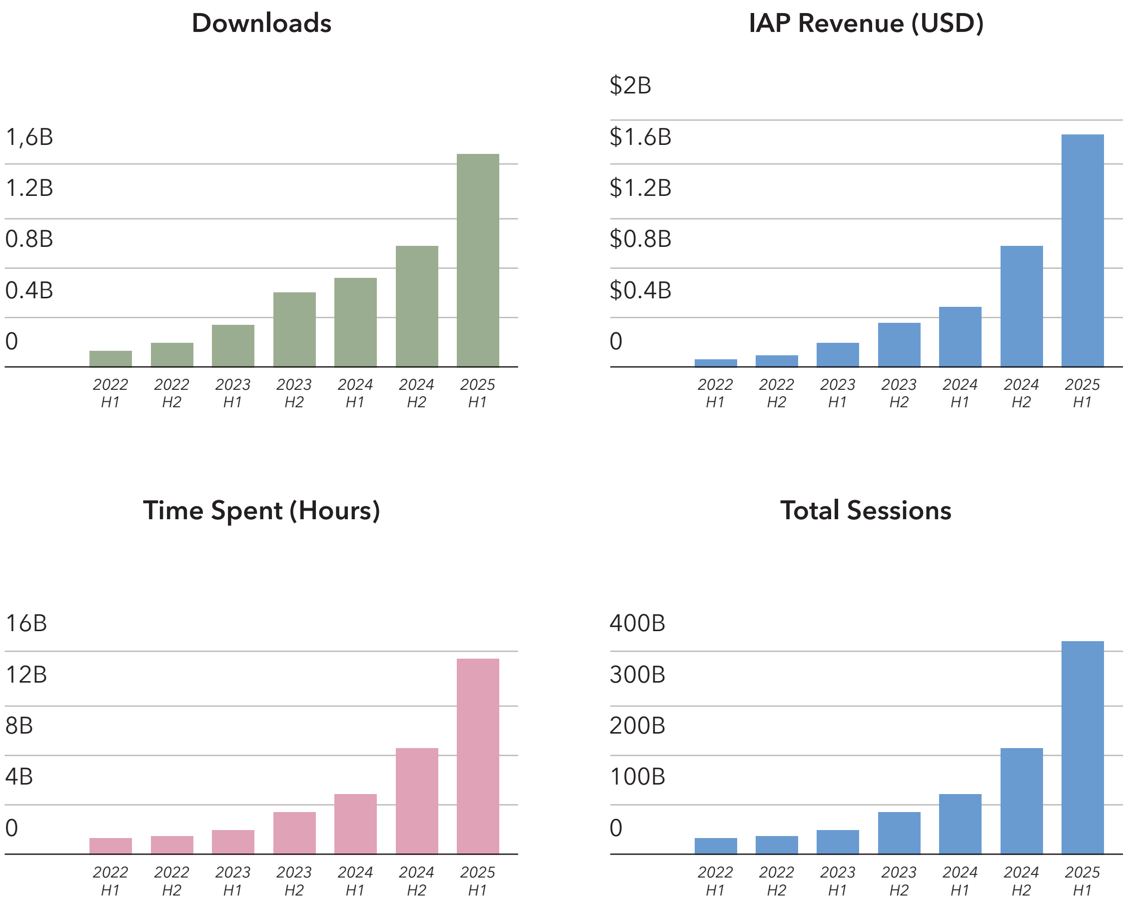
3.1 Entries and the competitive dynamic of AI markets

The GenAI stack can be structured in three layers: data center infrastructure, GenAI foundational models and platforms, and GenAI services.[19] Most relevant market entries and competitive pressure on leading tech companies pertain to the second layer, i.e. GenAI foundational models and platforms,[20] which may be further segmented in two main segments: AI-Assistants (ChatGPT, Claude, Gemini, MetaAI, DeepSeek, etc) and AI-Content Generators (of audio, video, images and text). The market for GenAI foundational models and platforms reached $11 billion investment in 2024, globally.

Considering both foundation models and services layers of GenAI, it is undeniable that there has been a surge in product offerings, from co-pilots that draft and optimize computers to AI powered virtual companions that offer support and conversation. This variety is attributed to the competitive pressure imposed by ChatGPT, which resulted, for instance, in the coming of Meta's LLaMA 2 model and Google's Gemini (formerly Bert)[21].

As of May 2025, ChatGPT combined with Microsoft Copilot had a 74.2% market share in the global GenAI markets[22]. However, OpenAI's market share for broader AI tools is lower compared to other competitors[23], which indicates that Gen AI markets are fiercely competitive and OpenAI faces challenges from both established companies (such as Microsoft, Google, Meta, Amazon, Alibaba and Baidu) and startups[24].

Leading tech companies have focused on the development of large-scale language models, proprietary chips, and robust cloud infrastructures for internal use as well as for selling, providing support to a broad range of applications—from enterprise tools to consumer-facing platforms, reaching broader audiences with the launching of AI Assistants. Meanwhile, a wave of GenAI-focused firms has contributed with innovations in video generation, creative content, human-computer interaction, and domain-specific AI, helping shape the current diversity and specialization of sector, which is experiencing significant and accelerating growth since the last two years. The charts below show impressive growth of AI-native apps in terms of downloads, in-app revenues, time spent and total sessions, measured from iOS and GooglePlay:



Source: Sensor Tower, January 2025

As it is typical in growing markets, the increasing demand attracts entries and new investments. This movement is observed both with respect to AI-Assistants and AI-Content Generators. From 2024 to 2025, 17 new companies appeared in the ranking of the top 50 AI-products, including DeepSeek (another important player outside the group of leading tech companies) which ranked #2 globally in unique monthly visits after six months, and outperformed ChatGPT by reaching 10 million users in 20 days, compared with the already impressive figure of 40 days by ChatGPT.[25] The table below shows the top 50 GenAI-web products in 2025 in unique monthly visits:

The Top 50 Gen AI Web Products, by Unique Monthly Visits

1. ChatGPT	11. Kimi	21. CIVITAI	31. Photoroom	41. Monica
2. deepseek	12. Hailuo AI	22. IIElevenLabs	32. Moescape AI	42. CURSOR
3. character.ai	13. Hugging Face	23. Sora	33. Midjourney	43. ideogram
4. perplexity	14. Poe	24. Crushon AI	34. candy.ai	44. CHUB
5. JanitorAI	15. Adot	25. BLACKBOX AI	35. zeemo	45. Clipchamp
6. Claude	16. Eden AI	26. DeepAI	36. VEED	46. Meta AI
7. QuillBot	17. PolyBuzz	27. Gamma	37. invideo AI	47. StudyX
8. SUNO	18. SEAART.AI	28. Leonardo.Ai	38. Pixelcut	48. bolt
9. SPICYCHAT.AI	19. liner	29. cutout.pro	39. talkie	49. PicWish
10. Doubao	20. KLING AI	30. BRAINLY	40. PixAI	50. Joyland

Source: Similarweb, January 2025. Elaborated by Moore, Olivia and Zhao, Daisy (2025)

Another interesting aspect is that the top 50 GenAI apps changes significantly if we consider the criterium of monthly active users, and again if we consider the criterium of revenue. The table below shows the top 50 GenAI apps by monthly active users. We first notice that there is an overlap of only 8 platforms in both lists[26], which shows that there is experimentation of different AI apps besides a preferred regular app used, given the possibility of multihoming. Another interesting aspect is that AI-Assistants usually figure in higher ranks in unique visits, while AI Content Generators are higher in rank when it comes to monthly active users, since AI-Assistants are becoming multimodal and investing in their content generation features and have potentially broader audiences. Thus, AI-Assistants attract more visits and experimentation, while more specialized content generators still get preference for regular use. For instance, while DeepSeek championed unique visits, it appears only as #14 monthly active users. In its turn, Perplexity moves from #4 in unique monthly visits to #50 in monthly active users. The top 10 GenAI apps in unique monthly visits are all native AI-Assistants, while there are five AI-Content Generators in the top 10 GenAI-apps in monthly active users.

The Top 50 Gen AI Mobile Apps, by Monthly Users

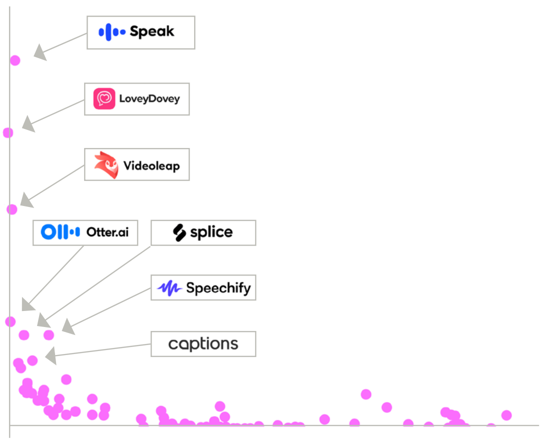
1. ChatGPT	11. talkie	21. UpFoto	31. Photoshop Express	41. Cici
2. NOVA AI CHATBOT	12. B612	22. Gemini	32. EPIK	42. Copilot
3. Microsoft Edge	13. Remini	23. AI Mirror	33. Remove Objects	43. Photo Lab
4. Baidu AI Search	14. deepseek	24. Hypic	34. Photoroom	44. Photo AI
5. photomath	15. VivaCut	25. BRAINLY	35. Facemoji	45. Face Dance
6. Quark AI Assistant	16. Chatbot AI Search Assistant	26. Polish	36. Beat.ly	46. Retake
7. Doubao	17. meitu	27. Translate	37. AI Chatbot: AI Chat Smith 4	47. Question.AI
8. character.ai	18. FaceApp	28. Genius	38. FaceMagic	48. ChatBox
9. Chat & Ask AI	19. Filmora	29. Luzia	39. MVideo	49. LooksMax AI
10. ChatOn AI	20. BeautyPlus	30. Remove It	40. ChatBot	50. perplexity

Source: Sensor Tower, January 2025.

With respect to revenues it is also noteworthy that popularity does not translate into revenue. AI-Assistants are more popular and rank in the top for the metrics of usage but not in the metrics for revenue. On the other hand, content generators that serve specific goals or skills or that reach enterprise-level, such as photo and video and music generators, language learning or dictation are more likely to attract paying users. The charts below show the mismatch between popularity and revenue with AI Content-Generators excelling in revenue, regarding mobile subscriptions:

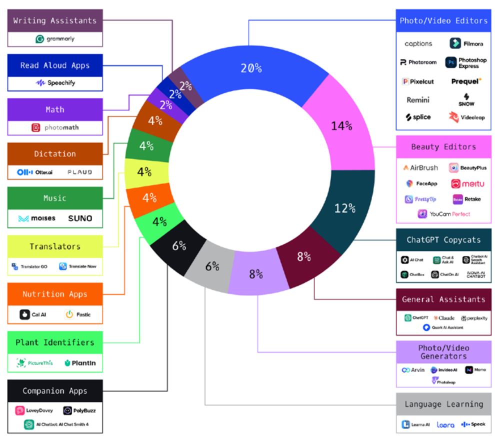
Top AI Consumer Apps: Usage vs. Revenue

Based on mobile subscriptions



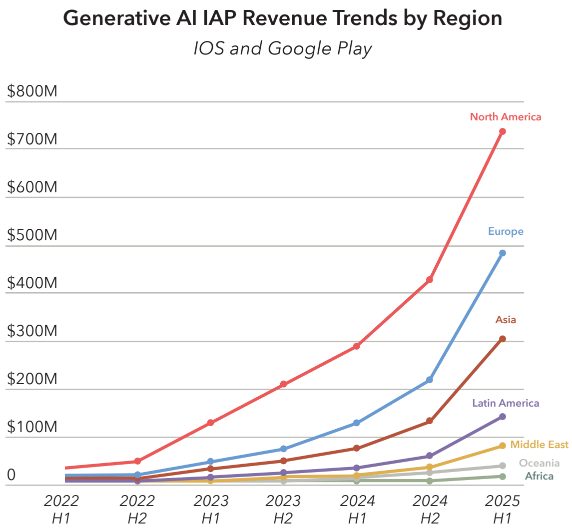
Top Categories Among AI Consumer Apps vs. Revenue

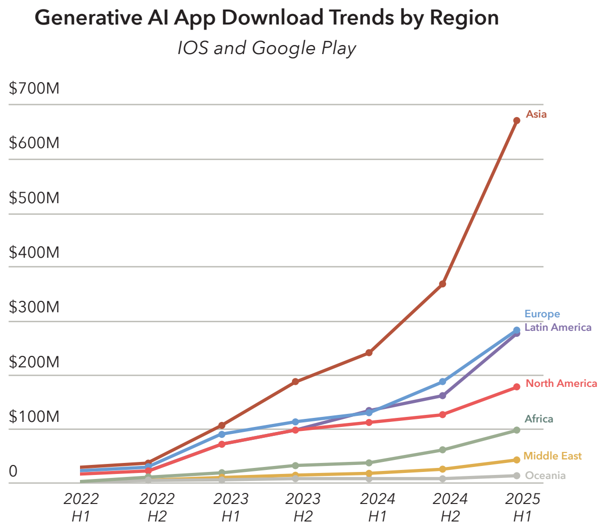
Based on mobile subscriptions



Source: SensorTower, January 2025

Revenue is still led by North American GenAI apps, but European, Asian and Latin American apps are significantly increasing their figures. Besides, Asia, Europe and Latin America are outperforming North American GenAI in the trend of downloading, showing that US leaders, tech giants among them, tend to face competition in the dispute for user subscriptions. Evidence is shown in the charts below:





Source: SensorTower, January 2025

The dynamic of entry, experimentation and rivalry, with the mismatch between popularity and revenue is driving developers to integrate capabilities, first, by offering new modalities of content in the market of AI-Generators and, second, with the AI-Assistants increasingly becoming also AI-generators.

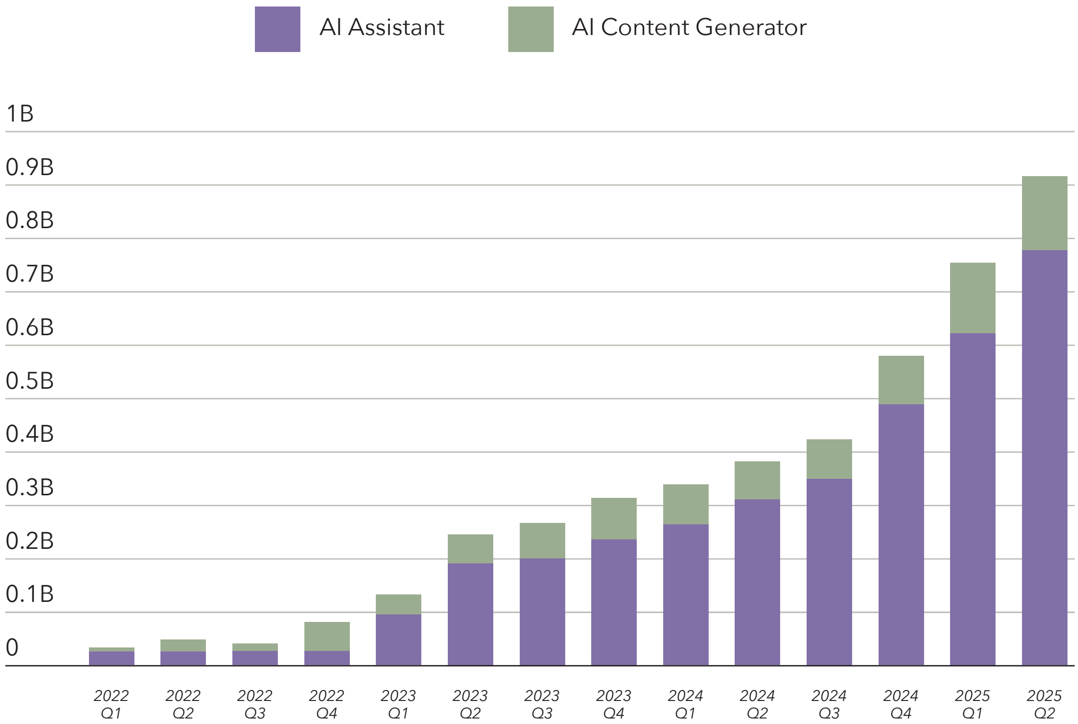
AI-Content Generator apps built on generative models have moved beyond single-purpose features (e.g., only text-to-text or only text-to-image) and are becoming truly multimodal platforms—sometimes even embedding AI assistants inside broader digital services. Google Veo (Veo 3 on Vertex AI) was born wired into Google Cloud/Vertex, so video generation plugs straight into the rest of the digital ecosystem. Midjourney, which started with images, now brings them to life with its Video Model v1, stitching visual styles into motion right inside the app. OpenAI likewise bundles multiple modalities under one roof: ChatGPT serves as the text-to-text interface while other models handle image-to-text, text-to-image (DALL·E), and even text-to-video (Sora). In audio, Suno (v3+), Udio, and ElevenLabs' Eleven Music show the same convergence: they began as music/voice generators and now slot into end-to-end pipelines where an agent can write lyrics, compose melodies, synthesize vocals, and master tracks in a single flow.

Breaking down the growth in downloads of GenAI markets into the segments of AI Assistants and AI Content Generators, we observe that Content Generators led in downloads as recently as 2022. The launch of ChatGPT, however, marked a turning point, accelerating the adoption of AI Assistants and chatbots. By 2025, 85% of downloads across these two segments came from AI Assistants such as ChatGPT, Google Gemini, and DeepSeek. This shift signals the broader trend that AI Assistants are increasingly incorporating multimodal generation capabilities—text, image, audio, and beyond—transforming them into comprehensive platforms that blend assistance with creative functionality.

Generative AI App Download Trends by Subgenre

IOS and Google Play

Worldwide



Source: SensorTower, January 2025

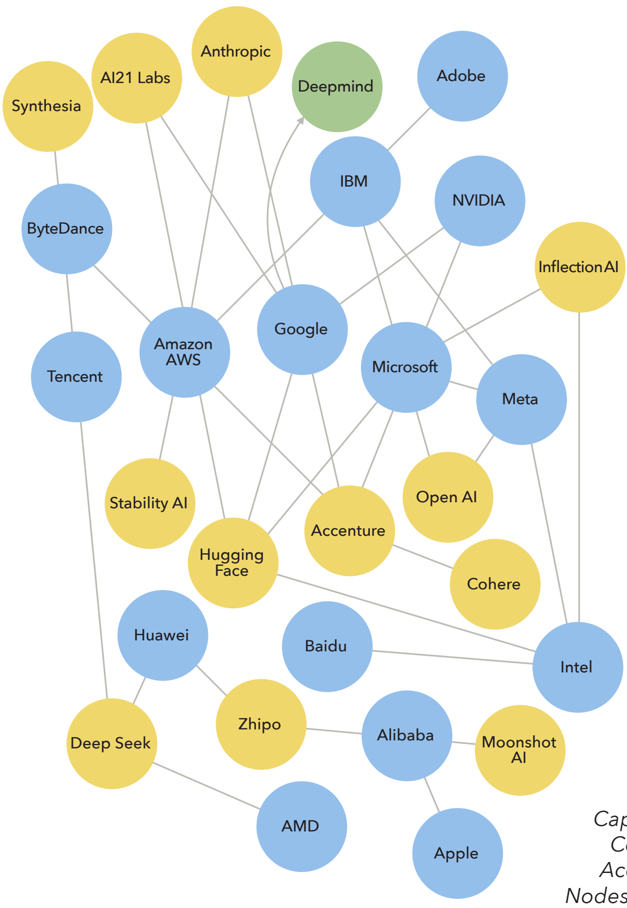
The evidence presented above indicates that the current market for GenAI applications is characterized by high levels of competition, marked by the successful entry of numerous new players. These entrants operate across distinct segments, yet their activities increasingly blur traditional boundaries between AI Content Generators and AI Assistants, as well as among different modalities such as text, audio, video, and images, due to cross-segment entries and product integration.

The market is expanding rapidly, and consumers appear willing to experiment with alternative solutions, which enhances user mobility and facilitates migration toward more efficient offerings. This dynamic fosters an environment conducive to further entry and innovation. The observed pattern suggests a trend toward convergence of these markets, with significant competitive advantages over one another, and product differentiation among participants, which will pose difficulties in defining relevant markets for antitrust analyses. A salient feature of this evolution is the versatility of AI Assistants, which have achieved broader adoption by offering bundled functionalities. However, greater popularity does not necessarily translate into higher revenues, as specialized content-generation solutions continue to attract substantial subscription-based demand.

Despite OpenAI's leadership in the competitive scenario, the company depends on its innovation, strategic partnerships and adaptation to industry evolving demands. Therefore, while OpenAI engenders competitive pressure on other players, the company must use its advantages and strengths to navigate the AI sectors challenges and maintain its position as a leader. Those advantages include proprietary technologies and intellectual property, brand value, cutting-edge capabilities and innovation, the strategic partnership with Microsoft, a talent pool and a perception of ethical AI leadership.[27] These factors indicate that OpenAI creates competitive pressure on leading companies, but also suffers pressure from competitors, therefore not enjoying a "first-mover" or "winner takes all" position.[28]

As previously mentioned, leading companies with infrastructure such as cloud computing, hardware design, and enterprise software are investing heavier on broader AI-Assistants. In contrast, startups tend to operate in more specialized niches, targeting innovation in model design, user experience, and emerging applications of GenAI. This general structure has fostered a dynamic ecosystem in which foundational technologies and practical applications co-evolve, reflecting both competitive pressures and collaborative opportunities across the market.

In this context, a prominent competitive strategy has been the formation of partnerships aimed at achieving differentiation, enhancing technical capabilities, and expanding the functional scope of products and services. This collaborative approach intensifies rivalry among players by fostering significant investments in product development and the introduction of innovative solutions. Notably, these arrangements tend not to result in mergers or acquisitions; rather, they take the form of partnerships that preserve the independence and strategic autonomy of the firms involved. The figure below shows the main partnerships and acquisitions in the GenAI sector.



Caption: Blue Nodes: Investor Companies. Green Nodes: Acquired Companies. Yellow Nodes: Partner Companies. Straight Line: Partnership. Curved Line: Acquisitions

Some authorities recognize the procompetitive effects of partnerships. The FTC's report on Partnerships Between Cloud Services Providers and AI Developers indicates that partnerships agreements allow cloud services providers to use technical and business information that other cloud services providers and AI developers may not have, such as AI models, AI development methods, chip designs, among others[29]. Additionally, the CMA highlighted how partnerships facilitate foundational model developers to access scarce compute resources[30]. The authority also highlights how partnerships grow interconnectedness between players, allowing access to direct financial investments, to data and distribution agreements[31].

A close look at the figure above corroborates this dynamic. Google[32] and Amazon[33] are Anthropic's main investors, while the AI startup committed to purchasing computing power from its investors. Microsoft and OpenAI's notorious partnership is a good example of access to language models through cloud platforms[34]. Meta's collaboration with several companies, such as OpenAI, Microsoft and Intel, illustrates its intention to create an advanced infrastructure of processors and AI accelerators[35].

Chinese companies are also experiencing dynamism. Alibaba is China's main investor in GenAI for e-commerce (Alibaba Cloud) and has a current partnership with Apple to enhance AI capabilities in iPhones[36]. Baidu developed the advanced language model Ernie and collaborated with Intel to achieve performance improvements in its AI applications, such as PaddlePaddle 2.0[37]. TikTok's developer ByteDance has partnerships with AWS and Tencent for AI integration[38]. Tencent has a partnership with DeepSeek, offering the AI company its HAI platform[39]. Huawei also collaborates with DeepSeek, hosting DeepSeek R1/V3 models on Huawei's Ascend and supported via Huawei's cloud[40]. Lastly, Zhipu AI's collaborations with Alibaba Cloud[41] and Huawei[42] has expanded its infrastructure and hardware integration.

Some other noticeable partnerships are Moonshot AI venture capital investments from Alibaba[43], HuggingFace's partnerships with Microsoft, Google and Intel to provide pre-trained models and API development[44], and NVIDIA with Microsoft and Google for AI solutions developments[45].

These partnerships illustrate Generative AI markets vibrancy and broadness of players[46]. Furthermore, they indicate that several firms are developing foundational models, attracting a large inflow of venture capital to this sector[47].

Investments in AI startups increased from US$408 million in 2018 to US$4.5 billion by 2022 – the year of OpenAI's ChatGPT launch[48]– and leading tech companies such as Google, Facebook and Microsoft multiplied new generative AI products announcements[49]. Investments continued in the following years. For instance, in September 2023, Amazon invested US$4 billion in Anthropic, becoming the company's minority stakeholder and cloud partner[50]. In 2024, the global generative AI venture capital had a total of US$56 billion investment across 885 deals – a 92% increase from 2023's $ 29.1 billion[51]. As of 2025, OpenAI closed a $40 billion funding round, the largest raised by a tech company.[52]

Latin American countries are also experiencing market entries and innovation propelled by AI. In 2024, AI startups represented 19% of all startup funding in Latin America, achieving US$1.65 billion of investments – 22% of which towards AI-first startups, and 78% towards AI-enabled startups.[53] Brazil is the regional leader in general startups investments[54] and captured

55% of AI startup investments in the region, with US$35 million in AI-first startups in the first months of 2024.[55] As of the writing of this report, a Brazilian AI-first startup has just become the country's newest unicorn: Enter, a legaltech that created AI agents and generators for legal filings to reduce costs of mass litigation for companies, captured R$200 million in its latest investments rounds, and was valued at R$2 billion.[56] This timely example illustrates how AI is attracting investments in Brazil, especially niched applications.

Therefore, current competitive dynamics—marked by substantial investments, the continuous introduction of innovative products, and strategic alliances aimed at combining competitive advantages and enhancing market differentiation—appear, at first glance, to be inconsistent with predictions of dominance grounded in control over basic infrastructure, as suggested by the Joint Statement. This observation, in turn, calls for a critical examination of the premises underlying the studies that preceded the Joint Statement, an inquiry that will be pursued in the following sections.

3.2 Does AI infrastructure necessarily lead to market foreclosure?

Infrastructure is mentioned in the Joint Statement as a potential source of barriers to entry into AI markets. According to the CMA's initial report,[57] the development of cutting-edge AI technologies requires access to considerable amounts of computing power, data, and expertise, among other resources, which tend to be concentrated in the hands of a few established players.[58] As such, they believe in incentives for companies holding infrastructure to leverage their power to AI-related markets, particularly markets of foundational models. In this section, we examine whether and how such incentives might be overcome in a way that fosters competition for AI.

3.2.1 Is computing power an unsurmountable barrier in the age of AI?

Access to substantial computing power is a critical prerequisite for the development of foundational models. Such capacity depends heavily on specialized hardware components, including Graphics Processing Units (GPUs) and AI accelerators, which are not only costly but have also been subject to recurrent shortages in light of rapidly escalating demand.

According to the studies that support the Joint Statement, establishing in-house infrastructure to meet these computational needs is prohibitively expensive and poses significant barriers for new entrants, rendering cloud computing the primary alternative. However, reliance on cloud services is also associated with considerable costs, as training state-of-the-art models can require expenditures amounting to tens or even hundreds of millions of dollars.

As of 2025, foundational models remain very expensive to develop and run. According to the latest edition of Stanford's AI Index Report, training a cutting-edge model such as Gemini or Grok can cost over 100 million dollars,[59] and the generation of inferences from such models costs considerably more than it does for less advanced models.[60] Those considerable costs are, in part, the result of the greater number of floating-point operations (FLOPs) needed for training such models. But they also follow from the use of specialized AI chips and dedicated data centers for carrying out those operations more efficiently.[61]

However, the competitive analysis must be prospective regarding the development of the market, especially in the field of technology. Such a prospective approach brings two aspects that undermine the belief that computational capacity constitutes an insurmountable barrier to entry. First, technological breakthroughs may reduce the development and inference costs for foundational models. Second, it does not present the complete picture of competition in AI, as computing power is more accessible for downstream applications.

3.2.1.1 Technological Breakthroughs Regarding Computational Power

Regarding the barriers to entry at the high-end of AI model development, current assumptions on the relationship between computational power and model capabilities are reflected in so-called *scaling laws*. Those laws, built on empirical observations and assumptions about system development, reflect their developers' best estimates of how much bigger the trained model must be to improve its performance.[62] Yet, given their character as extrapolations, they can be overcome by breakthroughs in research and engineering. This is particularly true in a recent field of technological development, like AI.

A significant example of these breakthroughs is the development and launching of DeepSeek.

In late 2024, the Chinese company DeepSeek released its DeepSeek-V3 model, which could match the performance of advanced models from companies such as OpenAI and Google, while being trained on only a fraction of the computing power needed to train those models, by focusing on a more efficient architecture.[63] DeepSeek significantly reduced computational costs for developing foundational models by effectively implementing the so-called *"mixture of experts"* approach. Instead of training a single massive network that required constant communication across GPUs, DeepSeek divided the system into many smaller specialized networks ("experts") dedicated to specific domains like poetry, programming, or biology. The key innovation was pairing these experts with a "generalist" system, which coordinated their outputs without forcing all experts to interact continuously. This architecture minimized unnecessary data transfer between chips, leading to far more efficient training and substantially lower costs. The table below compares the costs of development of DeepSeek with respect to GPT-4.

Development costs of DeepSeek vs GPT-4

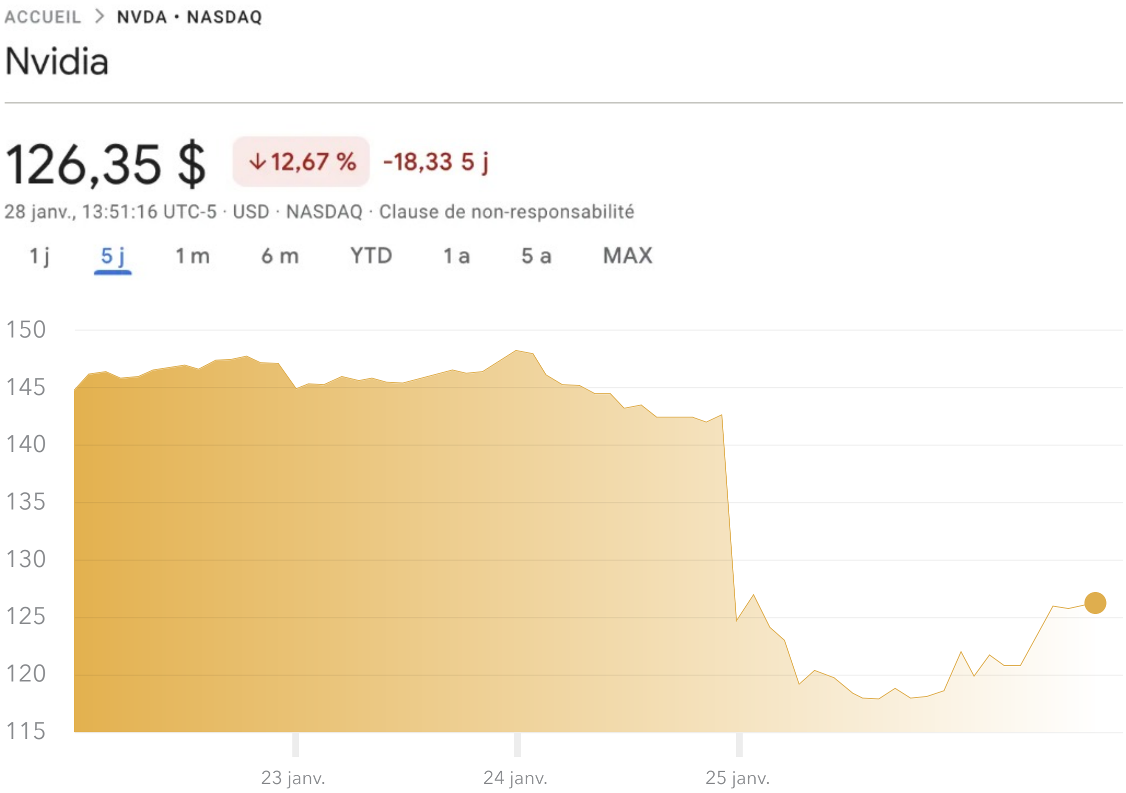
Criterion	DeepSeek	ChatGPT (GPT-4)
Development Cost	$5.6M	$3B+
Number of Chips	2,000	16,000+
Chip Type	H800	H100
Overall Performance	Comparable	Standard Reference
Supported Languages	English, Chinese	Multilingual
User Price	Free	$20/month
API Cost	-$0.006/1K tokens	-$0.03/1K tokens

Source: LEGRAND, T. DeepSeek vs ChatGPT: The Comprehensive 2025 Comparison Shaking Up the AI Industry. Digidop, 28 Jan. 2025. Available at: https://www.digidop.com/blog/deepseek-vs-chatgpt. Accessed 18 August 2025

Although the development of DeepSeek-V3 still demanded specialized hardware and considerable expenses for its execution, the reduction of costs was substantial and DeepSeek's engineering breakthroughs have also led to a reduction of inference costs, reducing the expenses needed for offering those models as a service after training.[64] Given the architecture that coordinated smaller specialized neural networks the model also performed successfully in specialized domains being a pioneer in the so called Large Reasoning Models, which became a major field of investment by leading companies.

The graphic below shows the impact of DeepSeek on the value of NVIDIA, the market leader on computing infrastructure:

NVIDIA's value variations after DeepSeek's launch



Source: LEGRAND, T. DeepSeek vs ChatGPT: The Comprehensive 2025 Comparison Shaking Up the AI Industry. Digidop, 28 Jan. 2025. Available at: https://www.digidop.com/blog/deepseek-vs-chatgpt. Accessed 18 August 2025

The remarkable impact of DeepSeek's market entry on the valuation of leading infrastructure providers, such as NVIDIA, indicates a more limited role that infrastructure control may play in determining competitive positioning within AI application markets. From a competition law perspective, this development is particularly significant, as it generated substantial effects and intensified competitive pressure on incumbent firms. In response, rivals have accelerated investment both in cost-efficient architectures and in advanced reasoning models, signaling a strategic shift toward innovation-driven differentiation rather than reliance on infrastructural leadership.

3.2.1 The complete picture of upstream and downstream AI markets

On the other hand, not all AI-related markets consist in the development of high-end GenAI models. Given the high costs associated with the generation of inferences by the most advanced models, many downstream applications are better served by smaller models. Organizations might develop their own, smaller generative models that meet their own needs. Alternatively, they might rely on open-source models, such as the multilingual model developed by a Swiss research consortium,[65] or other commercial solutions, such as models tailored for specific tasks.[66] Consequently, the development of competitive AI products for particular markets is possible at a fraction of the costs typically associated with GenAI.

At such smaller scales, the use of cloud computing solutions becomes more feasible. By utilizing the computing capabilities provided by third parties, such as AWS, organizations can create their own models without having to acquire all the dedicated software needed for its efficient training.[67] Reliance on cloud resources is particularly valuable when it comes to downstream AI applications, as discussed in Subsection 3.2.5 below. Still, it remains an option for organizations developing their own models, especially if they are working on smaller models, that do not demand as many computing resources as the high-end models at the state of the art. Even if cloud computing turns out not to be a feasible solution, there is a growing tendency towards the commoditization of computational resources, as new entrants join the infrastructure markets by offering AI-dedicated cloud computing with a fraction of the investment needed by their competitors offering general cloud services.[68] Computing power is not, therefore, an unsurmountable barrier to entry into AI markets, even in the markets for AI models.

3.2.2 Is data an entry barrier factor for AI markets?

The studies supporting the Joint Statement also emphasize data as an entry barrier factor for competition in AI.

Indeed, modern breakthroughs on AI are heavily dependent on data. For machine learning algorithms such as those powering the most advanced GenAI models, data quality is critical not just for generating specific outputs, but also for the training process through which such models develop their capabilities.[69] For large-scale models, this means that AI developers must secure gargantuan amounts of data. Potentially, that data might be obtained from public sources, such as social networks or Wikipedia; however, issues with the quality of publicly-available data and legal issues that might emerge from its use can reduce the usefulness of those sources.[70] Consequently, debates about AI markets often raise the concern that organizations with access to private data sources—such as those which control large social networks—might have an irreplicable advantage in the development of their own AI models.[71]

However, current evidence suggests that the advantages drawn from private data are not as strong as those attributed to digital markets.[72] From a descriptive standpoint, it is noteworthy that the leading players in high-end AI development, such as OpenAI and Anthropic, have not benefited from extensive use of private data. They have established partnerships with sources of high-quality data, as seen in the partnership between Reddit and OpenAI,[73] but these are often non-exclusive licenses, which potential competitors might also pursue. Furthermore, the market actors who are best known for their wealth of data, such as Meta and X, have so far failed to transpose that abundance of data into dominant GenAI models.[74] Access to data remains a critical asset in model development, but it has not led to market leadership or dominance, which raises serious doubts on its qualification as competitive advantage of incumbents, and therefore on its conceptualization as an entry barrier factor.

There are reasons to believe that the scenario outlined above is not just a transient anomaly. Over the past few years, AI scholarship has suggested the diminishing returns of data: after a certain point, adding more data would only lead to marginal improvements on a model.[75] This hypothesis remains to be confirmed in practice, but OpenAI's Sam Altman has been on the record about the upcoming end of the "era of giant models".[76] If and when that is the case, future advancements in AI technologies would benefit from the quality as opposed to the quantity of data. While such a development might be useful for actors which already hold large quantities of private data, such as social networks, it would also allow potential competitors to gain efficiency from exploiting smaller, high-quality or even specialized data sets that might be advantageous for downstream applications. If so, potential competitors might be able to tap into the advantages of high-quality data without having to secure an agreement with large providers.

The consideration of data as an entry barrier factor might be also contested by developments in synthetic data generation. Using GenAI models, organizations can generate large datasets based on smaller, high-quality datasets drawn from real-world observations.[77] Such synthetic datasets can, in turn, be used as source materials for the training of large-scale GenAI models, thus potentially enabling smaller actors to secure the data they need for competing with established players. Some concerns have been raised in the technical literature about the limits of relying solely on synthetic data, but, under the state of the art, a combination of synthetic and real-world data leads to robust training outcomes.[78] Further developments on synthetic data thus hold the potential of increasing competition for AI.

3.2.3 Concentration of AI expertise?

The third infrastructure element pointed out in the studies supporting the Joint Statement is AI expertise, meaning the computer scientists and engineers available in the professional market for the development of AI.

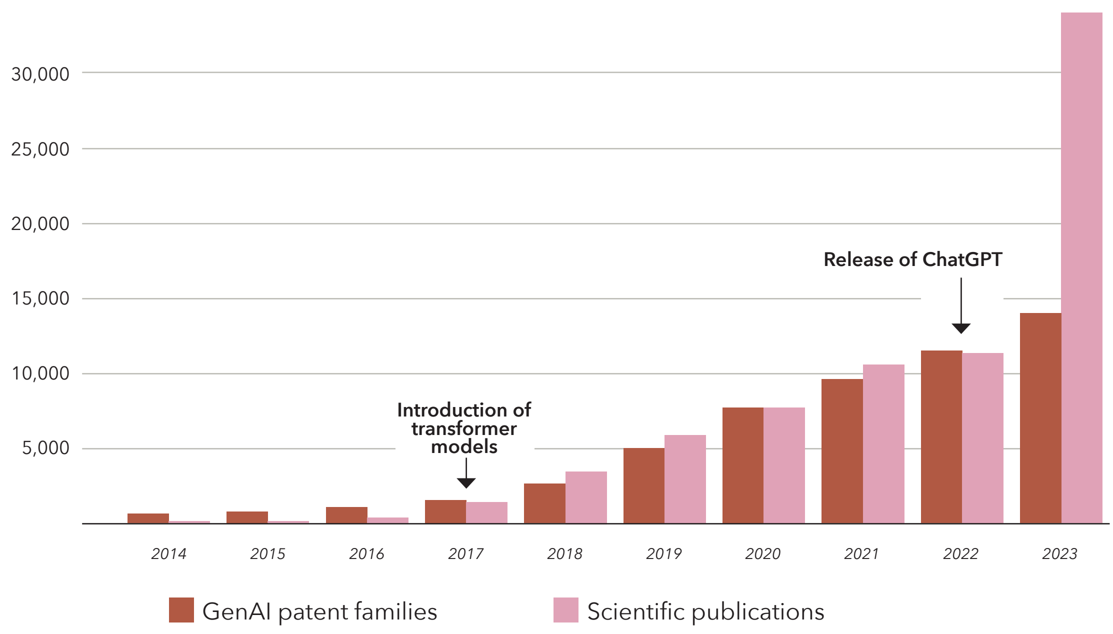
Of course, a salient trait of AI technologies is their technical complexity. Current breakthroughs on GenAI are the (current) endpoint of decades of research and technical developments,[79] which depend on intricate supply chains for their operation.[80] In this context, innovation—or even ordinary development—requires considerable technological expertise, which comes at a premium. Overviews of the AI developer workforce, for instance, show that talent is disproportionately concentrated in rich countries, which are hiring significant numbers of software professionals with AI-related skills.[81] At the upper echelons of this market, Meta has recently made the news by hiring OpenAI researchers with signing bonuses said to reach 100 million dollars.[82] With the growing costs for hiring AI professionals, one might expect start-ups and smaller businesses to be priced out of any serious AI-related innovation.

AI professionals are incredibly well-remunerated in the current market, and that does have consequences for how AI technologies are created and developed. However, those shifts in work dynamics have not eliminated competition in AI. Quite the contrary: one of the most prominent causes of the recent decline in the share of highly-cited AI publications authored by industry researchers is that major market players are more reticent to make their innovations public in light of heightened competition.[83] While experts have pointed out that this enclosing of research can have deleterious consequences for the research environment,[84] this scenario signals that the market for high-end AI models is still contested.

In addition, smaller organizations do not necessarily require as many professionals as the larger, established players. Recognized players in the high-end GenAI markets, such as Mistral AI and Midjourney, have kept lean operations, with fewer than 50 employees at the time of some of their major breakthroughs.[85] While the expansion of those businesses will inevitably require more talent, there is little reason to believe supply and demand dynamics could not ensure the redistribution of talent towards growing businesses and away from stagnating ones.[86] And, as AI experts and talent move between companies, they contribute to the dissemination of knowledge and skills between organizations.[87] The substantial investments in AI research in recent years have also contributed to a significant expansion of the pool of available talent. This trend is reflected in the marked increase in patents related to AI systems, originating from diverse sources across both industry and academia, rather than being predominantly concentrated within the activities of major technology companies.

Not only the release of ChatGPT prompted new startup entries and product launches by both startups and incumbents, it also pressured the sector to increase research and development. As demonstrated in the figure below, scientific publications had a rampant increase since 2022:

Development of global patent families and scientific publications in GenAI 2014 - 2023



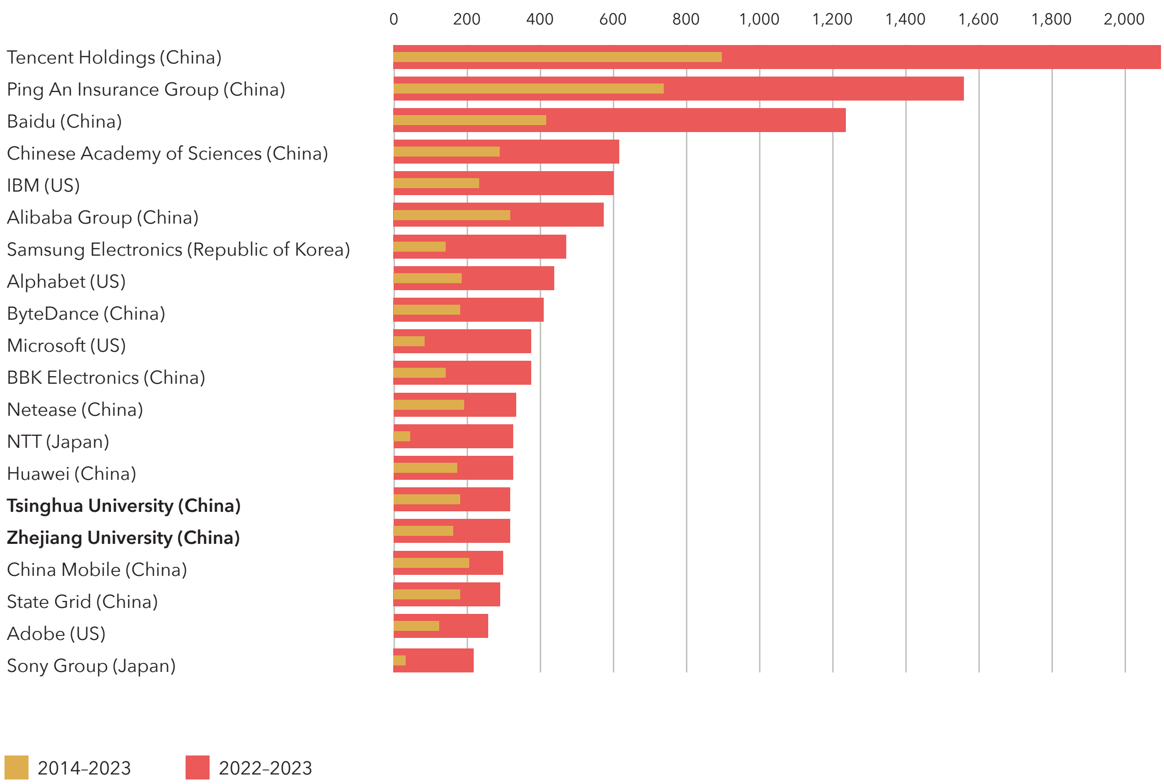
Source: WIPO, based on patent data from EconSight/IFI Claims, April 2024, p. 34

WIPO studies indicate that the success of ChatGPT and other GenAI models and tools initiated a new wave of GenAI research[88]. Despite GenAI having a small portion of patent family publications in the AI patent family publications (only 6% from 2014 to 2024, according to the studies), its share has been increasing since 2017, given the massive increase in public interest in GenAI since ChatGPT launch in November 2022[89].

Additionally, WIPO's prediction is that GenAI patents will become increasingly important within the AI field. This increase will be visible in patent data from 2024 onwards[90].

Chinese companies Tencent, Ping An Insurance Group and Baidu published the most GenAI patent families in the last 10 years[91]. Following China, US' largest patent owners are companies IBM (fifth), Alphabet/Google (eighth), Microsoft (10th) and Adobe (19th)[92].

12 top patent owners in GenAI, 2014-2023



Source: WIPO, WIPO, based on patent data from EconSight/IFI Claims, April 2024, p. 36

The Chinese Academy of Science is the only research organization present in the top 10, while other academic and research organizations are present in the top 20, such as the Tsinghua University (15th) and the Zhejiang University (16th). This suggests that companies are playing a key role in research activity. For instance, Google[93] had the most accepted papers in the Neural Informational Processing Systems conference, while the second most represented institution, Stanford, had only half of Google's accepted papers[94].

Regarding OpenAI, WIPO's report concluded that the lack of patents comes from its own non-profit origin. OpenAI's beginnings were to encourage its researchers to publish and share their work to benefit humanity as a hole. After ChatGPT's success, the company transitioned to a capped for-profit model. An alternative explanation is that OpenAI might be opting to protect its IP in the form of trade secrets.

It is interesting to observe that, among research and academic organizations, Chinese universities published the most GenAI patent families since 2014 (around 600). Apart from Chinese universities, there are four US universities, three Korean research organizations, three Japanese research organizations and one Swiss university in the top 20.[95] Chinese companies and university/research organizations are the main patent owners in the Generative AI sector, which shows an increasing non-western presence in this market.

Therefore, the analysis of GenAI markets demonstrates that innovation and dynamism flourished from an increasing number of academic institutions, companies and startups, what renders questionable the statement that there is a high concentration of expertise to an extent that would hinder entry and the development of competitive rivals in AI.

Certain public policy interventions can help ensure the flows of AI talent and expertise match market needs. In some markets, particularly in the US, the extensive use of non-compete clauses has been raised as a potential source of friction in talent mobility, but analyses by the European Commission and the UK market regulator have showed little evidence of such clauses being used in AI sector.[96] Additionally, and perhaps more fruitfully, the development of AI-relevant expertise might be a better direction for action, both among software developers and the general workforce.[97] By ensuring that the supply of qualified AI professionals matches local demand, policymakers can ensure that access to expertise does not become a barrier to entry into AI.

3.2.4 Are there incentives for market foreclosure?

The difficulties and costs associated with developing the infrastructure required for the production of high-end AI systems, by themselves, do not suffice to raise significant competitive concerns. As shown above, these challenges are not insurmountable and even call into question whether they amount to entry barriers in the sense of conferring a substantial competitive advantage upon incumbents. Even if factors such as computational power, access to data, and specialized expertise are considered barriers, it remains essential to examine whether leading infrastructure providers have the incentive to leverage their position into AI services and products through anticompetitive practices.

On the one hand, providers of computing and data infrastructures are indeed active in AI services and products[98], which raises concerns over potential anticompetitive practices (such as refusing to provide access to cloud computing services or imposing draconian terms for licensing high-quality data to competitors). In this sense, competition authorities have increased their scrutiny of agreements between AI providers and cloud providers, such as the partnership between Microsoft and OpenAI[99] and Mistral,[100] to address the potential of such agreements stifling the entry of new players.[101]

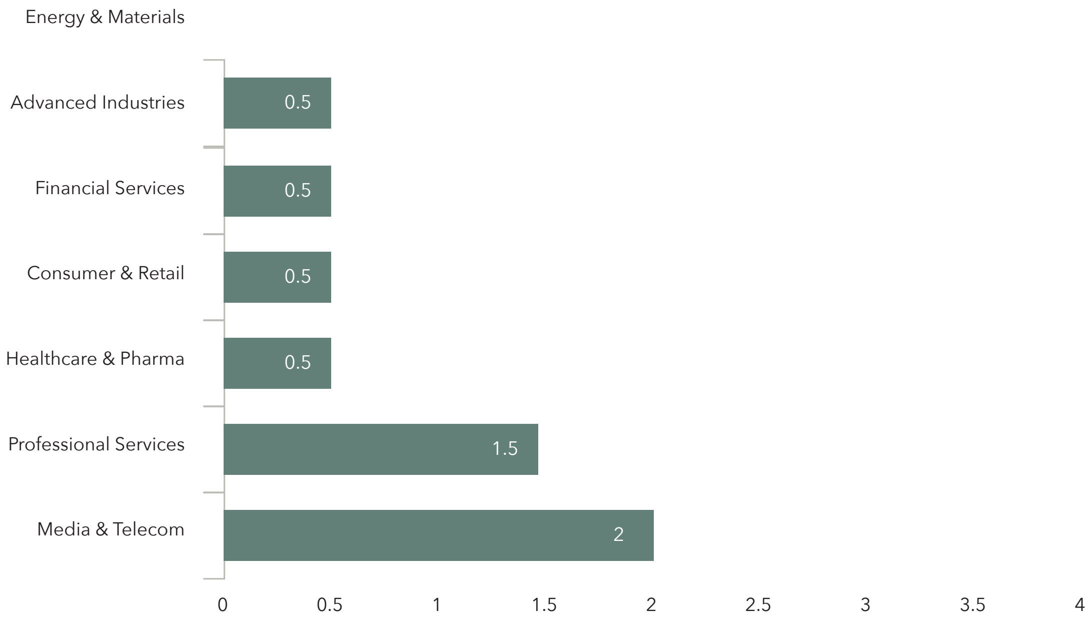
However, the relevance of market foreclosure concerns does not mean they are likely to occur, if there are no substantial incentives for anticompetitive practices leading to leveraging of market power. As each of the previous subsections has shown, the power that established actors hold on compute, data, and expertise has not translated itself into an unassailable market position. Because each of these major players holds a strong position in some parts of the AI supply chain while being weaker in others, they have tried to commoditize the positions held by others: for example, Meta has released its AI models as open-source tools to counterweight the growing dominance of OpenAI, while major companies have sought to develop their own AI chips to avoid being too dependent on Nvidia.[102]

Some investors have in fact raised concerns that this commoditization race to the bottom makes the profits of AI models uncertain when contrasted with the growing infrastructure costs.[103] Even if the most alarming scenarios do not come to pass, the efforts to commodify other parts of the supply chain are likely to result in lowered barriers to entry.[104]

Moreover, the growing number of agreements between AI start-ups and established IT firms has not, to date, resulted in a reduction of competition, as previously discussed in Section 3. On the contrary, new entrants have successfully penetrated markets for AI technologies through the introduction of AI Assistants and AI Content Generators, incorporating novel modalities and progressively eroding earlier segmentation patterns. Additionally, usage and download metrics reveal substantial consumer experimentation across services that facilitate multihoming, indicating low switching costs and high user mobility. Most importantly, these dynamics demonstrate that market popularity does not necessarily correlate with revenue generation, as specialized solutions often capture monetization advantages despite lower overall adoption.

Besides, the corporate markets for AI technologies, most likely to bring revenues, are still to be explored. As a recent study by MIT shows, the market for GenAI systems in the corporate sector is still in its infancy, as disruption varies across industries. Industries such as Energy & Materials, Advanced Industries, Financial Services, Consumer & Retail, and Healthcare & Pharma are experiencing relatively modest levels of disruption, as too general models do not fit expectations in terms of process specific-customization and integration in the workflow. On the other hand, Professional Services face a higher degree of disruption on areas such as consulting, legal, and other knowledge-based work, and prominently in in Media & Telecom, highlighting how GenAI is transforming content creation, communication, and digital services. Even in these markets, however, there is large room to explore if suppliers are able to scale the development of GenAI models and integrate to domain specific demands.

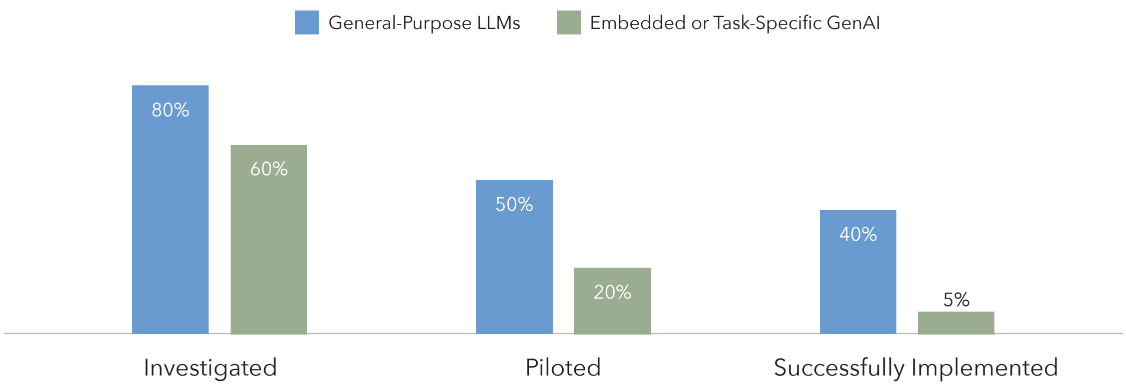
Exhibit: GenAI disruption varies sharply by industry



Source: The Gen AI divide: State of AI in Business, MIT 2025

As the study shows, there is a GenAI divide between General Purpose LLMs that gained popularity and are successfully implemented for personal usage and the Embedded or Task Specific Gen-AI for the corporate demand, with a very modest figure of 5% of projects resulting in successful implementations in business, which result in revenue for developers, even though investment figures amounted to US$30-40 billion in 2025.

Exhibit: The steep drop from pilots to production for task-specific GenAI tools reveals the GenAI device



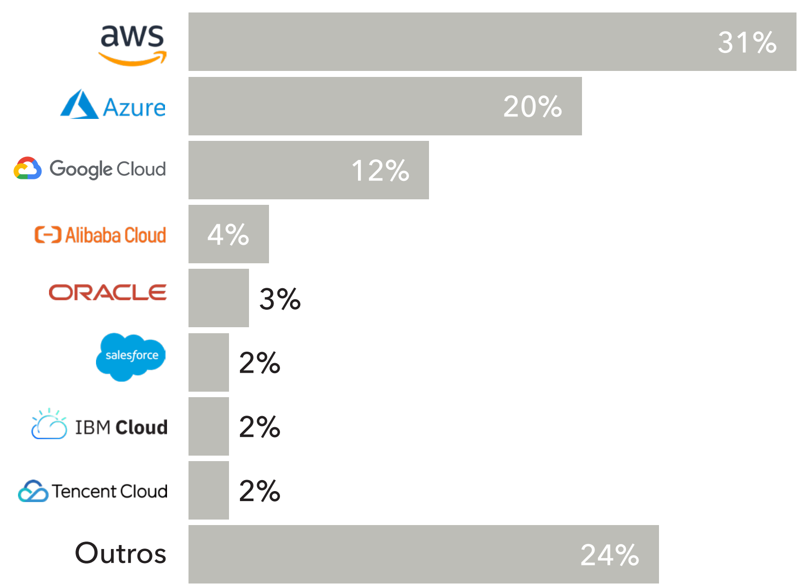
Source: The Gen AI divide: State of AI in Business, MIT 2025

Business adoption of AI (including GenAI) is especially modest in Brazil. While 40% of Brazilian businesses use AI, only 12% use it for advanced purposes, transforming their operations. 62% of those businesses focus on more basic uses of AI and on incremental gains rather than innovation, and 26% are on the intermediate stage of AI adoption.[105]

Furthermore, as discussed in the next item, there are several layers of generality/specificity in AI-Assistants and AI-Content Generators (blurring the analytical division between foundational models versus applications) – although it is clear that the greater margins of revenue come from specialized users or industry-level applications. These aspects show that there is no clarity yet about which layer of specialization or business will be profitable, which makes it less likely that incumbents would risk exclusionary practices before uncertainties of profitability in downstream markets, considering that they may secure profits by exploring their leading positions in infrastructure counting on the increasing demand in downstream markets.

In contrast to the fierce competitive dynamic of AI and uncertainties about effective sources of revenue, the infrastructure sector is securing high levels of increasing profitability. The cloud infrastructure market has a C4 of 67%, led by AWS-Amazon, Microsoft Azure and Google Cloud.

Global Cloud Market Share (Q3, 2024)



Source: Statista

The size of the cloud infrastructure market is projected to grow significantly over the next years: in 2024, the market size was valued at USD 1125.9 billion, and is projected to grow from USD 1294.9 billion in 2025 to USD 2281.1 by 2030 – a compound annual growth rate (CAGR) of 12% in the forecast period.[106] Revenues are expected to surpass 400 billion in 2025,[107] and reach 2 trillion by 2030 due to the GenAI demand[108]. And profitability margins are not only high but increasing, as may be observed in AWS' recent earnings: in the second quarter of 2025, sales increased 17.5% year-over-year to $30.9 billion, and operating income was $10.2

billion, compared with $9.3 billion in second quarter 2024.[109]

Standard antitrust principles are sufficient to analyze any potential risks of foreclose in AI segments. Incentives to engage in exclusionary conduct by firms with strong positions in AI infrastructure hinge on the classic “leverage” trade-off: whether restricting rivals downstream increases total profits net of lost sales upstream. Several features dampen the profitability of exclusion.

First, infrastructure suppliers earn high margins and face, demand driven by: downstream experimentation by many independent AI Assistants and AI Content Generators, which increases aggregate compute consumption. Excluding downstream rivals would risk slowing the expansion of total demand, especially where multihoming by users and rapid product churn limit the prospect of durable downstream dominance.

Second, product differentiation and uncertainty about which use-case niches will prove most monetizable reduce the option value of committing to a narrow, vertically integrated pathway; neutrality with broad, non-exclusive access allows infrastructure firms to “sell picks and shovels” into all promising veins.

Third, dynamic considerations matter: reputation for input neutrality, avoidance of regulatory scrutiny, and the need for complements (i.e. the experimenting providers of AI services and products) all increase the opportunity cost of exclusion and favor open partnerships, as have been observed in this sector (see Section 3.1 above).

The more plausible equilibrium, therefore, is for infrastructure supliers to focus on the upstream— competing via capacity, performance, and reliability advantages—while permitting vigorous downstream competition that expands the market frontier for compute and model services. This predicts strategies centered on non-exclusive partnerships, preferential but not exclusive contracts, interoperability commitments, and usage-based pricing, rather than outright foreclosure.

A distinct line of analysis considers the possibility that vertical leveraging incentives may arise not from the pursuit of incremental income in competitive AI-related markets, but as a competitive response to disruption. Leading firms in digital services—particularly those in search engines, cloud productivity suites, and advertising—face a credible threat from advanced AI Assistants that could displace core functionalities and erode traditional revenue streams. Under these conditions, adopting a vertical integration model could be conceived as a strategy rather than to capture profits in an adjacent market. This hypothesis is better interpreted as evidence of competitive pressure flowing from AI toward established digital services, rather than the reverse dynamic of incumbents securing dominance over AI, as we shall see in Section 5.

3.2.5 Fine-tuning competition in downstream markets

By construction, cutting-edge GenAI models are broad in scope. They are trained with a wide variety of data and with the view of performing a broad range of tasks.[110] Such an approach not only allows those models to benefit from larger training datasets but it also ensures their providers will be able to monetize their tools by offering them to more potential customers.[111] To maximize the performance of those models in specific tasks, downstream providers often carry out a follow-up learning process, called *fine-tuning*, in which a general-purpose model is optimized for a specific task.purpose model is optimized for a specific task.

The fine-tuning process takes as its starting point a general-purpose model, such as Claude or GPT-4. An organization that wants to fine-tune a model will subject that pre-existing model to a new training process, which focuses on performance for the specific task for which the model is being fine-tuned. For example, if a business wants to use an AI model to classify its customer service claims into the categories used by that business, it might start by gathering a training data set, in which sample claims are paired with their correct classification. That data is then fed to the general-purpose model through a specific training process,[112] in which the existing model learns how to generate the desired output. Because that process does not build a new model from scratch, it requires much less data and computing resources than the original development of the original foundation model; sometimes, a few dozen labelled examples might be enough to adapt a general model for a specific task.[113] Consequently, the wide availability of general-purpose models can also lead to a proliferation of fine-tuned models that are suitable for specific tasks.

The CMA's report analyzes these dynamics through a dichotomous separation of markets into, on the one hand, foundational models and, on the other, a monolithic set of fine-tuned models presumed to depend unilaterally on the "upstream" market. That picture leads to the conclusion that developers of foundational models would have the power and incentive to leverage their position to downstream markets.

But reality is far more complex. In practice, there are multiple layers of refinement, encompassing varying levels of specificity across a range of evolving and still unexplored markets. This layered structure, as opposed to a dichotomic separation, generates interdependencies that lead to rather opposite conclusions.

First, it is important to consider that the possibility of fine-tuning models reduces the barriers to the use of AI models in downstream markets. It reduces the impact of the concentration of expertise previously discussed: while fine-tuning is itself a technical process, it is much less knowledge-intensive than the creation of the original model, and there are established processes for doing so.[114] As such, a business wanting to fine-tune a model will be less starved for AI talent than one trying to create its own foundation model. Because the fine-tuning process requires less data than the original training, the advantages of leading tech players in securing data are not as prominent as they are in the creation of foundation models, and small businesses might be able to make good use of their small private data sets to secure a competitive advantage in narrow markets.[115] Additionally, the reduction of data also leads to a much smaller need for computational power,[116] making the costs of fine-tuning much more accessible to smaller organizations.

For these reasons, fine-tuning allows for the creation of many niche startups, especially in emerging markets where resources for the development of foundation models are limited. In Brazil, for example, many of the most prominent AI startups rely on fine tuning: legaltech Lexter.ai uses GPT-4 combined with proprietary algorithms;[117] legaltech Jusbrasil's new AI assistant also uses the main general purpose AI models available;[118] fintech Magie uses LLMs, adjusted to understand informal language and Brazilian specificities, to provide a centralized service of transactions integrating many different banks through WhatsApp;[119] to name a few.

Fine-tuning also allows actors in downstream markets to adjust their AI tools to changes in context. It is cheaper than the long and expensive process of originally training an AI model, and it can be done as often as necessary. In the example above, a change in categories would likely require a new round of fine-tuning while leaving the original model unchanged, but these adjustments can be made as often as necessary. Moreover, fine-tuning is possible even if the downstream provider lacks the resources or permissions to tinker with the model, as the process involves applying data (controlled by the provider) to the model rather than rewriting it. As long as an organization has access to a GenAI model and to some high-quality data, it may fine-tune that model for its own purposes.[120]

Second, this complex structure, where companies may develop foundational models in different levels of generality from scratch or fine-tune general ones, generates both competition and interdependencies, as innovations and applications at higher levels of specificity may create significant spillovers and new opportunities for more general models. While providers of foundational models may indeed develop their own fine-tuned systems at relatively lower cost to appropriate the gains of successful refinements, downstream developers can nonetheless retain competitive advantages derived from domain-specific expertise and know-how.

For example, a multimodal foundational model combining images and text may be fine-tuned to describe images in general, further specified to generate textual descriptions of medical scans, or adapted more broadly to provide diagnostic outputs from radiographic images. At yet higher levels of specificity, such refinement may focus on identifying fractures, or even more narrowly on pelvic fractures. These gradations of refinement complicate the categorical distinction advanced in the CMA's study between foundational models and the market for fine-tuned foundational models, as both the base model and its refinements admit multiple layers of specification. In expanding markets, it is also inherently uncertain which level of refinement will ultimately generate the highest value, in what domain of application, and at which stage of technological development. As we have seen, popularity and broad use of more general models do not necessarily translate into revenue and niche applications may perform better in revenue and profit margins. This uncertainty undermines any straightforward prediction of market power leverage strategies by upstream developers.

This layered structure of refinement makes AI-related markets distinct from conventional input markets, where raw materials or components flow from an upstream to a downstream stage in largely linear value chains. In traditional settings, competition between supplier and buyer is generally absent, except where firms integrate across stages. By contrast, in AI markets competition is intrinsic: the relevant margin of rivalry lies in the relative accuracy of systems in performing tasks of greater or lesser specificity. Generalist models inevitably compete with more specialized variants, yet they also benefit from downstream fine-tuning efforts, which may create novel applications and expand the scope of demand. In this context, the holder of the general model is not necessarily incentivized to exclude downstream refiners. Rather, given its lower marginal costs of further refinement, the upstream provider may choose to adapt its model to capture some of the value, while still enabling downstream innovators to explore new opportunities. Such dynamics reflect the characteristics of innovation markets, where rivalry and complementarities coexist, and where value appropriation occurs across multiple layers of technological development.

Consequently, rather than producing exclusion and dominance, as the two-tier framework suggests, this multi-layered dynamic is more consistent with differentiation and, potentially, with intensified competition. And this scenario of rivalry and competition may be further enhanced by the availability of open-source AI models, as explored in the next subsection.

3.2.6 The competitive relevance of open-source AI models

The most advanced AI systems are developed as proprietary models. Potential users can interact with them through interfaces such as chatbots or application programming interfaces (APIs), but details about how the AI model was trained, how it operates, and what data was used for its training is not usually made public.[121] As such, access to these models is mediated by the companies providing them, which can use their terms of service as a tool to limit their use by individuals and corporate users.[122] However, a growing number of foundation models is made available under some form of open-source license, lowering barriers to entry into the use of AI.[123]

Currently, there is some controversy about what counts as an "open source" AI model. A recent study has identified 14 dimensions of openness that are invoked by providers of such models:[124] some providers claim that releasing the internal weights of a model is enough to make it open, while the Open Source Initiative requires an open-source model to be licensed under terms that allow anyone to use, study, modify, and share a model without restrictions.[125] Most models that are described as "open" lie somewhere between those two poles: models such as DeepSeek-V3 release their weights to the public, but under a license that does not allow any commercial use of the freely-released model.[126] As a result of this diverse scenario, providers on downstream AI markets must understand what is allowed or prohibited by the licenses of the specific model they intend to use.

Variations in the degree of openness of a model may contribute to its effect in the competition for downstream AI markets. An "open" model that is released under a relatively restrictive license that only allows the use of its weighs for non-commercial purposes, such as DeepSeek-V3, might still allow market actors to create prototypes of their AI-powered products. Doing so, in turn, would reduce the costs involved in switching AI models, as an organization can now test whether a potential model is suitable for its purposes before having to retool its entire infrastructure. More open models would impose fewer restrictions on their potential users, who would be free to adjust them to meet their needs.

The greater possibilities afforded by increased openness lead to the emergence of what Thibault Schrepel and Jason Potts describe as *innovation commons*,[127] that is, shared resource pools that are maintained by a community for collective benefit. New tools offer access to models and datasets that individuals and organizations can tailor to their purposes: HuggingFace, for example, contains over 1,800,000 models available under various open-source licenses, as well as over 450,000 datasets that can be used to train AI systems.[128] Many of these models are fine-tuned from previously released[130] models or distilled from larger ones,[129] allowing players to benefit from AI capabilities even if they do not have the resources needed to train cutting-edge models. The creation of an open-source AI environment can therefore reduce the hold of large AI providers on downstream markets.

This is not to say that the existence of an open-source ecosystem solves all competition issues that might emerge from AI. Cutting-edge foundation models, which are usually released under proprietary licenses, have so far outperformed open-source ones, thus suggesting that open-source AI models might not be adequate for certain functions. However, the actual gap between open-source and closed-source solutions is an empirical fact that can change over time: in 2024, open-source models were thought to be 5 to 22 months behind their best proprietary competitors,[131] but later estimates point out that the gap has shortened considerably in 2025.[132] These variations suggest that open-source AI models might be enough to address many market needs, thus restricting the number of applications in which the providers of advanced AI models have an unsurmountable edge.

Another potential risk from the use of open-source AI models is the risk of changes to the license. Friso Bostoen and Anouk van der Veer raise the risk that open-source models might be subject to an "open early, closed late" strategy, in which companies change the license to their models once downstream providers have already incorporated them into their own products.[133] By that point, the sunk cost might be enough to ensure that those downstream providers are unlikely to migrate to a competitor. Business strategies of this kind can reduce the reach of open-source AI models, both by ensuring that chunks of the market are tied to a specific provider and by eroding overall trust in open-source. As such, they are being investigated by competition authorities around the world.[134] However, they are not an unavoidable consequence of the technical properties of AI, or an exclusive problem of the markets for AI technologies. They are better understood as another piece of the broader challenge of situating open-source software environment within the digital economy.

4. AI MARKETS DO NOT SHARE THE SAME FEATURES THAT HAVE RAISED CONCERNS ABOUT CONCENTRATION IN DIGITAL SERVICES

Various scholars and authorities raise cancerns about mechanisms such as network effects, near-zero marginal costs, data feedback loops and ecosystem architectures, arguing that these features would be responsible for high levels of concentration in digital markets. concentration in digital markets.[135] Some of these arguments are advanced in general, under the label "digital markets", without attention to specificities of each digital service and business model, which may bring imprecision due to relevant differences in each of them. It is important to visit those general arguments, independently of their merits or applicability to particular digital services, with the purpose of checking if those features are present in the AI sector.

Network effects—where the value of a product or service increases as more users adopt it—have been described as a factor generating market power for digital services[136]. When combined with the near-zero marginal cost of replicating and distributing digital goods, these dynamics are purported to generate powerful economies of scale that would allow incumbents to expand rapidly once a critical mass is achieved[137]. In markets such as search engines, operational systems, and social networks, these dynamics are said to have favored early movers[138].

In addition to these scale advantages, digital services may often be reinforced by data feedback loops. According to this argument, the more data a firm accumulates from user interactions, the more effectively it can improve its services, thereby attracting additional users and generating further data—a self-reinforcing cycle that can entrench incumbents and disadvantage new entrants[139]. Closely related are ecosystem architectures, a concept used by scholars to describe a dynamic where firms leverage complementarities across services to create integrated bundles that allegedly lock in users and raise rivals' costs of entry[140]. These phenomena have been the focus of much of the antitrust scrutiny of leading tech companies, with concerns centered on the capacity of those firms to leverage existing advantages in one market into adjacent markets[141].

Competition authorities' analyses of AI often rely on the premise of structural anticompetitive issues in digital markets and transpose those issues into AI. In this sense, it is argued that the foundation model markets would be characterized by economies of scale, economies of scope, network and data feedback effects, switching costs and potential lock-in – which, according to the CMA, could provide leading tech companies with insurmountable competitive advantages against smaller organizations,[143] and, to the *Autorité*, creates conditions for concentration in GenAI and may reinforce leading digital firms' market power.[144]

As seen in Section 3, there are misconceptions and evidence contradicting the structural analyses of AI proposed by the studies underpinning the Joint Statement. In the section below we show that there are critical differences with the main characteristics of digital markets traditionally associated with market concentration and incentives for anticompetitive practices.

4.1 Economies of scale and near-zero marginal costs?

The OECD has described economies of scale as a barrier to entry in digital markets due to high fixed costs combined with low or zero marginal costs.[145] In GenAI markets, the Autorité asserts economies of scale are present due to the high fixed costs involved in the initial training of a foundation model, which prompts operators to spread costs over as many users as possible.[146] Indeed, pre-training can be costly depending on the size and type of model,[147] but the initially assumed trend of ever-larger models appears to be reversing, with models such as DeepMind's Chinchilla and Meta's Llama outperforming GPT-3 with fewer parameters,[148] as well as Stanford's Alpaca[149] and DeepSeek-V3 defying the costs of many LLMs to deliver performance.[150] Moreover, such costs have not shown to be prohibitive, given the relevant presence of start-ups developing foundation models in direct competition with incumbents' models, which is a more competitive scenario than the one observed even in early stages of digital markets.[151]

But the main driver of economies of scale in digital markets is the near-zero marginal cost of serving additional users. Once an incumbent provider has achieved a critical mass of adoption and established the necessary digital infrastructure, further expansion—whether through attracting new users or intensifying usage among existing ones—does not entail significant additional costs[152]. This cost structure may confer a substantial advantage on pioneering firms, enabling them to grow rapidly while reducing both the incentives and the feasible opportunities for new entrants. In two-sided platform markets, such as search engines and social networks, these dynamics may be further reinforced by cross-subsidization strategies: incumbents often charge users little or nothing on one side of the market, financing their operations through revenues generated on the other side, typically from advertisers[153]. This combination of scale economies, near-zero marginal costs, and cross-subsidies is said to create significant barriers to entry.

However, the infrastructure for the development and operation of GenAI systems has a quite different mechanism with significant increase of marginal costs for its deployment.

As indicated above, training large-scale AI models is a resource-intensive process. It demands significant computational power—typically in the form of high-performance GPUs or TPUs—alongside vast amounts of data. Training is inherently iterative: the model generates predictions, compares them against the correct outcomes, and adjusts its parameters through the technique of backpropagation. This cycle is repeated thousands or even millions of times until the model achieves satisfactory performance. Because of this, the training phase is often described as the most capital-intensive component of AI development.

By contrast, inference is comparatively less resource-intensive. The computationally demanding task of learning has already been completed during training, allowing the model to focus on applying acquired patterns to new inputs. Inference is therefore faster and cheaper, which is critical in contexts where outputs must be generated in real time, such as in conversational agents or recommender systems.

This relative efficiency, however, does not mean that inference is without significant cost. Each inference request requires computational resources, meaning that marginal costs increase with each additional user or query processed by the system.

Indeed, once a model has been successfully trained and deployed at scale, the aggregate computational demand of inference often exceeds the original costs of training. Recent empirical studies—particularly those measuring the environmental impact of GenAI—demonstrate that the energy consumed during inference can significantly outweigh the resources invested in model development. For instance, analyses of the carbon footprint of large-scale generative systems suggest that the cumulative energy consumption in the inference stage surpasses that of training once the user base reaches sufficient scale. This finding challenges the assumption that training is the primary bottleneck in resource allocation for AI systems.

Recent research further highlights that, for some deployed AI systems, as much as 80% of total energy demand arises from inference rather than from development or training.[154] This trend is especially relevant in light of the extraordinary growth projected for GenAI applications and personal assistants, which are expected to scale massively in the coming years. Since compute required for inference scales along with deployment,[155] the cost per use of the foundation models increases.[156] The OECD study mentions the high costs for foundation model development, arguing they could entail economies of scale if developers adopt licensing models capable of lowering running costs to a certain extent, but also acknowledges that model deployment shows non-zero marginal costs.[157]

The energy consumption measures are not only relevant to highlight the significant cost increase with deployment, but also to the effect that it is linked to a regulatory concern regarding sustainability and the use of renewable energy as a requirement of the responsible development and deployment of AI systems.

Therefore the costs for deployment of successful AI systems increases not only due to computer power cost itself, but also due to a growing societal and regulatory demand for investments in clean energy to address the environmental impact of data centers. Initially, data centers' environmental impact was equated to cooling equipment, as air free cooling and electricity production dominated the total life cycle impact and the operational phase[158]. However, with growing concerns over the energy consumption of data centers and its environmental impact,[159] clean energy emerged as a demand, creating a new market valued at approximately $72 billion in 2024[160]. In addition to clean data centers, this demand also prompted investments in AI solutions for data center and energy efficiency,[161] and in more sustainable hardware.[162]

Data centers became the leading sector in clean energy procurement in 2024.[161] For instance, the US data center sector procured 50GW of clean energy by the third quarter of 2024,[163] while Europe lagged with around 12W, though rapidly increasing.[165] Hence, typical marginal costs are diminished, as growth in the adoption of AI is followed by costs to mitigate its environmental impact.

Such costs may even be seen as a disadvantage for incumbents in relation to entrants or AI developers focusing on some niche or on fine-tuning to specialized users, since providers with greater number of users would have to comply with stronger and more costly environmental requirements.

Therefore, economies of scale associated with near-zero marginal costs are not present in foundation models. The diminished fixed costs for pre-training and the high marginal costs for deploying AI models are different from the structure described in digital markets, impairing incumbents' advantages and 'winner takes all' effects. The predominance of the business model based on licensing in GenAI markets is an aspect that corroborates the non-zero marginal costs feature of this market.

4.2 Network effects and switching costs?

Network effect (also described as "demand side economies of scale"[166]), is a common phenomenon that take place where a rise in adoption of a product/service increases demand. Network effects can be direct ("where the value of a product or service to an incremental adopter depends on the total number of other adopters"[167]) or indirect ("where there are two or more types of complementary adopters"[168], such as in multisided platforms that serve users of digital services and advertisers).

Such effects are not present in GenAI products as there is no immediate gain for a user of the AI system with the increase of users of that same system. Indirectly there may be gains to the extent that new users generate more queries and further data to improve the system performance, but this aspect will be examined in the section about the feature of "data feedback loops".

While network effects are not unique to digital services or products, some argue that they provide digital technology incumbents with significant advantages when consumers are unlikely to switch providers, for instance due to high switching costs, limited data portability, and the need to learn a new system.[169]

Switching costs are not present in AI. A risk of high switching costs is only pointed out by the *Autorité* in the upstream market of cloud services, but even then not as a structural condition of the market, only as potentially anticompetitive conducts. According to the authority's investigations, some providers may bill clients for their data transfers with egress fees that, are potentially disconnected from the costs directly incurred by suppliers regarding data transfers and may make it more difficult for business users to leave their primary provider or to use several providers at once in a multi-cloud environment. The investigation also pointed out other practices causing switching costs on the cloud market, such as restrictive contractual clauses, tied sales, pricing advantages, and technical restrictions. However, as noted by the *Autorité*, these practices are not conditions of the market, but conducts that, if implemented by an operator in a dominant position, could amount to anticompetitive effects. As such, the European Commission is already examining those practices due to complaints,[168] and Microsoft, for instance, changed its cloud licensing conditions to facilitate switching providers.[171]

The adoption of similar restrictive practices in the provision of foundation models seems unlikely, since users are able to switch between different model providers without significant data migration costs, as there are multiple providers offering comparable services through similar interfaces,[172] to the point of AI models becoming commoditized.[173] Switching is particularly common for business users, as they are highly cost-driven, therefore more prone to rapidly switching to better or more efficient options than individual users, who may have a tendency to inertia due to habit or brand perception.[174]

Data portability, enabled by open standards and interoperability, is an important mitigation to eventual lock-in, reducing incumbents' market power and fostering competition among AI providers.[175-176] For direct use cases of AI platforms (such as using consumer-facing GenAI platforms on an as-is basis), data portability is centered on conversations history, whose transfer does not suffer from relevant technical limitations, and can be facilitated by solutions that build adapters and transfer tools between APIs allowing users to export and import their chat history.[177]

For downstream applications that integrate foundational models into services, interoperability between foundation models could be more technically complex,[178] especially when models adopt proprietary formats and APIs. However, the need for interoperability and data portability prompted the creation of data portability and model interoperability solutions,[179] and management of AI workflows may adopt methods to facilitate data and model portability (such as using standardized APIs and SDKs, normalizing prompts and outputs, and centralizing analytics).[180] Moreover, open?source models are increasingly adopted as a solution, since they have evolved to present competitive performance and offer greater interoperability than closed models, avoiding proprietary silos.[181]

Therefore, if lock-in practices were adopted to hinder switching foundation models, the traditional antitrust evaluation of abuse of a dominant position would be required on a case-by-case basis. Foundation model markets do not seem to be characterized by network effects, switching costs, limited data portability, or other difficulties to changing providers or multi-homing. Since users currently tend to multi-home (simultaneously adopting different models and APIs for different purposes, especially in the context of business users),[182] concentration or lock-in to specific providers is not currently observed, and network effects from demand-side adoption are not present.

4.3 Data feedback loops?

According to the Autorité, network effects may be observed when connected to data feedback loops, to the extent that feedback data from users may be used to refine future models and improve performance or offer new services, attracting new users.[183] But even scholars who argue that foundation models can be subject to networks effects from positive feedback loops also point out limitations to the enhancement of models from feedback.[184] Other analyses conclude that it is uncertain to what extent feedback loops will generate network effect in AI.[185]

There are many differences indicating that even if GenAI benefits from reinforcement learning, feedback loops should not be intense. First, because GenAI is more quality sensitive. To remain competitive, models must generate satisfactory outputs (e.g. hallucinations may be strongly undesired for certain uses of AI), which requires data quality in fine-tuning. Additionally, as AI "learns" based on pattern recognition, the exposure of AI models to their own output can risk degrading their performance,[186] i.e. feeding back AI content to AI models is likely to cause problems. Reinforcement learning is more complex and costly than data feedback loops in traditional digital services. If data quality is not strongly influenced by quantity of users, then network effects are not likely to take place.

Moreover, for general purpose foundation models (e.g. GPTs, Llama, Claude), feedback loops do not automatically and continuously generate adaptation to specific user preferences, like recommender systems in some digital services do. Instead, learnings from interactions only return to users when a new update is released, as noted by Schrepel and Pentland.[187] Many of these models may not even learn from user preferences, since they often provide users with the option to opt-out of model training based on user data (such as ChatGPT), or do not train with user data by default (such as Claude and Google's NotebookLM).

Last but not least, there is a crucial distinction between the business model of traditional digital services when compared to AI providers: whereas traditional digital services benefit from feedback loops between users, data, and advertising revenues, GenAI providers base their gains on licensing and not on the exploration of personal data to obtain advertising revenues. Therefore, the AI data loop, if present, lacks the advertising component, making it much less relevant and unlikely to generate self-reinforcing data advantages.

In multi-sided digital platforms—such as social networks, search engines, or e-commerce marketplaces—data feedback loops are central to be concerns voiced by scholars and authorities regarding market power. As the user base expands, platforms acquire vast quantities of behavioral and transactional data, which in turn can be deployed to improve recommendation algorithms and personalization techniques. Enhanced algorithmic performance increases user engagement and satisfaction, thereby attracting additional consumers and advertisers. This expanded audience enhances the value of the platform for advertisers, who are willing to pay higher prices for targeted exposure, further increasing the platform's revenues. In their view, the reinvestment of these revenues into infrastructure and algorithmic innovation would close the loop, producing a self-reinforcing cycle that strengthens incumbents' competitive advantage and raises entry barriers.[188]

The critical feature for those concerns is that the accumulation of data is not merely a by-product of scale but a resource that directly enhances product quality, thereby reinforcing network effects. Data-driven improvements in matching and targeting would benefit incumbents by enabling cross-subsidization strategies—such as free or below-cost services to users financed through advertising revenues—that could hamper market entry for potential competitors.

By contrast, the same type of data feedback loop is not observed in the markets for general-purpose GenAI systems.

First, because, as seen above, not all GenAI systems are designed to incorporate continuous learning during deployment. Many operate as static models once trained, with improvements occurring through discrete retraining cycles rather than constant reinforcement from user data. As a result, the expansion of the user base, while critical for revenue, does not automatically produce an equivalent virtuous circle of data accumulation and algorithmic improvement.

Second, and most importantly, because unlike advertising-funded services, GenAI models such as large language models or image generators are not primarily sustained by harvesting user data to refine recommendation systems for targeted marketing. Their business models are generally based on licensing, subscription fees, or enterprise integration rather than monetizing personal data through advertising. Consequently, while usage at scale may produce some marginal data benefits—such as fine-tuning or reinforcement learning from user interactions—these are not inherently tied to the same revenue-generation cycle that characterizes multi-sided platforms. The absence of relevant advertising-based cross-subsidies fundamentally alters the competitive dynamics.

5. A DIFFERENT PERSPECTIVE: AI DIGITAL MARKETS

In Section 3, the notion that incumbents would likely leverage their AI infrastructure to foreclose downstream markets has been challenged, based on a detailed analysis of the present dynamics of GenAI and the close scrutiny on the capability, likelihood and incentives of leveraging strategies from leading players in the AI infrastructure layer. In Section 4, the assumption that AI markets present the same structural characteristics said to favored concentration in digital markets has been also shown to be based on fragile analogies and unverified presumptions.

These conclusions raise doubts on the prospect made by the studies underpinning the Joint Statement to the effect that AI would be dominated leading digital firms.

On such a basis, we may raise the opposite hypothesis and ask whether the observed competitive dynamics in AI could be a drive to foster competition in the traditional digital services.

In essence, the Joint Statement belief in the threat of leveraging underscores the Schumpeterian character of current rivalry: innovation at the AI layer exerts dynamic competition on entrenched business models, prompting incumbents to accelerate their own deployments of generative technologies, bundle them with legacy services, and adapt monetization strategies. The structural asymmetry lies in the fact that the AI sector nowadays exhibit constant new entries, rapid technological churn, and high product differentiation. These features make it unlikely that leading positions in digital services will straightforwardly translate into dominance in AI markets. Instead, the emergent scenario reflects a competitive realignment where incumbents, rather than leveraging AI to entrench their positions, are compelled to innovate defensively to mitigate erosion of their leadership in other markets.

AI is not just a tool for improving existing digital services, but a disruptive force that challenges previously well-established markets. An example of such disruptive potential is the multiplication of AI-powered search engines that prompted Google to accelerate the investment on its AI tools and to enhance its services with embedded GenAI tools.[190]

Other digital services were also immediately threatened and prompted to enhance to maintain consumers, such as image editing tools (for instance, Adobe Photoshop was significantly challenged by image generation AI tools like Midjourney and Stability AI, creating its own AI image generation tool in response).[191]

Indeed, with the development and further improvement observed in personal assistants powered by GenAI, the access to digital services may become intermediated by such AI assistants that collect online information and present it in a user-friendly and customized way, with clear advantages, reducing the costs of accessing websites or apps. A similar effect resulting from the intermediation and distribution of traditional media content by digital media platforms may also be observed with respect to personal assistants and AI Agents in relation to websites. Highly capable conversational systems integrating search, recommendation, and task automation challenging the very search-advertising model by reducing user reliance on multi-click navigation and sponsored results.

This potential threat has fostered significant investments in AI by digital service providers by combining their current offerings with a differentiation on its AI product. Such investments on differentiation on AI models that compete in the same market have not only strengthened competition in AI-related markets, but have brough competitive pressures to keep market share and users in different services irradiating innovation through digital services.

Such observation leads to the question of whether the concept of “ecosystem” may be present in AI. The studies supporting the Joint Statement also suggest ecosystem architectures having foundational model providers as orchestrators and, on the other hand, AI application or fine-tuned systems providers as complementors. As we shall see in the following section, the analogy is also unconvincing and invites the question of whether AI is not a driver to entice inter-ecosystem competition in the very digital markets.

5.1 Are there ecosystem effects? And are they anticompetitive?

5.1.1 Ecosystem effects and competition in digital markets

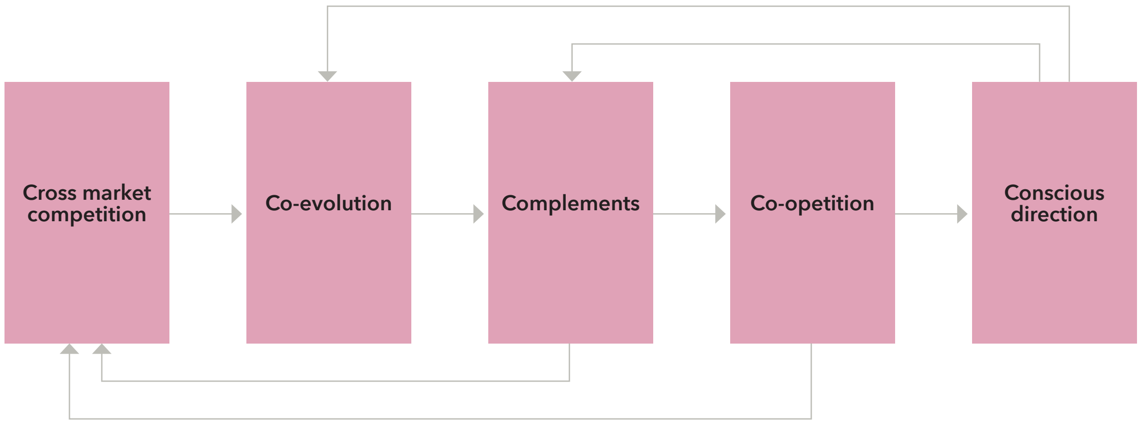
The integration of AI technologies into the economy increasingly takes place within complex organizational structures that extend beyond the traditional notion of "platforms". Earlier debates about digital markets often focused on platform dynamics, but later the literature has explored the antitrust analysis based on the concept of broader "ecosystems" combining multiple products, services, and complementary activities. It should be noted that "ecosystem" is also a vague term whose definition is still debated in the literature.[193]

This picture of ecosystems is said to profoundly influence competitive conditions. On the one hand, they may drive efficiencies and innovation through integration and co-evolution. On the other hand, some competition authorities and scholars raise concerns about ecosystems reinforcing incumbency and restricting market entry, especially if orchestrators can leverage their position across interconnected markets.[194] This picture of ecosystem architectures poses "complementors" (providers of complimentary services) that orbit around the "orchestrator" (the leading platform and proprietor of the digital ecosystem).

In order to understand how AI technologies are embedded in these organizational structures, one should first distinguish between the concepts of online platforms and digital ecosystems. According to the European Commission, "online platforms can be described as software-based facilities offering two- or even multi-sided markets where providers and users of content, goods, and services can meet."[195] In its turn, the concept of a digital ecosystem is broader and more dynamic. According to Petit and Teece five concepts characterize a business ecosystem: a) cross business, market and industry competition; b) co-evolution; c) complementor; d) co-opetition; and e) conscious direction.[196]

In essence, these "Cs" are analytical indicators used to describe the nature of successful digital product ecosystems. For example, "cross business, market and industry competition" refers to the fact that platforms and complementors are not a member of a single industry but participate in broad-spectrum competition that crosses a variety of industries. Competition can occur between one platform and another, between a platform and its complementors, and among complementors themselves[197]. "Co-evolution" describes the mutual interactions between participants from different and autonomous ecosystems, which give rise to generativity, that is, the formation of new structures or behavior.[198] "*Complementarity*" refers to the added value created by the interaction with and among complements, both in terms of their quality and variety[199]. "Co-opetition" means that ecosystem partners both cooperate and compete at the same time. They work together to create long-term value by investing in shared capabilities, while avoiding harmful short-term rivalries.[200] Finally, "conscious direction" reflects how self-organized leadership is essential to articulate a shared vision, align objectives, and ensure consistent action across the ecosystem.[201]

The Five "Cs" of Business Ecosystems

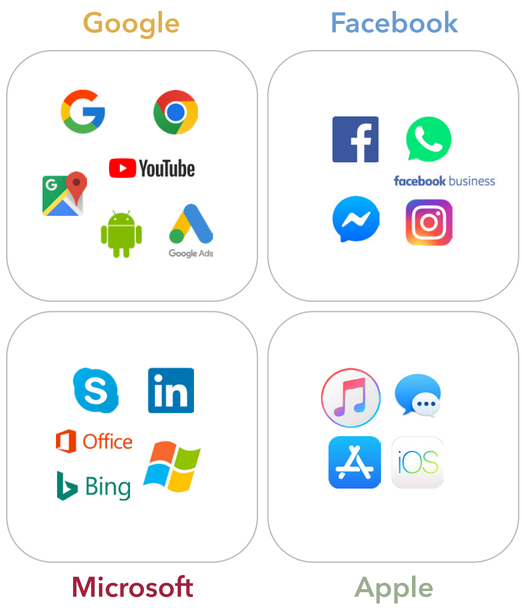


Source: Petit, N. & Teece, D.J. (2020). Taking Ecosystems Competition Seriously in the Digital Economy. OECD Competition Committee, DAF/COMP/WD(2020)90, p. 6

These "five Cs" serve as analytical indicators of successful digital ecosystems, but there are other elements that make these ecosystems possible. Among these technical foundations are modularity, which allows components to be recombined and adapted; interconnectivity, which ensures that different parts of the system can interact and influence one another; complementarity, which increases the value of products or services when used together; and interoperability, which enables data and information to flow seamlessly across applications and systems.[202]

Concrete examples of such digital ecosystems can be seen in the figure below. Google, for instance, integrates services such as Search, Chrome, YouTube, Maps, Android, Google Ads, Gmail, and Google Drive into a connected environment that reinforces user engagement and consolidates data across platforms. Microsoft combines core offerings like Office, Windows, LinkedIn, Skype, Outlook, and Bing to create a suite of products that seamlessly work together, strengthening its competitive position across both consumer and enterprise segments. Apple builds a cohesive ecosystem encompassing iOS, the App Store, iTunes, iMessage, iCloud, and its proprietary hardware devices, allowing tight integration between hardware and software. Meta (formerly Facebook) connects Facebook, Instagram, WhatsApp, and Messenger, leveraging unified advertising infrastructure.[203]

Examples of product and service ecosystems

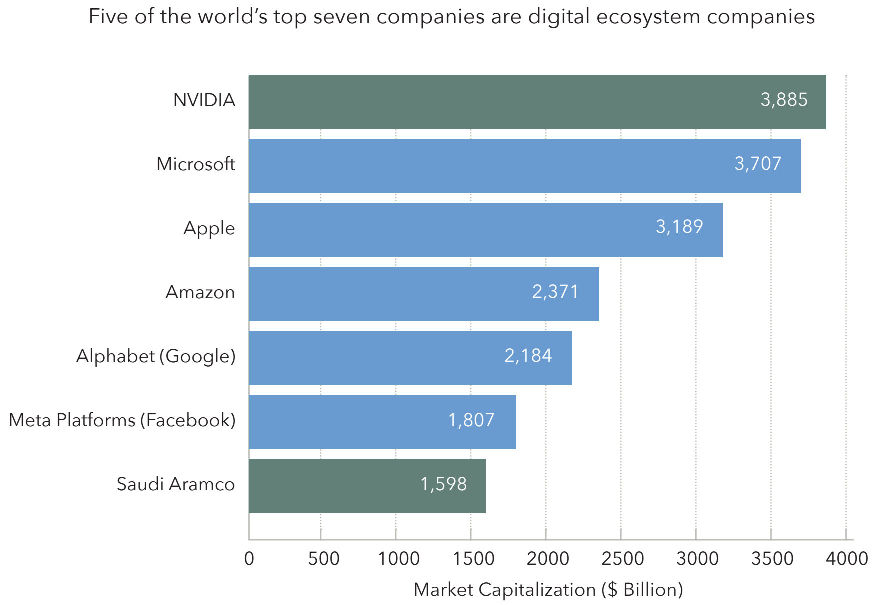


Source: Autoridade da Concorrência. Ecossistemas digitais, Big Data e Algoritmos – Issues Paper

To identify the main digital ecosystems currently in operation, market capitalization is used as a reference criterion.[204] It serves as an important proxy, as it reflects the economic significance and the scale associated with strategies that integrate multiple products, services, and complementary activities.

As shown in the graph below, among the seven largest global companies by market capitalization, five operate established models of digital ecosystems: Microsoft, which integrates operating systems, enterprise solutions, cloud platforms, consumer products, and digital entertainment; Apple, with an ecosystem that combines devices, operating systems, digital services, proprietary applications, and wearables; Amazon, which articulates e-commerce, cloud infrastructure, subscription services, and smart devices with voice assistants; Alphabet, whose structure connects search, online advertising, operating systems, cloud platforms, video platforms, and navigation services; and Meta, which brings together social networks, messaging services, content platforms, and virtual reality technologies. In contrast, companies such as NVIDIA and Saudi Aramco, although also among the largest by market value, do not fit the concept of a digital ecosystem as previously presented, since their activities are more focused, respectively, on supplying hardware components and producing energy resources.

Overview of the world's largest digital ecosystem companies by market capitalization



Source: Companies Market Cap. "Companies Ranked by Market Cap." Available at: https://companiesmarketcap.com/ (accessed 05 July 2025)

Considering that these large digital ecosystems are organized by companies that occupy positions of global leadership, different analyses proposed in the literature have highlighted factors that may affect competition. Among them, indirect network effects would play a critical role when data collected through complementary products and services could be used to reinforce an orchestrator's market power in its core activities. Rather than generating direct financial returns in the complementary market, these data would be leveraged to improve the effectiveness of an orchestrator's primary business model—particularly advertising and targeted services. As suggested by the Portuguese Competition Authority, the sharing of data across products within the same ecosystem creates consumption synergies that enhance the value of the platform, for example by refining consumer profiling algorithms and increasing the precision of advertising placements. According to this view, these dynamics could raise switching costs and lock-in effects, since user interactions in one product contribute to strengthening the orchestrator's overall competitive advantage across the ecosystem.[205]

Scholars also raise concerns related to switching costs and behavioral factors that favor the retention of users or complementors within the same ecosystem.[206] Part of the literature argues that "complementors" might become strongly dependent on the governance exercised by the ecosystem orchestrator, who defines operating rules, access criteria, and commercial conditions. This dependence could open room for the orchestrator, to unilaterally change these rules over time, impose restrictions, or increase participation costs, making it difficult for complementors to operate independently or compete on equal terms within the ecosystem.[207]

Another factor said to strengthen leading companies is the expansion of ecosystems through strategic acquisitions, by integrating services that previously operated independently, amplifying the so-called “tipping effect”, through which a platform progressively attracts most users and suppliers.[208] Scholars also alert to potentially anticompetitive strategies such as the encouragement of single-homing, bundling practices and exclusivity clauses that limit effective competition in adjacent markets,[209] and self-preferencing (concerns that the orchestrator, by simultaneously acting as a supplier of products or services that compete with those of complementors, may prioritize its own offerings in recommendation mechanisms, positioning, or interoperability)[210].

5.1.2 Are AI markets structured on potentially anticompetitive ecosystems?

As noted, “digital ecosystems” that emerged over the past decades are platform based[211] and specialized in particular digital services.[212] Since, by definition, the orchestrator is the central actor in the value creation network and determines how value is distributed, it can have the capacity to capture the majority of the value generated, as well as to control, monitor, and leverage resources without necessarily owning them.[213]

The unequal distribution of value within a business ecosystem does not necessarily raise an antitrust issue. Often, such disparity stems from structural deficiencies of the ecosystem itself—such as inadequate platform design, the absence of critical partners for value creation, a collective inability to innovate, or, crucially, a governance failure by its orchestrator. Conversely, the literature proposing this analytical framework to digital services defines the digital ecosystems by complementarity and “coopetition”, a hybrid relation of cooperation and competition. The orchestrator would therefore act not only as the architect of the ecosystem but also as a competitor to the complementors that depend on its platform to reach the market. According to the literature, this dual role could create conflicts of interest and incentives for the orchestrator to adopt exclusionary practices designed to favor its own services at the expense of rival offerings within its platform.

These characteristics elucidate why a hypothesis was raised that digital ecosystems in the context of foundational model development on the one hand, and fine-tuned systems and applications on the other hand, would form a similar ecosystem with competition issues arising therefrom, in analogy with digital ecosystems. Nonetheless, the extrapolation of competition concerns associated with digital ecosystems should be undertaken with restraint and must take into account the specific attributes governing relationships among participants in foundation model AI markets.

Competition authorities[214] and scholars[215] have expressed concern about ecosystem effects in foundational models in two principal respects. First, they often draw a direct analogy by positioning major foundational model developers as the new “orchestrators” and specialized application developers as “complementors” in their orbit.[216] Second, they argue that applications built on foundational models tend to complement the orchestrator’s core services, thereby reinforcing the orchestrator’s ecosystem position and creating incentives to favor its own applications at the expense of those developed by complementors.[217]

In the first instance, it is necessary to assess whether the characteristics that govern AI allow for such an equivalence. Ecosystems are defined by architectures that enable collective value creation among participants and joint value propositions to end users through complementarities.[218] A larger number of active complementors within an ecosystem underpins its success by stimulating user demand.[219] Because users consume products jointly, an interdependent relationship emerges in which both orchestrator and the complementors rely on the user traffic generated by the ecosystem's value proposition.[220] However, this interdependence is asymmetrical, insofar as the orchestrator retains the ability to control the flow of user traffic to its complementors.[221] Consequently, within digital ecosystems, complementors become dependent on the value architecture defined by the orchestrator, which is grounded in both the volume of user traffic and its allocation.

In AI, however, significant differences call this analogy into question[222]. The value creation architecture of digital ecosystems does not directly translate to AI sector, as complementarities are more limited and the dependency relationship between the orchestrator and its complementors is distinct. There is no genuine joint value proposition to end users for consumption; consequently, increasing the number of active complementors within an AI ecosystem would not necessarily boost overall demand.

Thus, the orchestrator–complementor dependency would not reside in the control of user traffic but rather in the quality (or availability) of the product—namely, the foundational model upon which specific AI applications depend[223]—and its characteristics such as processing speed, cost per token, robustness against hallucinations, and domain specific compatibility. The dependency would rest on the technical quality of the tool, not on audience flow. This shifts the logic of the orchestrator–complementor relationship: when the input is traffic, complementarity and rivalry may become indistinguishable, but when the input is the language model, an application developer can, at least in principle, migrate to another provider. Accordingly, this aspect would be problematic only if the market structure were monopolistic or dominated by a few large suppliers. However, the current state and trajectory of the AI-related markets are far from confirming such a structure as inevitable as we have seen. On the contrary, one observes vibrant competition among various models—both proprietary and open source—with differing degrees of specialization, cost, and business models, leaving open the question of a potential monopolistic structure[224].

On the other hand, this dependency relationship is also relative, since it remains uncertain where the bulk of value creation will occur across the various levels of refinement of foundational models and among GenAI Assistants and GenAI generators. This may depend on the type of foundational model (specialized or general)[225], shift as a result of dynamic innovations, or be concentrated in another layer of the AI chain.[226]

In a second respect, the very structure of the underlying markets is distinct, which further undermines this equivalence. As we have seen in Section 3.1, AI-Assistants and AI-Generators are converging into the same market of multi-modal GenAI systems exploring differentiations and levels of quality. In this context, the orchestrators of digital ecosystems compete within the same foundational model markets—or in other related layers—pointing to a far more intense competitive dynamic.[227] Accordingly, it is difficult to characterize markets based on foundational models as ecosystems with the typical attributes ascribed to digital ecosystems.

The second kind of concern relates to the consolidation of power by digital ecosystem orchestrators and the potential incentives to adopt practices that disadvantage complementors. With respect to anticompetitive conduct vis à vis complementors, one should refer to Section 3, which makes clear that the incentives for exclusionary behavior within intra ecosystem relationships are not present. Conversely, drawing the conclusion that ecosystem orchestrators' power has definitively consolidated may be premature, as it overlooks important implications of AI for the competitive dynamics of these markets. In fact, the ecosystem structure that forms around foundational model providers often functions as a vector of competition in digital markets, as evidenced by the deployment of these models across diverse services.

As noted, the framework of digital ecosystems refers to proprietary business models that do not compete directly.[228] Nevertheless, competitive pressure between ecosystems may emerge in two distinct forms: through the commoditization of various market layers to advantage their core services[229], or via substitute complementarities.[230]

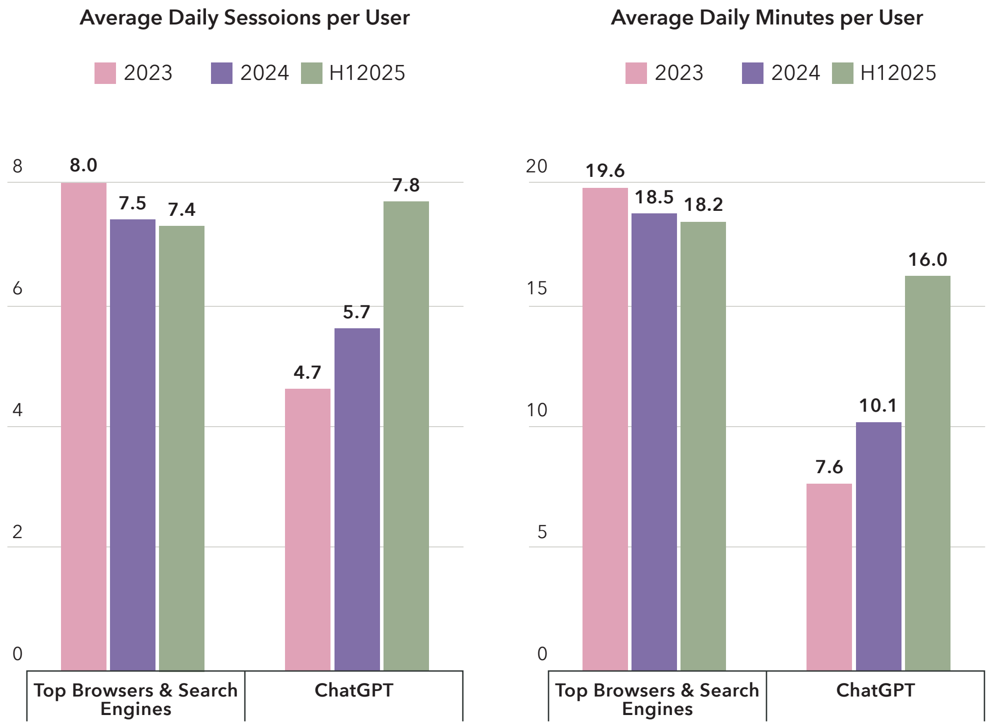
In the first scenario, an orchestrator seeks to commoditize a service at layers where it holds a weaker position and to shift value creation toward other service layers in which it enjoys a more consolidated foothold. For example, this may explain Meta's endorsement of open source large language models (LLMs): both to avoid dependence on external foundational model suppliers for its platforms[231] and to assert that the ecosystem's value proposition stems from its platforms and related products rather than proprietary foundational models. This mode of competitive pressure is advantageous in two respects: it allows the development of more cost effective solutions based on open models and incentivizes innovations that differentiate closed models so as to prevent commoditization.

5.1.3 The impact of AI on digital ecosystems: anticompetitive or procompetitive effects?

Having mapped the main features and concerns associated with digital ecosystems, it is necessary to explore how the integration of AI reshapes these dynamics. This section examines how AI applications are being embedded into established digital ecosystems and assesses their potential to alter competitive balances across markets.

One clear illustration is the threat posed by AI Assistant on search engines, which from a conversational tool has become increasingly used as a source of information and search and due to research and investments have become more reliable in this task, The figure below shows how GPT is increasingly matching the profile of use of Google search:

Browsers & Search Engine App Engagement vs. ChatGPT
Worldwide, iOS and Google Play



Source: Sensor Tower 2025

Given the predictions that advanced language models such as GPT could disrupt Google's leadership by delivering direct answers to user queries, the company has responded by embedding GenAI tools directly into its search engine.[232]

By combining these innovations with its established infrastructure, Google has demonstrated how digital ecosystems can leverage AI both to enhance functionality. Similar strategies are visible across other major digital service providers, where AI capabilities are becoming essential components of ecosystem development.

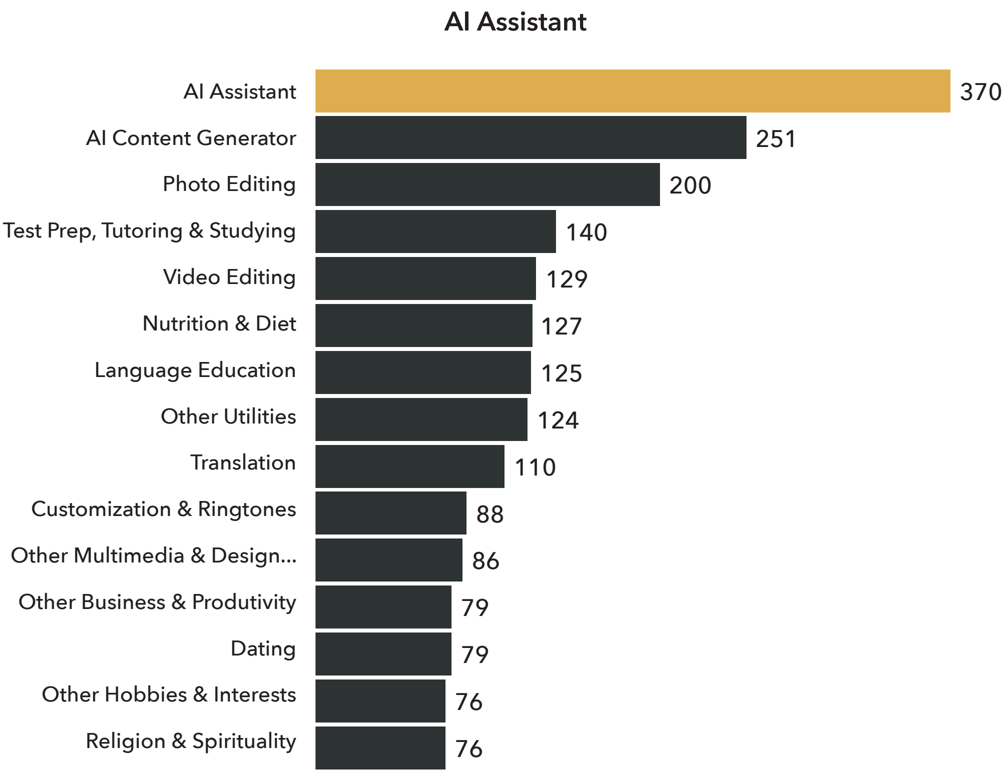
More broadly, this trend is not limited to search services. Building on this observation, the table below provides a structured overview of how the main ecosystems have integrated AI into their systems. Rather than limiting the focus to GenAI alone, the table highlights a wider spectrum of capabilities—including recommendation engines, computer vision, advertising optimization, and conversational interfaces—that together represent the main AI components underpinning each ecosystem's value proposition. By summarizing these main systems and their integration contexts, the table illustrates how AI has become a foundational layer that not only enhances existing products and services but also has the potential to reshape competitive dynamics across markets.

Table 3: Overview of AI Systems Integrated within Major Digital Ecosystems

Company	AI System Type	Example Systems	Integration Context
Microsoft	Recommender Systems, Computer Vision, Conversational AI, GenAI	Azure Personalizer, Azure Cognitive Services, (Vision Speech), Copilot	Azure Cloud APIs, Microsoft 365 Suite, Bing Search, Windows
Alphabet	Search Ranking AI, Advertising Optimization, Computer Vision, GenAI	RankBrain, Smart Bidding in Ads, VertexAI, Google Lens, Gemini	Search Engine, Google Ads Platform, Android and Pixel devices, Workspace
Apple	Computer Vision, Voice Recognition, Personalization AI, GenAI	FaceID, Siri Speech Recognition, On-device Recommendation engines, Apple Intelligence	iOS and macOS devices, Siri, App Store, Mail, Notes
Amazon	Recommender Systems, Computer Vision, Conversational AI, GenAI	Amazon Personalize, AWS Recognition, Alexa NLU, Bedrockm SageMaker	E-commerce Platforms, AWS Cloud APIs, Alexa devices, Prime Video
Meta	Content Ranking AI, Computer Vision, GenAI, Recommendation AI	News Feed Ranking Models, Automatic Alt Text, Llama 3, AI Recommendation Engines	Facebook, Instagram, WhatsApp, Meta AI Reserarch, Ads Manager

In addition to the AI systems embedded within the main digital ecosystems, other AI models and services have emerged that are equally relevant. OpenAI's GPT series provides LLMs specialized in GenAI for text generation, summarization, and conversational interfaces[233]. Anthropic's Claude models are also LLMs designed for GenAI applications, with an emphasis on safety alignment and controllability[234]. DeepSeek offers open-source GenAI models that are optimized for text generation, multilingual understanding, and research-oriented tasks[235]. Oracle provides AI services and integrated machine learning functionalities within its cloud infrastructure and business applications, enabling predictive analytics, natural language processing, and automation capabilities tailored to corporate environments.[236] The chart below indicates the top subgenres of apps adding AI capabilities in the first half of 2025. Overall, it demonstrates that while AI assistants dominate adoption, AI integration is spreading across a diverse range of app categories, from education and productivity to lifestyle and entertainment:

Top Subgenres by Numbers of Apps Adding AI in H1 2025



Source: Sensor Tower 2025

In summary, as illustrated by the table mapping the range of AI systems embedded within digital ecosystems, many AI technologies—such as recommendation engines, computer vision, and targeted advertising—have long been integral components of digital services. Therefore, traditional systems of predictive AI was not a transformative factor for the competition dynamics in digital markets.

What has changed more recently is the rapid emergence of GenAI applications and the competitive disruption they triggered, particularly through the development and commercialization of LLMs. In this context, the adoption of GenAI tools by incumbent ecosystems— as illustrated above by Google's decision to embed GenAI tools directly into its search engine —appears, to a significant extent, to reflect strategic responses aimed at preserving or adapting their positions in the face of growing pressure from specialized AI-focused entrants.

The integration of AI therefore results in efficiencies and innovation in digital markets. Nonetheless, these beneficial effects should be balanced with potential concerns.

One first concern raised by competition authorities regards the AI partnerships discussed in Section 3.1.[237] Firms do not necessarily need to develop AI capabilities entirely in-house. In many cases, collaborations with external providers emerged as a key strategy to integrate advanced AI systems into existing digital ecosystems.

Partnerships are seen in the integration of third-party AI models within ecosystems. For instance, Microsoft's collaboration with OpenAI grants exclusive rights to host and distribute models such as GPT-3.5, Codex, DALL·E, and ChatGPT via Azure OpenAI Service, allowing customers to embed GenAI capabilities into applications ranging from productivity tools to customer support solutions[238]. Similarly, Amazon has integrated Anthropic's Claude models into its Bedrock platform, enabling AWS customers to access advanced language models as part of the broader Amazon ecosystem.[239]

These forms of integration of AI capabilities into digital ecosystems have attracted attention from competition authorities and scholars. Notably, most of the concerns identified in the literature point to traditional types of conduct that may acquire increased significance as AI is embedded across markets. These practices are already addressed under established antitrust principles and therefore require a case-by-case assessment to determine whether they have anticompetitive effects in specific context.

One example of such traditional concerns relates to exclusive deals, where foundation model providers access unique and proprietary datasets. However, to date, many of these arrangements have taken the form of non-exclusive licenses—such as those between Google and OpenAI with Reddit, Meta and OpenAI with Shutterstock, or Google with Stack Overflow. This pattern likely reflects firms' awareness of the antitrust risks associated with exclusive access, indicating that the potential threat of enforcement is already acting as an effective deterrent.[240]

Another discussed issue concerns data-driven acquisitions aimed at obtaining unique and proprietary data or preventing rivals from accessing such data. Although such deals could in theory be used to restrict competitors' ability to develop or train AI models, several authors have noted that the diversity and availability of relevant data sources substantially reduce the likelihood of foreclosure[241]. In particular, many high-quality datasets are publicly accessible or open source—such as LAION, Common Crawl, and The Pile—making it difficult for any single transaction to create insurmountable barriers to entry. Moreover, as Schrepel and Pentland highlight, advances in data-efficient training techniques and synthetic data generation have further diminished the reliance on proprietary data by enabling firms to build competitive models with smaller or alternative datasets.[242]

Additional concerns involve leveraging market power from cloud infrastructure to control other parts of the AI value chain, as discussed in Section 3.2.4. This could occur through tying or bundling practices—for instance, requiring cloud customers to use the hyperscaler's AI models as a condition for accessing infrastructure services. While such practices are covered by existing competition law, the scale and technical integration of cloud and AI services may create enforcement challenges. There are also concerns with lock-in. For instance, it is feared that, players like NVIDIA, due to the widespread adoption of its CUDA software (which is now an industry standard for developing AI applications), could create lock-in because most AI frameworks and developers are optimized for NVIDIA hardware. NVIDIA could potentially reinforce this position by limiting CUDA's compatibility with rival chips or integrating its hardware more tightly with CUDA software.[243] Confirming this practice, however, would also necessitate a case-specific antitrust analysis.

Thus, most of the concerns identified by scholars and competition authorities relate to traditional forms of potentially anticompetitive conduct—such as exclusive data arrangements, bundling, and leveraging practices—that are already subject to established antitrust frameworks and require careful case-by-case assessment. When balancing these concerns with the potential efficiencies and innovation that AI integration may generate, the conclusion is that there is, at this stage, no clear evidence indicating that the incorporation of AI into digital ecosystems has produced structural competition problems or systematically adverse effects.

On the contrary, AI is increasing the competitive pressures that digital ecosystems may exert over one another through non substitutable offerings that give rise to alternative complementarities. This refers to situations in which rival ecosystems can be viewed as substitutes by virtue of their differing value propositions. In this context, the integration of language models becomes a strategic tool for differentiation and rivalry. For example, Microsoft, by embedding the capabilities of models such as GPT into its Office suite via Copilot, creates a significant differentiator that injects new competitive pressure into the text generation market. Similarly, Meta integrates its own LLM into its private messaging services, Google redefines the search experience with Gemini, and other players such as Anthropic pair the computational power of their Claude model with cloud computing ecosystems, thereby crafting distinct value propositions.

What one observes, therefore, is not a mere replication of the isolated leadership model in each core service attributed to digital ecosystems. On the contrary, there is an emergence of dynamic competitive differentials[244] driven by AI, with multiple competitors vying for superiority and consumer preference within the same or adjacent markets. The consequence of this dynamic is significant for antitrust analysis, since, even if "ecosystem architectures" were formed centered on different LLMs, their integration with various digital services would be procompetitive by fostering vigorous inter ecosystem competition. This phenomenon injects competitive dynamism among the established digital ecosystems, dismantling entrenched positions and opening new fronts of dispute over innovation and consumer value.

6. EFFECTS OF FINDINGS ON BRAZILIAN AI INNOVATION AND CORRESPONDING REGULATORY DEBATES

The competitive dynamics outlined in the previous sections should inform the corresponding regulatory debates in Brazil, namely (i) the competition policy regarding AI markets, (ii) the regulation of digital, and (iii) the regulation and national strategies for AI.

As previously mentioned, CADE began inquiring into partnerships between leading tech companies and AI startups. Even if any decisions regarding the effects of such partnerships would necessarily include an analysis of procompetitive effects balanced with eventual restrictions to competition, the mere establishment of such investigations impacts the markets, as it signals the authority's concerns and inclination for intervention, casting legal uncertainty over AI partnerships. This does not mean that antitrust authorities should never inquire into potential anticompetitive practices over the risk of causing chilling effects over legitimate commercial practices, but inquiries need more caution when it comes to markets in nascent and dynamic states of competition.

Mature markets tend to have legal certainty over acceptable practices and anticompetitive ones, and inquiries in those contexts do not risk inhibiting the development of new practices. Nascent markets, on the other hand, do not enjoy the same level of predictability, thus starting inquiries into new practices without serious indicators of anticompetitive effects risks inhibiting the development of innovative practices – such as the partnerships between leading tech companies and AI startups. This chilling effect could be particularly damaging for startups in emerging economies like Brazil, where startups need more access to capital and incentives to scale (as detailed henceforth).

Second, the regulation of digital markets is also impacted by the findings regarding the strong differences between AI and digital markets (Section 4) and the competitive pressure injected by AI on digital markets (Section 5). Brazil has been discussing regulation of digital markets inspired by the European Digital Markets Act (DMA) since 2022, with Bill nº 2768/2022, and now with Bill nº 4675/2025 introduced to Congress by the Ministry of Finance. Both initiatives foresee obligations to a set of leading tech companies ("gatekeepers") aiming to prohibit certain practices deemed as anticompetitive while avoiding lengthy antitrust investigations.

This model of regulation is based on retrospective analyses of competition on digital markets. If not rediscussed with a proper view of competitive pressures imposed on digital markets by AI, the proposed bills risk becoming inadequate to tackle relevant conducts, or to promote fairness and innovation in digital services. It also risks impacting AI services added to digital services inadequately if not considering the dynamic driving innovation and competition in AI. For example, many of the prohibitions of the European DMA aim at preventing lock-in effects observed in digital markets[245] – which are not observed in AI, as discussed in Section 4. If Brazilian regulation of digital markets were to also prohibit certain practices that used to favor lock-in effects and to encompass AI services provided by gatekeepers, it could fail to achieve the desired goal of promoting competition, thereby imposing unnecessary restrictions in nascent markets.

Lastly, Brazil is also discussing the regulation of AI through Bill nº 2338/2023. In addition to establishing rules for the responsible development and use of AI, the Bill also aims to promote "socioeconomic, scientific and technological development and innovation"[246] and has a chapter dedicated to promoting sustainable innovation, envisaging measures of incentive by the public administration[247] and determining simplified rules to support SMEs and startups.[248] To foment AI development and innovation, the Executive branch put forward in July 2024 the Brazilian Plan for AI (PBIA), which foresees R$23 billion of investments between 2024 and 2028 to apply in critical infrastructure, incentivize the private sector, develop AI solutions for public services, among other ends.[249]

These provisions envisaged on Bill nº 2338/2023 and established on PBIA are coherent with the factors that already granted Brazil a distinguished position in the scenario of innovation and startups in relation to Latin America, as Brazil is home to most Latin American "unicorns" created in the last decades,[250] and has been capturing most investments in AI startups in the region recently.[251] While many factors influence the success of startups in a country (such as access to venture capital and the existence of favorable ecosystems, including in universities),[252] the State played a significant role in Brazil, from subsidizing SMEs and startups through public agencies to creating a favorable regulatory environment. The State traditionally focuses on supply-side mechanisms, which include:

• **Direct subsidies and grants:** Institutions like BNDES, Embrapii, and FINEP provide non-reimbursable funding, matching grants, or subventions directly to companies or consortia developing new technologies. At the state level, programs like PIPE ("Programa de Pesquisa Inovativa em Pequenas Empresas") of Fapesp provide early-stage funding to startups and small firms undertaking R&D and innovation. Such grants reduce risks for innovators and help them sustain early development before revenue flows.

• **Tax incentives:** One key instrument is "Lei do Bem" (Law nº 11.196/2005), which offers tax reductions to companies on expenses linked to research, development, and innovation (PD&I), faster deduction of costs with equipment (depreciation), among other benefits. Another one is Law nº 8.248/1991 ("ICT Law", concerning competitiveness of the IT and automation sector), which provides fiscal incentives for companies that manufacture computing, telecommunications or automation goods in Brazil under certain process/product requirements.

• **Simplified frameworks for startups and SMEs:** Brazil has also introduced legal frameworks that reduce bureaucracy and create more favorable conditions for innovation. The Legal Framework for Startups (Complementary Law nº 182/2021) establishes simplified rules for investing in startups, limits investors' liability, and allows experimental regulatory sandboxes. The Statute of Micro and Small Enterprises (Complementary Law nº 123/2006) grants simplified tax regimes and reduced reporting obligations for SMEs. Together, these measures reduce regulatory costs and improve access both to public funding and to innovation-oriented procurement opportunities.

• **Incentives to R&D partnerships between public and private institutions:** Federal and state governments in Brazil are responsible for many of the best universities in the country. Investments in higher education translate into incentives for innovation, as many universities also act as incubators[253] and have been at the origin of the most prominent Brazilian startups.[254] The Legal Framework for Innovation (Law nº 10.973/2004) was created to further develop universities' and other public research institutions' role of supporting innovation, and to enhance this support by incentivizing and regulating partnerships between public institutions and private companies, including startups.

• **National Fund for Scientific and Technological Development (FNDCT):** The FNDCT is a federal fund created by law to finance scientific and technological development and innovation in Brazil. It operates through different modalities: non-reimbursable support (direct grants or subsidies), reimbursable support (loans and credit lines), and capital injections.

These supply-side mechanisms have been effective as they facilitate access to capital in early phases when private investment is hard to obtain; allow experimentation and development of prototypes before commercialization; reduce barriers to entry by lowering fixed costs (equipment, regulatory compliance, payroll for R&D); help build local innovation ecosystems and improving; and overall improve certainty for innovators. However, these mechanisms are not the only State action available to foster innovation. Other countries and blocs, such as China, South Korea, United States, Canada and the European Union, implement demand-side mechanisms such as public procurement of innovation, where governments use strategic demand, infrastructure programmes, large public R&D/or defence contracts, or public sector modernization efforts to pull innovations into the market.[255]

Demand-side mechanisms remain under-leveraged in Brazil, even though some of the above-mentioned laws allow the State to promote innovation through procurement: the Legal Framework for Innovation provides for the use of the government's purchasing power to promote innovation,[256] and the Legal Framework for Startups created a promising new instrument called Public Contract for Innovative Solutions (CPSI).[257]

However, studies on innovation policy in Brazil show that the State rarely acts as a demanding customer for innovative solutions, and many innovations used by public agencies are still developed internally rather than procured from startups.[258] Specialists argue that implementing demand-side instruments (such as the CPSI, where the State commits to buying innovative solutions meeting specified technical standards) could help reduce risk for startups by guaranteeing a buyer, and facilitate scaling.[259] Without some demand side interventions, startups often succeed at the developmental phase (supported by subventions, credit or incentives) but then risk failing when coming to market, especially in contexts where private demand is weak or uncertain.

Therefore, to the end of promoting AI development and innovation in Brazil, there are still unexplored public policy instruments that should be capable of stimulating technology development and market entrance by startups and SMEs. Bill nº 2338/2023 mentions public procurement of innovative solutions as a mechanism to stimulate technological development[260] in addition to direct investments and other supply-side mechanisms aimed at fomenting public interest innovations.[261] However, this is a legislative proposal that could be modified or take long until approval, and, as with the other laws foreseeing public procurement for innovation, its effectiveness would depend on implementation by the public administration. PBIA could have been an opportunity to implement demand mechanisms, but it also focuses on the above-mentioned traditional foment mechanisms utilized by the State, such as investments and credit trough BNDES, FNDCT, Embrapii and FINEP.

Considering this context of how innovation and technological development are incentivized in Brazil, as well as the shortcomings of competition policy trends tackling AI partnerships and of the discussed regulation of digital markets, a better strategy would be not focusing on competition interventions in AI-related markets (whether ex ante or ex post), since this risks errors type 1, which are especially dangerous in nascent and dynamic markets. As demonstrated throughout this report, especially in Section 3, the current markets for AI technologies do not show structural limitations to competition, nor incentives for foreclosure by leading tech companies. Thus, instead of risking antitrust interventions that could stifle competitive market dynamics and that so far seem unnecessary, countries seeking to enhance their competitiveness in AI should focus on measures of fomenting technological development – which, in Brazil, should involve leveraging public procurement.

7. SUMMARY AND MAIN FINDINGS

Competition authorities globally have initiated intense scrutiny of markets for Artificial Intelligence (AI) technologies, particularly GenAI, driven by the significant presence of leading tech companies and aiming to avoid perceived past failures in regulating so-called digital markets. This concern is encapsulated by the Joint Statement on Competition in GenAI, issued in July 2024 by authorities from the UK, US, and Europe, which highlights three main risks: concentrated control of key inputs, incumbents leveraging existing market power from digital markets into AI, and partnerships between key players amplifying these risks. This perspective is largely based on the presumption that AI would be destined for strong concentration, mirroring dynamics attributed to digital markets. It is also based on the arguments that markets for AI would have high barriers to entry (substantial computing power, vast quantities of high-quality data, and AI expertise), which grant leading tech companies advantages due to their existing market positions.

However, when closely analyzing these conclusions, this report notes that they often rely on questionable premises, such as presumptions that are unlikely to materialize or have already been contradicted by recent technological and market developments, or analogies drawn with the characteristics of digital markets that do not hold true when considering the production chain of AI systems and the specificities of the markets involved.

This report questions those assumptions, arguing that the competitive landscape of AI is far more dynamic than suggested. It points to a vibrant sector characterized by new entries, substantial investments (e.g., OpenAI's rise as a market leader, unforeseen by the literature analyzing digital markets), and intense rivalry, which casts doubt on the inevitability of concentration. This report highlights technological breakthroughs which demonstrated that high-performance AI models can be developed with significantly less computing power through efficient architectures, thereby undermining the notion of an insurmountable compute barrier. It also suggests that data advantages may not be as relevant, due to factors like the diminishing returns of data, the rise of synthetic data generation, and the fact that leading AI developers have not exclusively relied on private data (while those with privileged access to data, such as Meta, have not necessarily had sufficient advantage). Moreover, while AI talent is expensive, the increasing pool of expertise and mobility of professionals between companies contributes to knowledge dissemination, challenging the idea of insurmountable talent concentration.

Crucially, the report draws critical differences between digital services and AI, refuting the direct transposition of factors that favor concentration. Unlike digital markets with near-zero marginal costs, AI models, particularly during inference (deployment), incur significant and increasing marginal costs due to substantial computational and energy demands, challenging economies of scale. Network effects are less prominent in AI, as there is no immediate gain for users from increased adoption, and data feedback loops are different, lacking the advertising-revenue component. Switching costs in AI markets are often low, facilitated by standardized APIs and open-source models, allowing users to multi-home and switch providers easily.

Key findings from those analyses are:

• **The AI sector is currently dynamic and competitive**, challenging the presumption of inevitable concentration. Market dynamics are experiencing substantial investments, the continuous introduction of innovative products, and strategic alliances aimed at combining competitive advantages and enhancing market differentiation. It therefore appears inconsistent with predictions of dominance grounded in control over basic infrastructure, as suggested by the Joint Statement. New entrants like OpenAI and the presence of many startups and niches also demonstrate that dominance by existing players is not a foregone conclusion.

• **Computing power is not an insurmountable barrier to entry** due to technological breakthroughs (e.g., DeepSeek-V3's efficient architecture) that significantly reduce training and inference costs. Cloud computing solutions also make resources more accessible for downstream applications.

• **Access to data is not a definitive entry barrier** for AI. Leading AI companies have not relied heavily on private data, and the state of the art observes diminishing returns of data, which suggests that quality, not just quantity, will drive future advancements. The emergence of synthetic data generation further reduces reliance on vast proprietary datasets.

• **AI markets differ significantly from digital markets.** Unlike the near-zero marginal costs of digital services, AI models, especially during inference, incur substantial and increasing marginal costs due to high computational and energy demands. This challenges the "winner-takes-all" dynamic attributed to digital markets.

• **Network effects and switching costs are less prevalent in AI.** There is no direct "network effect" benefit for users with increased adoption, and current market practices indicate low switching costs for AI models, with users often multi-homing across different providers and open-source solutions providing greater interoperability.

• **Data feedback loops in AI are fundamentally different.** They are not driven by the same advertising revenue mechanisms observed in multi-sided digital platforms. AI models' learning from user interactions is often through ex post updates rather than continuous reinforcement, and quality rather than quantity of data is increasingly crucial.

• **AI has the potential to foster procompetitive effects on digital markets.** Instead of reinforcing existing dominance, AI acts as a disruptive force, compelling established digital ecosystems to innovate and integrate AI capabilities to remain competitive, leading to inter-ecosystem rivalry.

• **AI "ecosystems", if existent, tend to be competitive.** The relationship between foundational model providers and downstream application developers is less about controlling user traffic and more about the technical quality of the models, allowing for greater flexibility and competition. Existing antitrust frameworks are generally sufficient to address specific anticompetitive conduct that might arise.

Therefore, the report concludes that AI is more likely to be a disruptive force that fosters inter-ecosystem competition, leading to differentiation and competitive pressure.

Lastly, the report provides recommendations to promote entry of startups and SMEs in markets for AI technologies in Brazil, considering the existing framework of incentives to innovation and the national competition and AI policy debates. The report finds shortcomings in competition policy trends tackling AI partnerships and in the discussed regulation of digital markets, which risk hindering competitive market dynamics and tackling outdated problems in digital markets. Therefore, it suggests that a better strategy to foster innovation and competitiveness would be not focusing on competition interventions in AI-related markets (whether ex ante or ex post), but rather on public policy promoting technological development – which, in Brazil, should leverage unexplored mechanisms such as public procurement.

8. POLICY RECOMMENDATIONS

The arguments and findings developed in this report are evidence-based and should inform policymakers. For policies aiming at improving technological development, innovation, national competitiveness and competition in AI, the conclusions of this report lead to the following recommendations:

1. Avoid analogies with inapplicable past experiences: Competition authorities should avoid analyzing AI through the lenses of experience in digital markets, given that they are crucially different in relation to factors that can lead to concentration and incentives for anticompetitive conducts.

2. Monitor the evolution of markets related to AI: Many competition authorities have been closely overseeing AI-related markets, especially for GenAI. This is a positive measure, as long as it takes into consideration nuances of market dynamics (for example, recognizing that there is not a clear line between markets for foundation models and fine-tuned solutions). Monitoring should seek concrete evidence of the level of competition and effective conditions of access to computing, quality data, and expertise, as well as empirical data on key competitive variables.

3. Not stifling partnerships: Partnerships in AI have been vectors of competition and do not resemble the "killer acquisitions" debated in digital markets. Therefore, interventions on AI partnerships may be premature. When investigations are carried out, they must be swift to prevent the risk of discouraging or suspending partnerships that bring competitive benefits in highly dynamic markets.

4. Beware of the impact of AI on digital markets: When discussing regulating digital markets (such as Brazil currently does with Bill nº 2768/2022 and proposals by the Ministry of Finance), policymakers should consider the impact of AI on the markets for different digital services. AI is increasing competition in digital markets with investments to incorporate the technology and strive for service differentiation. Additionally, AI-based services pose a threat of disrupting traditional digital services. This moment of profound transformation points to the inadequacy of per se prohibitions on vertical practices, and to the need for case-by-case and prospective analyses of competition in digital markets and AI.

5. Fomenting market entries, especially for national players: In Brazil, the best way for the State to promote competition in AI is through programs that encourage new entrants and the development of national players. This can be done with State incentives on both the supply and demand sides: through infrastructure projects, public-private partnerships, reduction of fees and bureaucracy for investment, retention of talent, and public procurement of national technology or other demand-side solutions. These measures should be discussed and implemented within the scope of Bill nº 2338/2023 (which aims to regulate the responsible use of AI in Brazil).

9. NOTES

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6. "Digital markets" is a colloquial term widely used by the literature discussing competition in many markets involving digital products and services. In this report, the term is used to dialogue with such literature, but not to mean a relevant market for antitrust analysis, since there is not a single relevant market encompassing all the main digital services. In this sense, the term encompasses markets for different digital services, especially search engines, social media, online marketplaces, etc.
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markets where firms solidified their dominance with anticompetitive practices. Antitrust intervention came too late—if it came at all. Federal Trade Commission (FTC) Chair Khan warns that 'public officials have a responsibility to ensure this hard-learned history dœsn't repeat itself.' EU Commissioner Vestager ties the timing of regulation even more closely to the trajectory of the technology: 'If the development of AI mirrors this history [of disruption followed by competition problems], then the right response is to phase in competition control gradually, in line with market growth. To respond faster than we did for Web 2.0, but to still give some time for the benefits of disruption to fully play out.'" BOSTŒN, F.; VAN DER VEER, A. Regulating Competition in Generative AI: A Matter of Trajectory, Timing and Tools. Available at: https://papers.ssrn.com/abstract=4756641. Accessed July 16, 2025. p. 6.

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