

Brühl, Volker

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Volker Brühl

Big Tech, the Platform Economy and the European Digital Markets

Digital platforms have become an important part of the digital economy by facilitating transactions between large numbers of users and by fostering innovation on collaborative platforms. It is striking that platform-based services are dominated by a small number of global players. Most of them are headquartered in the USA, including Alphabet, Amazon, Apple, Meta and Microsoft, also known as the “Big Five”. A comparative analysis of the Big Five provides insights into their success factors and platform-related antitrust issues that could be helpful for policymakers to improve the European technology ecosystem. Business decision-makers can also benefit from these lessons learned when shaping digital strategies.

New technologies such as artificial intelligence (AI), cloud technologies or distributed ledgers affect more or less all industries. Various forms of digital platforms have emerged, facilitating transactions between large numbers of users and offering technical platform services. It is striking that, due to the specific economic drivers of the digital infrastructure, platform-based or platform-related services are dominated by a select number of global players. Most of the global platform operators are headquartered in the US, including Alphabet, Amazon, Apple, Meta and Microsoft, known as the “Big Five”. Some are located in Asia (e.g. Alibaba and Tencent). In Europe, there are only a limited number of platform operators, with a small market share.

Much research has been conducted on the emergence and characteristics of platforms, network externalities and platform competition. However, there has been very little research on whether one can identify common features that might explain the success of Big Tech. The following article focuses on an analysis of the Big Five based on their strategies and development paths. The comparison reveals certain commonalities, from which several conclusions can be drawn regarding the success factors

of the Big Five. These insights could be helpful for business decision-makers when shaping digital strategies and to policymakers to improve the European technology ecosystem and thus increase the chances of becoming the home base for the next Big Tech.

Digital platforms and the platform economy

The digital age has given rise to various electronic platform-based business models. One can distinguish between traditional (one-sided) e-commerce platforms, such as Amazon, which are essentially retail businesses that sell and distribute products and services through web stores rather than physical stores. In contrast to this merchant model, two-sided platforms allow affiliated sellers to sell directly to affiliated buyers (e.g. Baldwin and Woodard, 2009; Hagiu, 2007; Rochet and Tirole, 2003). In more general terms, multi-sided platforms facilitate direct interaction within or between multiple user groups (e.g. Abdelkafi et al., 2019; Evans and Schmalensee, 2016; Verfaillie et al., 2021). This, in turn, may result in transactions among users (e.g. Ebay) or the matching of users (e.g. online dating platforms).

Platforms help to reduce transaction costs between market participants, but can also foster innovation by facilitating collaboration or sharing common technological building blocks (e.g. Cusumano et al., 2019; Evans and Gawer, 2015; Goldfarb and Tucker, 2019). One can distinguish several types of platforms that can be classified by the type of user relationships (B2B, B2C, C2C), the business model (transacting, matching, sharing, innovating) or the sector in which they are primarily active (travel and tourism, pharmaceuticals, car sharing, etc.).

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Volker Brühl, Center for Financial Studies, Frankfurt, Germany.

Multi-sided platforms often form the basis of rapidly scaling business models due to their flexibility, adaptability and low incremental transaction costs (see e.g. McAfee and Brynjolfsson, 2017; McIntyre and Srinivasan, 2017). The success of platforms depends, inter alia, on their potential to create network effects among their users, which can be direct or indirect (see e.g. Shapiro and Varian, 1999). Direct network effects arise when a given user's utility increases with the number of other users of the platform. Such effects can be observed, for example, in social media networks. Indirect network effects, or cross-side network effects, occur when the individual utility of a user depends on the increased usage of other market participants. Examples can be found in the market for credit cards, where the value of a given card for the user depends on the number of credit card terminals of companies accepting this payment method.

Scientific studies have identified strong network effects and an early market entry as common features of successful platforms. First, or at least early, movers can attract many users in a short period of time. Due to network externalities, platforms can grow at a high rate, creating high barriers to entry for new entrants. However, the design of the platform's technological architecture has to facilitate interconnectivity between users and integration of additional products and services. On the other hand, empirical findings suggest that many platform initiatives fail, mainly due to mispricing on one side of the market, failure to develop trust with users and partners, prematurely dismissing the competition or entering the market too late (Yoffie et al., 2019).

Platforms and the contestability of markets

A lot of research has been conducted on network externalities and platform competition (e.g. Armstrong, 2006; Roche and Tirole, 2003). Related research topics cover the impact of platforms on industrial structures, the contestability of markets and antitrust issues (e.g. Hagui and Wright, 2015; Evans, 2003).

The increasing relevance of platforms and their underlying economics create new challenges for competition policy and antitrust authorities. If platform-based networks become more attractive with each additional user, a self-reinforcing process can lead to higher adoption rates, which in turn creates additional incentives for new users to join the network. Depending on the industry and the type and size of network effects, markets may become highly concentrated, with only a few or even a single platform operator dominating the industry. Consequently, those markets become less contestable if potential competitors face high barriers to entry, as they have to cope

with structural disadvantages compared to first or early movers in the market.

Platforms often require subscription to specific technical services for use, which may pave the way for business practices that prevent fair and open competition. Detecting such unfair market practices can be challenging as platform-based businesses tend to offer a variety of services that are technologically or economically interdependent. For example, search engines may offer email accounts, online advertising services, customer relationship tools, translation or publishing services.

Abuse of a dominant market position can take very different forms in digital markets. Examples of unfair market practices include the pre-installation of applications on digital devices, the bundling of ancillary services with core platform offerings, discriminatory pricing or the mandatory consent of third-party users to data collection by platform operators. Such business practices can prevent fair competition if they impede third-party access to the platform's end users. High prices, limited consumer choice and reduced innovation are likely consequences.

For instance, Google was sued in Europe in 2017 for abusing its dominant position as a search engine provider by granting an unfair advantage to its own service (Google Shopping) by placing it ahead of other comparable services in search results. Meta has been accused of abusing its dominant position in social networks by making the use of a service conditional on the user's consent to the collection and pooling of data from other subscribed services. The EU Commission imposed a fine on Microsoft for not offering Windows users the option of using web browsers other than the pre-installed Internet Explorer. Amazon has been accused of abusing its dual role as the world's largest online retailer and as an operator of a marketplace for third-party sellers. In response to Big Tech companies increasingly leveraging their financial and technological resources in related markets, the EU has put a new regulatory framework in place to ensure fair and open competition in digital markets.

The Digital Markets Act and the Digital Services Act

In 2020, the EU adopted the Digital Market Strategy to facilitate cross-border digital services and boost innovation activities in the EU (European Commission, 2020). At the same time, digital data protection and privacy must be safeguarded and cybersecurity prioritised to protect critical infrastructure. The Digital Services Act (DSA) and the Digital Markets Act (DMA) are important elements of the Digital Strategy and the Digital Decade policy programme 2030 (European Commission, 2023).

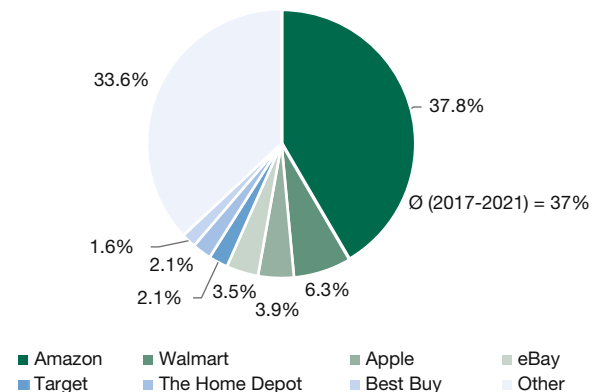
The DSA, which came into force on 16 November 2022 and will apply in all EU countries from 17 February 2024, sets out clear rules and obligations for online platforms to ensure a safe, credible and reliable online environment and the functioning of online services. This includes procedures for the immediate removal of illegal content such as hate messages or fake news. The DSA covers intermediary services (e.g. internet service providers), hosting services (cloud computing, web hosting) and online platforms (e.g. marketplaces, app stores and social media platforms).

The DMA complements existing EU (and national) competition rules. It was adopted on 1 November 2022 and applies from 2 May 2023 to address the growing importance of platforms in certain digital markets. The DMA was introduced to protect Europe's digital markets from anti-competitive behaviour by "gatekeepers", while at the same time ensuring a level playing field for existing and potential competitors. The DMA covers so-called core platform services, which can be exploited by their providers if they have a strong market position, such as app stores, search engines, social networks, virtual assistants, web browsers, operating systems, marketplaces or advertising services. Dominant providers of core platform services may abuse their strong market position through unfair practices such as bundling of products and services, control of APIs, data pooling or self-preferencing of products. According to the DMA, companies providing one or more of these core platform services may qualify as gatekeepers if they meet all of the following criteria:

- A size that impacts the internal market. This is presumed to be the case if the company achieves an annual turnover in the EU of at least €7.5 billion in each of the last three financial years, or has an average market capitalisation or equivalent fair market value of at least €75 billion in the last financial year, and provides a core platform service in at least three member states.
- The control of an important gateway for business users towards end consumers. This is presumed to be the case if the company operates a core platform service with more than 45 million monthly active end users established or located in the EU and more than 10,000 yearly active business users established in the EU in the last financial year.
- An entrenched and durable position. This is presumed to be the case if the company met the second criterion in each of the last three financial years.

In order to ensure fair, open and innovative digital markets, gatekeepers must refrain from any practices that

Figure 1
Market shares of retail e-commerce companies
(United States, 2022)



Source: eMarketer 2022, own calculations.

limit the contestability of the respective markets through unfair market practices.

The case of Big Tech: Lessons learned

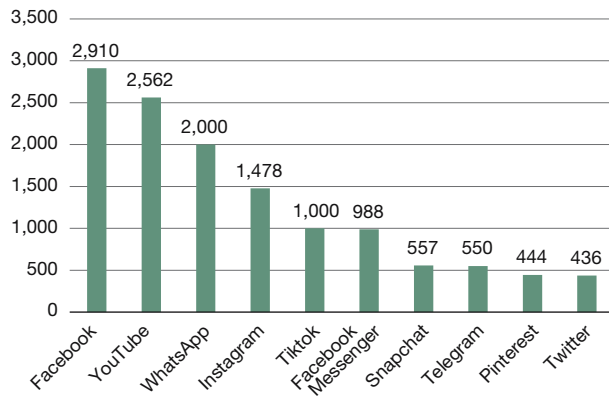
While the DMA will lay the foundations for fair competition in the European digital markets, it is important to gain a better understanding of how and why today's Big Tech companies have managed to become digital champions, and what Europe could potentially learn to help the European corporate sector catch up and harness the market potential in future digital markets. These insights may help to further shape the European digital strategy and provide the framework to bring about competitive European digital champions that would reduce dependence on American and Asian players in key technologies.

Establishment of new markets

Considering the Big Five, it is apparent that all of them have more or less created and defined a new market with their products or services. This is true for Amazon (e-commerce), Apple (smartphones, tablets), Microsoft (Office), Meta (social media) and Alphabet (search engines). They have all managed to keep a high market share in their core business, which underlines high barriers to entry and a reduced contestability of the respective markets. Let us now take a look at recent market shares of the Big Five and their development over time to the extent that the data is available.

More than 20 years after its founding, Amazon is still by far the largest e-commerce player with a market share of about 37%, which has been quite stable over the past

Figure 2a
Global social networks (number of users in million, 2022)



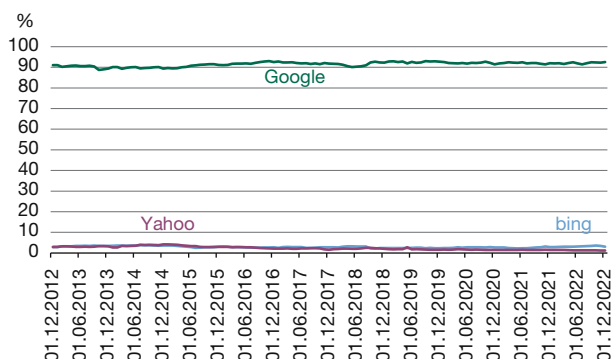
Source: DataReportal 2023, own calculations.

six years in the United States (Figure 1); it is followed by Walmart with a market share of about 6%. The picture is similar in Europe, while Alibaba has a comparable position in China.

Meta's business is mainly based on its leading position in social media networks and the traffic generated on their websites (Figure 2a and 2b), which it successfully translates into a high market share in online advertising.

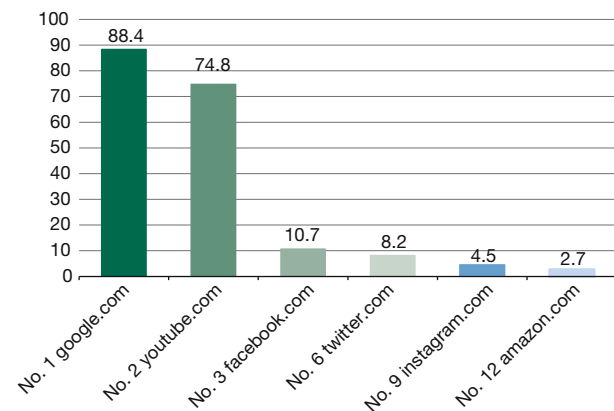
The picture is even more pronounced in the case of Alphabet (Google), whose search engine business, supported by a strong position in web browsers (Chrome), is a major driver of its advertising revenues (Figures 3a and 3b). Market shares in search engines in excess of 90% across plat-

Figure 3a
Global market shares search engines (desktop, mobile and tablet 2012-2022)



Source: Statcounter GlobalStats, own calculations.

Figure 2b
Selected largest websites by traffic (average monthly visits in billion, 2022)



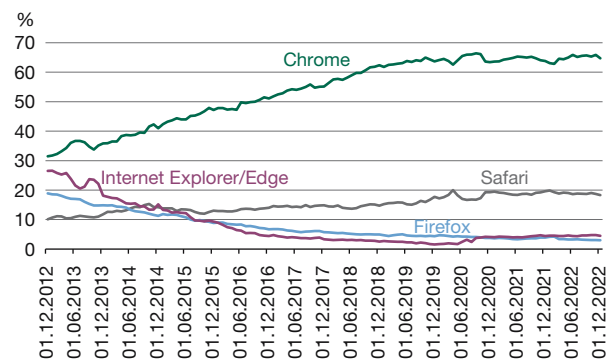
Source: DataReportal 2023, own calculations.

forms and regions speak for themselves. It is also striking how stable Google's market share is over time.

Figure 4 illustrates the development of the relative proportions of the online advertising revenues of Google, Facebook and Amazon. While Google's share has been slightly declining over time, Facebook's share is increasing with a combined share of Google and Facebook exceeding 50% of the online advertising revenue pool.

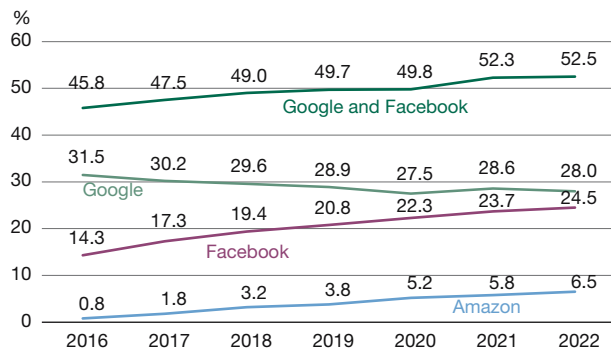
Microsoft has been the undisputed global market leader in operating systems for desktops and laptops and for office software products for decades (Figure 5a and 5b). Most recent data suggest a market share of about 90% for office software products. Google Workspace (G Suite)

Figure 3b
Global market shares browsers (desktop, mobile and tablet 2012-2022)



Source: Statcounter GlobalStats, own calculations.

Figure 4
Global online advertising revenue shares (2016-2022)



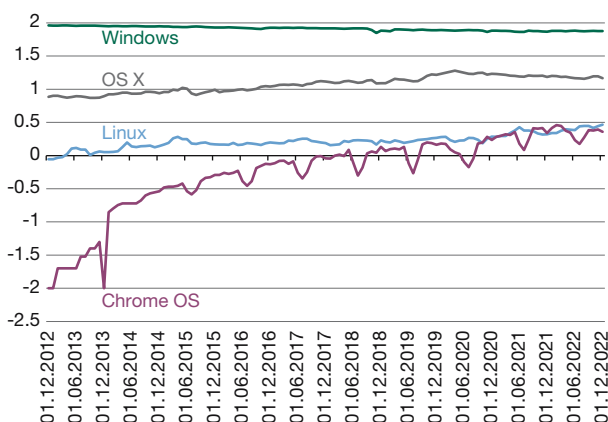
Source: eMarketer 2022, own calculations.

has not been able to challenge Microsoft's leading position among business users although its products are offered at a much lower price.

Apple's growth engine for many years has been its core product lines around the iPhone and iPad. Combined with its high market share in mobile operating systems, Apple has been able to keep its strong position in smartphones and tablets (Figure 6a and 6b). On the other hand, Google is trying to gain market share in smartphones based on its market-leading Android OS, which is also used by other major smartphone vendors such as Samsung.

Overall the market data suggest that the Big Five manage to maintain or even expand their dominant position in their original core businesses over a longer period of time.

Figure 5a
Global market shares, log₁₀ (Desktop OS, 2012-2022)



Source: Statcounter GlobalStats, own calculations.

Reduced contestability of core markets

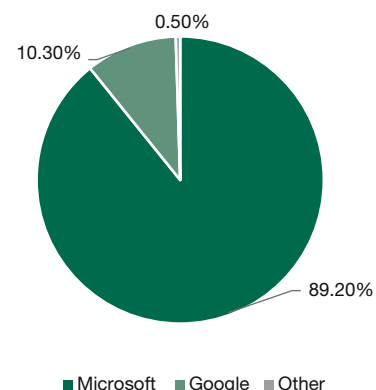
Furthermore, the data support the hypothesis that the business models of the Big Five create significant barriers to entry and reduce the contestability even of fast-changing digital markets. Highly concentrated market structures emerge and prevail that are often characterised by very few market leaders and a number of smaller players that remain in a marginal position or even exit the market.

Big Tech companies tend to build an ecosystem around their core and ancillary businesses in which their service offerings are mutually compatible, creating lock-in effects and increasing switching costs for their users. Such developments can raise serious antitrust issues if Big Tech companies act as gatekeepers to their platforms.

Platform-based business model

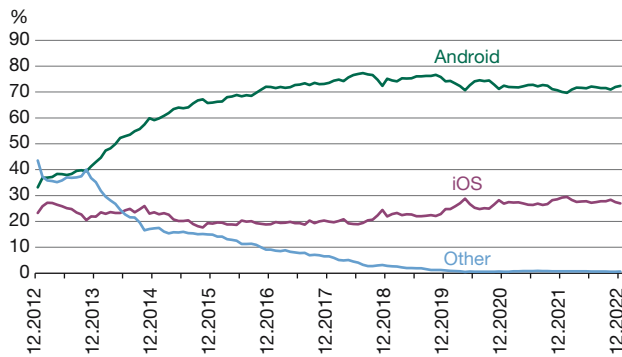
Big Tech companies typically operate one or more platforms, which may or may not be multi-sided (Table 1). For example, Amazon operates its e-commerce platform Amazon.com, the Amazon marketplaces for third parties and Amazon Web Services (AWS) as a web technology platform, e.g. for cloud computing. A closer look at their business models shows that they tend to be active in a number of markets, with a significant proportion of their revenues and profits coming from non-platform business activities. The growth of the core business of the Big Five is driven by consumer demand (B2C). This is obviously not a necessary condition for becoming a dominant digital player, but it seems to be a common feature of some Big Tech companies in their early stages of development.

Figure 5b
Global market shares (Office software products, 2020)



Source: Gartner.com (2021).

Figure 6a
Global market shares (Mobile OS, 2012-2022)



Source: Statcounter GlobalStats, own calculations.

Strong network economies

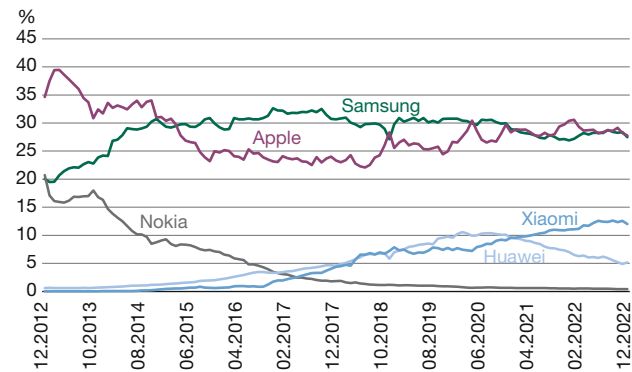
Competitive advantages of Big Tech companies in their core business are based on direct and indirect network economies. Amazon's marketplaces and Meta's social media networks are good examples of strong network effects driving the accelerated growth rates in the use of these platforms. Microsoft's operating systems and office applications generate both direct network externalities among their users and indirect network effects by linking complementary technologies to these platforms. Similar effects can be observed in Apple's hardware and software platforms (iPhone, iPad, iOS, iTunes, Apple Pay, etc.) and in Alphabet's business portfolio around Google.

Economies of scale and economies of scope

In addition to strong network effects, Big Tech also benefits from economies of scale (e.g. in manufacturing, overhead functions), economies of scope (e.g. in marketing and distribution, technology) or lock-in effects created by hardware or software solutions. Scale, scope and network economies often act as mutually reinforcing drivers of first-mover advantages, deterring potential competitors and leading to high barriers to entry (Table 1).

For instance, Amazon's e-commerce platforms benefit from economies of scale in IT infrastructure, procurement and logistics, as well as economies of scope in certain technical domains such as web technologies, software development and platform operations. In addition, direct and indirect network effects play a role in Amazon's marketplaces, which in turn increase the utilisation of shared assets such as IT or logistics infrastructure. Similar observations can be made, for ex-

Figure 6b
Global market shares (mobile devices and tablets, 2012-2022)



Source: Statcounter GlobalStats, own calculations.

ample, at Meta, whose large social media networks are based on – mainly direct – network externalities. At the same time, Meta's business model exploits economies of scale in basic IT infrastructure.

Strong financial position

Fast growing markets in combination with high barriers to entry lead to exceptionally strong financial performances for an extended period during which the Big Five have invested in new, primarily adjacent, markets. While the growth of the original core business remains strong, the new businesses often show even steeper growth trajectories.

Diversification into adjacent markets

In order to leverage their dominant position in their core market, Big Tech companies have conquered new markets by exploiting synergies between their core and new businesses. The strong capital base has enabled the Big Five to accelerate their corporate development both through organic growth and mergers and acquisitions (M&A).

Amazon, for instance, has diversified into areas such as web technologies, including cloud computing, media and AI, including robotics. Alphabet has moved into online advertising, social media, cloud computing and AI/robotics. For many years, Microsoft focused on strengthening its core software competencies through a series of smaller, mostly people-driven acquisitions before expanding into cloud computing, social media, gaming and even the mobile device market. Meta has also long focused its acquisition activity on social media networks, adding to the Facebook network. Only in recent years have acquisitions been made to build the Metaverse business. Even Apple, the least diversified of the Big Five, has acquired more

Table 1

Platforms, sources of competitive advantages and mergers and acquisitions

BigTech company	Core competencies		Platforms	Metrics	Net-work effects*	Econo-mies of scale	Econo-mies of scope	Diversifi-cation strategy	Selected acquisitions
	Common	Distinct							
Amazon	Innovations, web-tech-nologies, cloud comput-ing, software develop-ment, AI, data science, brand management, CRM, platform design	SCM, category manage-ment	amazon.com, amazon market-place, AWS	300 m active custom-ers (B2C); amazon.com 2.6 bn visi-tors globally 2/2023	✓	Logistics, procure-ment, IT infrastruc-ture	Web tech-nologies, software develop-ment, platform opera-tions	AWS (web-technologies), cloud, AI, robotics, media	More than 100 take-overs since 1998 iRobot (2022), One Medical (2022), Metro-Goldwyn-Mayer (2021), Zoxx (2020), PillPack (2018)
Alphab- et	Innovations, web-tech-nologies, cloud comput-ing, software develop-ment, AI, data science, brand management, CRM, platform design	Search engines, semantic web, online advertising	google.com, you-tube.com	97 bn visitors glob-ally 2/2023; youtube.com 80.5 bn visitors	✓	Data ana-lytics, IT infrastruc-ture	Web tech-nologies, software develop-ment, platform opera-tions	Robotics/AI/VR/AR/ana-lytics, online advertising, cybersecurity, HW technol-ogy, smart home	More than 250 take-overs since 2001 Mandiant (2022), Raxium (2022), Fit-bit (2021), Motorola Mobility (2011), DoubleClick (2007), YouTube (2006)
Apple	Innovations, web-tech-nologies, cloud comput-ing, software develop-ment, AI, data science, brand management, CRM, platform design	Product design, hardware develop-ment, manufactur-ing excel-lence	apple.com, iTunes, Apple Pay, Apple TV, iPhone, iOS, Mac, MacOS	Active iPhones (2022): 1.3 bn; more than 2 bn ac-tive devices (Mac, iPad, iPhone)	✓	Manu-facturing, logistics, procure-ment, IT infrastruc-ture	Manu-facturing, product develop-ment	Strengthening core business (iPhone, iPad, iOS), related services (Ap-ple Music, iCloud, Apple Pay, Siri)	More than 120 take-overs since 1988, mostly after 2010 Mobeewave (2020), NextVR (2020), Intel (modem business) (2019), Shazam (2018), Latice Data (2017)
Micro- soft	Innovations, web-tech-nologies, cloud comput-ing, software develop-ment, AI, data science, brand management, CRM, platform design	Operating systems, app devel-opment, software manufactur-ing	microsoft.com, MSN, Microsoft 365, Of-fice 365, linkedin.com	1.4 bn custom-ers; more than 250 m monthly users of Office; more than 1 bn Bing users daily; 900 m members of LinkedIn	✓	Software develop-ment, manu-facturing, IT infrastruc-ture	Common platform opera-tions for Skype, Teams, Azure	Software, cloud, AI, cy-ber security, social media, mobile apps, gaming	More than 200 take-overs since 1986 Activision Blizzard (2022), GitHub (2018), LinkedIn (2016), Nokia mobile phones unit (2013), Skype (2011)
Meta	Innovations, web-tech-nologies, cloud comput-ing, software develop-ment, AI, data science, brand management, CRM, platform design	Social me-dia, online advertising	facebook.com, insta-gram.com, whatsapp.com	Facebook: 12.5 bn visitors glob-ally 2/2023; Instagram: 5.2 bn	✓	Software develop-ment, IT infrastruc-ture	Common platform opera-tions for Face-book, In-stagram, WhatsApp	Meta labs (AR, VR), related tech-nologies	More than 90 take-overs since 2005 Armature Studio (2022), Twisted Pixel Games (2021), WhatsApp (2014), Oculus VR (2014), Instagram (2012)

Notes: * Direct and indirect network effects. AR: augmented reality; AWS: Amazon Web Services; SCM: supply chain management; CRM: customer relationship management; VR: virtual reality; AI: artificial intelligence.

Source: Own analysis.

than 120 companies since its inception. Table 1 illustrates that M&A is an important strategic tool for the Big Five, as each of them has made numerous acquisitions in a relatively short period of time. The ability to smoothly integrate acquired companies and their teams is obviously another common success factor.

Monetisation of customer/user base

The Big Five companies try to monetise their huge customer and user bases for online advertising and potentially selling advanced analytics services to third parties. A substantial portion of Big Tech's revenue tends to

come from advertising if the business model is primarily data-driven, as in the case of Alphabet and Meta. Intelligent algorithms collect big data to develop precise user profiles, enabling targeted online advertising campaigns. Another common feature is the provision of complementary services (e.g. payments) to deepen their customer relationships and gain further insights into customer behaviour.

Similar core competencies

A closer look at the core businesses and their development both organically and through M&A suggests that the Big Five share similar core competencies in terms of technology (web technologies, software development, AI, data science) as well as innovation, marketing and customer relationship management. The combination of those with outstanding industry-specific capabilities such as supply chain management or category management in the case of Amazon, or product design and development in the case of Apple, seems to provide the basis for building and expanding a strong leadership position in the respective sector (Table 1). An important ingredient in their success is their ability to attract the best talent in engineering, computing and data science. They offer attractive individual development opportunities, flat hierarchies and the financial incentives that come with fast-growing companies.

Convergent activities

With some similar core competencies in terms of digital skills and strong financial resources, it is not surprising that Big Tech companies become competitors in new markets, even though their original core activities were quite different. We have already seen some Big Tech players attack others on their home turf, such as Microsoft launching its Bing search engine as an alternative to Google, or Alphabet positioning its Google Work Suite to challenge MS Office. Google, Amazon and Microsoft have entered the smartphone market, while Apple is challenging Amazon Prime with its Apple TV. Other areas where the Big Five's business interests are converging include cloud computing, autonomous driving, wearables, gaming and e-health.

Early access to public capital markets

Because Big Tech companies need to raise large amounts of capital to fuel their high growth, early access to public capital markets is important. Most of the Big Five companies went public on the NASDAQ stock exchange within a period of less than ten years after their founding. In some cases, venture capital played an im-

portant role in the early stages of their development. But access to a major stock exchange was a key factor in their rapid rise.

Conclusions

Big Tech companies play an increasingly dominant role in many digital markets. These companies have successfully conquered a specific market in which they have quickly achieved a leading position. Moreover, they benefit from network effects, often combined with economies of scale or scope, which reinforce their competitive advantages in these markets. The contestability of such markets declines over time due to high barriers to entry for potential competitors. At the same time, fast-growing technology groups such as the Big Five use their exceptionally high cash flow base to expand into adjacent markets, gradually extending their market power beyond their original core business. If these companies act as gatekeepers to new incumbents, they may hinder the development of European competitors, damage the ecosystem for technology start-ups and even jeopardise Europe's core strengths in manufacturing industries. Therefore, the amendment of the existing antitrust rules by the Digital Markets Act and the Digital Services Act were appropriate steps to ensure fair competition in Europe's digital markets.

The comparative analysis of the Big Five provides insights from which entrepreneurs, investors, European regulators and policymakers can learn. The success of the Big Five is based on a combination of similar core competencies such as outstanding skills in certain digital technologies and distinct industry-specific competencies. Furthermore, the Big Five were all at least early movers in their initial core market. Both M&A and early access to public capital markets have been decisive for their success.

The evidence presented in this article suggests that the focus of both start-up activities and European industrial and research strategy should not be based on an approach of building a serious competitor in one of the fields already occupied by the Big Five. Such an approach has little chance of success. The strategic focus of European initiatives should be on markets such as GreenTech, B2B platforms or AI, where the markets are "in the making" and not yet dominated by the Big Five. An important element in restoring the competitiveness of Europe and European companies is the Gaia-X project, which aims to build a modern data infrastructure that promotes the digital sovereignty of European users of cloud services. An ecosystem that supports tech talent, a regulatory framework that encourages innovation, and

substantial funds available to finance innovative business models increase the likelihood of building a thriving economy in the digital age.

The European Commission has estimated that the EU will face a shortage of eight million IT professionals by 2030 and that the EU lags significantly behind the US in terms of AI, cybersecurity and cloud technology experts (Anderson, 2022; European Commission, 2021). The EU has well acknowledged the need for action to close the gap with the launch of the European Skills Agenda and the Digital Education Action Plan in 2020. Furthermore, it should be discussed whether European clusters for key digital technologies could help to close the gap with the United States and China. As M&A plays an important role for scaling up young businesses, the EU should consider reforming its regulatory framework to speed up the approval process for small to medium-sized transactions. In addition, there is currently no stock exchange in Europe that can compete with the US technology exchange NASDAQ. Therefore, the possibility of creating a European tech exchange should be explored in order to improve equity funding opportunities for European tech companies.

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