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The evolution of digital dominance: how and why we got to GAFA

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DIGITAL DOMINANCE

THE POWER OF

GOOGLE,

AMAZON,

FACEBOOK,

AND APPLE

EDITED BY

MARTIN MOORE

AND DAMIAN TAMBINI

DIGITAL DOMINANCE

*The Power of Google, Amazon,
Facebook, and Apple*

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and

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CHAPTER 1

The Evolution of Digital Dominance

How and Why We Got to GAFA

PATRICK BARWISE AND LEO WATKINS

Competition is for losers. If you want to create and capture lasting value, look to build a monopoly

—Peter Thiel, cofounder of PayPal and Palantir

Apple, Alphabet (Google), Microsoft, Amazon, and Facebook are now the five most valuable public companies in the world by market capitalization.¹ This is the first time ever that technology (“tech”) companies have so dominated the stock market—even more than at the end of the 1990s’ Internet bubble. They are a large part of everyday life in developed economies and increasingly elsewhere. They wield enormous power, raising difficult questions about their governance, regulation, and accountability. This chapter is about how and why this came about.

These tech giants vary in many ways. For instance, Apple is primarily a hardware company and Amazon has a huge physical distribution network, while Google, Microsoft, and Facebook are mainly “weightless” online businesses. Nevertheless, they share several features:

1. As of June 28, 2017 (see Table 1.1). A public company’s market capitalization is its value to its shareholders (share price times number of shares).

- A US West Coast base;
- Dominant founders: Steve Jobs (Apple), Larry Page and Sergey Brin (Google), Bill Gates (Microsoft), Jeff Bezos (Amazon), and Mark Zuckerberg (Facebook) (Lex 2017);
- Significant control of the digital markets on which consumers and other companies depend;
- A business model to “monetize” this market power by charging users and/or others, such as advertisers, leading to sustained supernormal profits and/or growth;
- A hard-driving, innovative corporate culture epitomized by Facebook’s former motto “Move fast and break things.”

They have combined annual revenue of over \$500bn, net income of over \$90bn, and market capitalization of over \$2.8 trillion (Table 1.1). Microsoft has been one of the world’s most valuable companies since the 1990s, but the other four—“GAFA” (Google, Apple, Facebook, Amazon)—are relative newcomers to the list.

A 60-YEAR PATTERN: DOMINANT TECH PLAYERS CAN BE ECLIPSED, BUT NOT DISPLACED

This is the latest stage of a 60-year pattern, with the emergence of increasingly important new technology markets. These typically start as highly contested but soon become dominated by one (or two) US companies:

- 1960s mainframes (IBM)
- 1980s PCs (Microsoft and Intel)
- 1990s the World Wide Web, creating multiple new online markets including search (Google), e-commerce (Amazon), and social networking (Facebook)
- 2010s the mobile Internet (Apple and Google/Android) plus numerous mobile apps/services (GAFA and others, mostly based in the United States and China).

These companies operate in markets with important winner-take-all features such as cost and revenue economies of scale, scope, and learning, and often high switching costs, locking users in. Their strategies typically include creating proprietary standards and platforms; gathering and exploiting vast quantities of user data; product bundling; building large-scale infrastructure, some of which is then rented to other companies; strategic acquisitions; branding and intellectual property (trademark and,

Table 1.1. THE BIG FIVE US TECHNOLOGY COMPANIES

	Founded	Based	Main Product	Revenue (2016)	Market Capitalization	After-Tax Profit (Net Income) (2016)	P/E Ratio
Apple	1976	Cupertino, CA	Hardware	\$216bn	\$749bn	\$45.7bn	16
Alphabet (Google)	1998	Mountain View, CA	Search	\$90bn	\$656bn	\$19.5bn	34
Microsoft	1975	Redmond, WA	PC Software	\$85bn	\$534bn	\$16.8bn	32
Amazon	1994	Seattle, WA	E-commerce	\$136bn	\$467bn	\$2.4bn	195
Facebook	2004	Menlo Park, CA	Social network	\$28bn	\$436bn	\$10.2bn	43
Total	-	-	-	\$555bn	\$2,843bn	\$94.6bn	30

Source: Company reports and Dogs of the Dow (2017).
P/E (Price/Earnings) ratio = share price/latest earnings per share = market capitalization/net income.

especially, patent) litigation; regulatory and tax arbitrage; and political lobbying.

The result is dominance of at least one product or service category—in some cases several—leading to sustained high profits, which are then invested in (1) protecting and enhancing the core business and (2) high-potential new markets, especially where the company can use the same technology, infrastructure, or brand.

Because of these markets' winner-take-all features, it is extremely hard to *displace* a dominant, well-managed tech business from its leadership of its core product market. Instead, the greater risk is that they will be *eclipsed* by another company dominating a new, eventually bigger, adjacent market with similar winner-take-all qualities. The new market may then overshadow the previous one, without necessarily destroying it (Thompson 2014). For instance, IBM still dominates mainframes and Microsoft still dominates PC software, but these are both mature markets that have been surpassed by newer, larger ones for online, mobile, and cloud-based services.

To head off this threat and exploit the new opportunities, dominant tech companies invest heavily in high-potential, emerging product markets and technologies, both organically and through acquisitions. Current examples include the augmented and virtual reality (AR/VR) platforms being developed by Apple, Google, and Facebook; the race between Google, Apple, Uber, Tesla, and others to develop self-driving car technology; and the creation of connected, voice-activated home hubs such as Apple's HomePod, the Amazon Echo, and Google Home.

The rest of the chapter is in three sections: the theory, the five company stories (Microsoft and GAFA), and the question: will the market end the tech giants' digital dominance?

THE THEORY: WHY TECH MARKETS ARE WINNER-TAKE-ALL

Traditional economics goes some way toward explaining these companies' market dominance. In particular, most tech markets exhibit extreme economies of scale. Software and digital content have high fixed development costs but low-to-zero marginal (copying and online distribution) costs. Unit costs are therefore almost inversely proportional to sales volume, giving a big competitive advantage to the market leader.

Digital products are also (1) "nonrivalrous"—unlike, say, pizzas, cars, or haircuts, they can be used simultaneously by a limitless number of people—and (2) "experience goods"—users need to try them and learn

about them (from personal experience, experts, and peers) to judge their quality.² Their nonrivalrous nature often leads to business models based on advertising (free services, maximizing reach) and/or continuing customer relationships rather than one-off sales.

The fact that these products are “experience goods” (1) increases the value of strong, trusted brands to encourage trial and (2) creates switching costs for existing users, further benefiting the market leader. The tech giants have some of the most valuable brands in the world: leading marketing company WPP now ranks Google, Apple, Microsoft, Amazon, and Facebook, in that order, as its top five global brands, with a combined value of \$892bn (Kantar Millwood Brown 2017).³ These estimates are of the shareholder value of *consumer* brand equity. These companies also have significant *employee* brand equity, helping them attract the best technical, managerial, and commercial talent—another winner-take-all factor.

Crucially, however, digital markets also have two other important characteristics that further encourage market concentration:

1. Many digital services serve communication or linking functions, generating both direct (within-market) and indirect (cross-market) network effects. These also occur in other markets but are especially prevalent and important in digital markets.
2. Digital technology enables large-scale real-time collection and automated analysis of usage data, which can be exploited both tactically and strategically, especially through continuous product improvement and personalization. The result is a recursive relationship between adoption and usage, product/service quality, and further adoption and usage, further reinforcing the winner-take-all dynamic.

Tech companies’ strategies aim to exploit these winner-take-all market characteristics as well as classic sources of competitive advantage: product quality and design; marketing and branding; brand extensions and bundling; and various forms of customer lock-in. Increasingly, the companies also operate in multiple product markets, often with products and services offered free or below cost as part of a wider strategy to protect and extend

2. Economic analysis of these features predates the Internet: the literature on non-rivalrous (and, in the first instance, nonexcludable) “public goods” like defense and free-to-air broadcasting goes back to the 1950s (Samuelson 1954; Coase 1959) and the pioneering paper on experience goods is Nelson (1970).

3. The other two main valuation companies, Interbrand (2016) and Brand Finance (2017), also value them all in their top ten apart from Interbrand’s #15 ranking for Facebook in 2016.

their core market dominance and capture more data. Examples include Amazon's Kindle and Google's Maps and Gmail.

We now discuss these distinctive winner-take-all characteristics of digital markets in more detail under four headings: direct network effects; indirect network effects ("multisided markets"); big data and machine learning; and switching costs and lock-in.

Direct Network Effects

In 1974, Jeffrey Rohlf, an economist at Bell Laboratories, published a seminal paper "A Theory of Interdependent Demand for a Telecommunications Service." Bell Labs' then-owner AT&T was contemplating the possible launch of a video telephony service, and Rohlf was researching how this should be priced if it went ahead. His mathematical model was based on the key qualitative insight (Rohlf 1974, 16) that "[t]he utility that a subscriber derives from a communications service increases as others join the system," enabling each person to communicate with more others (although some adopters are more influential than others in driving network externalities, see Tucker [2008]). Economists call this effect a direct network externality (Katz and Shapiro 1985).⁴ In the context of Rohlf's paper and this chapter, the relevant network effects are positive ("revenue economies of scale"), but they can be negative, as with congestion in transport and communication networks. There can also be both positive and negative "behavioral" direct network effects if other consumers' adoption of a product makes it either more, or less, acceptable, fashionable, or attractive.

Indirect Network Effects ("Multisided Markets")

Most tech companies are, at least to a degree, "platform" businesses, creating value by *matching customers with complementary needs*, such as software developers and users (Microsoft's MS-DOS and Apple's App Store), publishers and book buyers (Amazon), drivers and potential passengers (Uber), and, in many cases including Google and Facebook, advertisers and consumers.

These network effects are called "indirect" because—unlike with the direct, single-market, externalities discussed previously—the value to

4. "Externality" because it involves external third parties in addition to the individual firm and customer. We interchangeably use the less technical term "network effect."

participants in each market (e.g., diners) depends on the number of participants in the *other* market (e.g., restaurants), and vice versa. Once a platform dominates the relevant markets, these network effects become self-sustaining as users on each side help generate users on the other.

Most indirect network effects are, again, positive, although they too can be negative for behavioral reasons if some participants are antisocial or untrustworthy, for example, posting malicious reviews on TripAdvisor or fake news on Facebook, or overstating the size and quality of their homes (or, conversely, throwing a noisy, late-night party as a guest) on Airbnb. Platforms often incorporate governance processes to limit these behaviors (Parker, Van Alstyne, and Choudary 2016, Chapter 8).

The need to appeal to both buyers and sellers simultaneously has been known since the first organized markets. But there was no formal modeling of two-sided markets until the late 1990s, when Rochet and Tirole (2003) noted structural similarities between the business models of payment card businesses, telecommunication networks, and computer operating systems. All exhibited network effects under which the value of the service for one group (e.g., payment card users) depended on how many members of the other group (e.g., merchants) were in the system, and vice versa.⁵

More recent work uses the term “multisided”—rather than two-sided—markets because some platforms facilitate interaction between more than two types of participant. For instance, Facebook connects six distinct groups: friends as message senders, friends as message receivers, advertisers, app developers, and businesses as both message senders and receivers (Evans and Schmalensee 2016a, 110).

Digital devices with compatible software, such as Microsoft’s Xbox video games player, exhibit indirect network effects because (1) each device’s installed user base constitutes an addressable market for software developers and (2) the range and quality of software available for the device are key to its user appeal (Nair, Chintagunta, and Dubé 2004; Lee 2013). Similarly, automated online marketplaces such as Amazon, Airbnb, and Uber operate in multisided markets with indirect network effects.

All businesses that depend on indirect network effects face the “chicken-and-egg” challenge of achieving critical mass in both or all the key markets simultaneously. Until the business reaches this point, it will need to convince investors that early losses will be justified by its eventual dominance of a large and profitable multisided market. Most start-up tech businesses,

5. These effects were also modeled independently by Parker and Van Alstyne (2005), who had noticed that most successful 1990s Internet start-ups had a two-sided market strategy.

such as Twitter, Uber, Snapchat, and Pinterest, are heavily loss-making for years and the casualty rate is high.

Achieving critical mass is easier if the product or service offers immediate benefits independent of network effects. For instance, at its 2007 launch, the iPhone already offered 2G mobile (voice, texts, e-mail, and web browsing) and music, with a market-leading touch-screen interface, driving rapid adoption. The App Store (2008) then created a virtuous circle of further adoption and app development.

Hosting a large digital platform requires massive infrastructure—servers, data storage, machine learning, payment systems, and so forth. Most of these have marked economies of scale and scope, enabling the business to take on other markets and to rent out capacity to other firms, further increasing its efficiency and profitability. The preeminent example is Amazon—both its logistics arm and its cloud computing business Amazon Web Services (AWS). Google, too, sells cloud storage, machine learning, data analytics, and other digital services that have grown out of, or complement, its core search business, while Microsoft is building its cloud services business, Azure.

Big Data and Machine Learning

The Internet enables tech companies to collect extensive, granular, real-time usage data at low cost. The resulting “big” datasets are challenging for traditional software to process because of their size, complexity, and lack of structure, but new data analytics techniques, increasingly automated (“machine learning”), can use big data to drive relentless improvement in products, services, pricing, demand forecasting, and advertising targeting. For instance, Netflix constantly analyzes viewing and preference data to inform its content purchases and commissions and to automate its personalized recommendations to users.

The more detailed the data, the wider the range of transactions, the bigger the user sample, and the greater the company’s cumulative analytics experience, the better: quantity drives quality. Data and machine learning therefore offer both cost and revenue economies of scale, scope, and learning, encouraging digital businesses to offer free or subsidized additional services, at least initially, to capture more data.

The business benefits of big data are both tactical (continuous improvement) and strategic. These are interlinked: over time, continuous improvement can give the dominant provider an almost unassailable strategic advantage in service quality, customization, message targeting, and cost

reduction. Subject to privacy regulations (currently being loosened in the United States, see Waters and Bond [2017]), the data can also be sold to other, complementary companies, enabling them to obtain similar benefits. Finally, data can be analyzed at a more aggregate level to provide strategic insight into market trends. An important example is AWS's and other cloud companies' access to aggregate data on their many start-up clients, giving early intelligence on which are doing well and might be a competitive threat and/or investment opportunity.

Big data and machine learning can powerfully reinforce network effects, increasing the dominant companies' returns to scale and helping to entrench incumbents and deter market entry. However, economic theory has not yet caught up with this. For instance, Evans and Schmalensee (2016a) do not mention big data, analytics, algorithms, or machine learning. Parker, Van Alstyne, and Choudary (2016, 217–20) do list leveraging data as one of the ways in which platforms compete, but their discussion of it is barely two pages long and gives no references, reflecting the lack of relevant economic research to-date. There has been some broadly related work. Chen, Chiang, and Storey (2012) edited a special issue of *MIS Quarterly* on the use of big data analytics in business intelligence, while George, Haas, and Pentland (2014) and Einav and Levin (2014) explore its potential in management and economics research, respectively. But overall, although data and machine learning are key drivers of the tech giants' market and civic power, existing economic theory provides an insufficient framework for making this power accountable and regulating it to sustain effective competition (Feijoo, Gomez-Barroso, and Aggarwal 2016; Kahn 2017).

Switching Costs and Lock-In

Finally, all these companies use multiple ways to lock users in by increasing the cost or effort of switching to a rival product or service. As already noted, it takes time and effort to learn how to use unfamiliar systems and software. The greater the amount of such learning (“brand-specific consumer human capital”), the greater is the switching cost (Klemperer 1987; Ratchford 2001; Huang 2016). Often, there are also incompatibility issues locking users into a particular company's ecosystem (Iansiti and Levien 2004) or “walled garden”: for instance, apps bought on iOS cannot be carried over to an Android device. Similarly, users' personal data archives may not be portable to another platform.

Some services' utility also increases with use by allowing for customization by the user (e.g., creating playlists on iTunes or Spotify) and/or the

company (based on the individual's usage data) or enabling the user to accrue, over time, a reputation or status (e.g., Amazon marketplace ratings) or to accumulate content they do not want to lose (e.g., Facebook message histories), all of which reinforces lock-in.

Conclusion: Digital Markets Are Winner-Take-All and the Winners Are Hard to Dislodge

In this section, we have discussed several structural reasons why digital markets tend to be winner-take-all: economies of scale; important user and employee brands; direct and indirect network effects; big data and machine learning; and other factors that enable strategies based on switching costs and lock-in.

The tech giants' market dominance is strengthened by their corporate cultures. They are all ambitious, innovative, and constantly on the lookout for emerging threats and opportunities, exemplifying Grove's (1998) view that "only the paranoid survive." This makes them tough competitors. Finally, their tax avoidance further increases their net income and competitive advantage.

Given all these factors, once a tech platform dominates its markets, it is very hard to dislodge. For a rival to do so, it would need to offer a better user experience, or better value for money, in both or all the markets connected by the platform, in a way that the incumbent could not easily copy, and over a sufficient timescale to achieve market leadership. For example, Google dominates both user search and search advertising. To dislodge it—as several have tried to do—a rival would need to offer users better searches and/or a better overall experience than Google, or some other incentive to switch to it (since Google searches are free, it cannot be undercut on price), long enough to overcome their habitual "googling" for information. Only by attracting more high-value users than Google would the challenger then be able to overtake it in search advertising revenue, although it could perhaps accelerate this (at a cost) by offering advertisers lower prices to compensate for its lower reach until it overtook Google. The overall cost would be huge—tens of billions—and with a high risk of failure, given Google's alertness and incumbency advantages: search quality, superior user interface, brand/habitual usage, dominant reach and scale in search advertising, leadership in big data and machine learning, and deep pockets.

However, competitive platforms can coexist if: (1) users can "multihome," that is, engage with more than one platform (for instance, many consumers use several complementary social networks) and/or

(2) developers can create versions of their products for several platforms at little incremental cost.

Having discussed the drivers of tech market concentration in generic and theoretical terms, we now turn to the five company stories and the extent to which some combination of these factors has, in practice, enabled each of them to achieve market dominance.

THE FIVE COMPANY STORIES

We here summarize the five companies' individual histories, strategies, business models, and current market positions and concerns. Their stories have been much more fully documented elsewhere, for example, Wallace and Erickson (1992), Isaacson (2011), Auletta (2009), Kirkpatrick (2010), and Stone (2013).

Microsoft

Microsoft was founded by Bill Gates (19) and Paul Allen (22) in 1975 as a supplier of microcomputer programming language interpreters.⁶ Its big break came in 1980, when IBM gave it a contract to supply an operating system for the forthcoming IBM PC. Microsoft bought the software for \$75,000 from another company, hired the programmer who wrote it, branded it MS-DOS, and licensed it to IBM and all the PC clone manufacturers, receiving a licence fee on every sale. It then acquired and developed a series of PC software products: Word (1983), Excel (1985), Windows—MS-DOS with a graphical user interface emulating that of the Apple Mac (1985), PowerPoint (1987), and Office—combining Word, Excel, PowerPoint, and other applications (1989). In 1995, Windows 95, a major upgrade using faster Intel processors, was bundled with Internet Explorer, which soon eclipsed Netscape as the dominant web browser.

Users familiar with both the Apple Mac and the Windows/Intel PC generally preferred the Mac. But the PC, widely marketed by IBM and multiple clone manufacturers, outsold the Mac and soon became the standard, first in the corporate world and then across the whole market apart from niche segments such as desktop publishing, where the Mac's superiority won out. Every PC came with MS-DOS and, later, Windows and

6. Allen left in 1983 after being diagnosed with Hodgkin's lymphoma.

Office, making Microsoft the dominant PC software supplier. Shapiro and Varian (1999, 10–11) described the Microsoft-Intel approach as a classic strategy based on network effects, contrasting it with Apple’s strategy of controlling and integrating both the hardware and the software: “In the long run, the ‘Wintel’ strategy of strategic alliance was the better choice.” Today, Microsoft remains the dominant PC software supplier with a global market share of 89%, versus 8% for Apple’s OS X and 3% for all others (Netmarketshare 2018).

However, Microsoft has struggled to replicate this success elsewhere. Efforts under Steve Ballmer (CEO 2000–2014) to extend Windows to mobile devices repeatedly foundered, especially after the launch of Apple’s iPhone and iOS (2007) and Google’s Android mobile operating system (2008). Microsoft tried again to create a Windows mobile ecosystem based around Nokia’s handset division, acquired for \$7.9bn in 2013, but this too failed. Only 15 months later, under new CEO Satya Nadella, it took a \$7.5bn impairment charge on the acquisition plus \$2.5bn in restructuring costs.⁷ Ballmer’s resignation caused Microsoft’s stock price to jump over 7% (Reisinger 2013).

Since the 2008 launch of Google Chrome, Microsoft has also lost share in the web browser market, despite bundling Internet Explorer with Windows since 1995. In search, its estimated cumulative losses were \$11bn by 2013 (Reed 2013). However, its Bing search engine finally turned a profit in 2015 (Bright 2015), mainly as the default for Windows 10, iOS, Yahoo!, and AOL.

Historically, Microsoft’s most successful move away from PC software was into video game consoles. This was initially a defensive move prompted by fears that Sony’s PlayStation 2 would lure games players and developers away from the PC, but Microsoft’s Xbox, launched in 2001, succeeded in its own right. Since 2012, Microsoft has also marketed PCs, laptops, and other devices under the Surface brand name, with some success.

Microsoft’s challenge today is that the PC is no longer most users’ main device—and Apple Macs and Google Chromebooks are also eating into its installed PC base. In response, it has set about transforming itself into a major player in cloud computing and office productivity services. It bought Skype in 2011 for \$8.5bn, giving it a communications tool to integrate with other products like Office 365, the Lync enterprise phone platform, and real-time translation software (Bias 2015; Tun 2015). With this

7. Microsoft does, however, receive an estimated \$2bn a year in patent royalties from Android device manufacturers (Yarow 2013), the only positive legacy of its expensive 15-year effort to build a significant mobile business.

combination (Skype for Business), it aims both to shore up its core PC software business and to create new office service opportunities, especially in the enterprise market.

Its biggest gamble to-date is the \$26.2bn acquisition of the loss-making professional networking site LinkedIn in June 2016. Nadella claimed that the main aim was to exploit the data on LinkedIn's 433m users to "reinvent business processes and productivity" (Waters 2016). More prosaically, salespeople using Microsoft software could download LinkedIn data on potential leads to learn about their backgrounds, interests, and networks. Another aim may be to improve Microsoft's reputation and network in Silicon Valley (Hempel 2017).

Microsoft remains a powerful, highly profitable force and is undergoing rapid change under Satya Nadella. Nevertheless, since the millennium it has been increasingly overshadowed by the GAFSA companies.

Apple

Apple began as a personal computer company, but, as discussed earlier, lost out to Microsoft and Intel in that market. Its subsequent success, making it the world's most valuable public company today, stems from its mobile devices and ecosystem, especially the iPod and iTunes (2001), iPhone and iOS (2007), App Store (2008), and iPad (2010).

The launch of the App Store created a classic two-sided market. Consumers bought iPhones because iOS had the best apps, and developers prioritized iOS because it offered the best addressable market: compared with users of other platforms, iOS users spent more on apps and the devices they owned were more uniform, reducing app development costs.⁸ Underpinning all this was Apple's aesthetic and technical design edge, distinctive branding, and positioning as user-friendly rather than nerdish. The iPhone is also a personal device, not aimed at companies, as PCs were initially, increasing the scope for premium pricing.

Since 2010, Apple has sustained and extended its ecosystem by constantly adding new products (e.g., Siri and Watch) and features, driving repeated user upgrades to the latest device version. The breadth and quality of the user experience is also encouraging some PC users to switch to Macs. Finally, Apple's store network gives it a direct route to market, protects

8. Also, because iOS was based on the Mac operating system, Mac developers were able to write software for it with minimal retraining.

it from being squeezed by other retailers, boosts its brand exposure, and enables it to provide a superior, walk-in customer service.

Neither the iPod, nor the iPhone, nor the iPad was the first product in its category, but each met real consumer needs and delivered a much better user experience than the competition. Together with Apple's design edge and relentless incremental innovation (Barwise and Meehan 2011, 99–100), this has enabled the company to charge premium prices and turn its products into status symbols. Some, such as the Watch, have struggled to justify their premium prices, but the recent addition of contactless technology to the iPhone is encouraging retailers to adopt contactless payment terminals: Apple aims to use the scale of iPhone ownership to create an interactive environment for the Watch, justifying its high price, as the iPod and iTunes prepared the ground for the iPhone.

Apple is the world's most profitable public company and still dominates the premium end of the smartphone and tablet markets. However, as the rate of iPhone improvements slows and it runs out of new markets to conquer, it is increasingly turning toward its services to drive profits, including its commissions on app sales and in-app purchases in free-to-play games (Thompson 2017a). Meanwhile, it is constantly fighting the threat of hardware commoditization. The main company behind that threat is Google.

Google

Because the Internet is unimaginably vast, its value depends crucially on users' ability to find what they are looking for. In the early 1990s, the number of websites became too large for a simple index. By 1994, there were dozens of commercial search engines aiming to meet this growing need, using the relative "density" of the search terms (keywords) on different sites—a simple measure of relevance—to rank the results. They had a range of business models, all directly or indirectly based on display advertising.

Google began in 1996 as a research project by Stanford PhD students Larry Page and Sergey Brin. Page and Brin's key insight was that, from a user perspective, search results should be ranked by each site's importance as well as its relevance, reflected in the number and importance of other sites that linked to it. The resulting PageRank technology (named after Larry Page) was a big driver of their subsequent success, but far from the whole story. Page and Brin incorporated Google in 1998 with funding from angel investors including Amazon founder Jeff Bezos. In early 1999, Excite

turned down an offer to buy it for \$750,000, but by June that year, it had attracted \$25m in venture capital (VC) funding.

Its initial business model was based on sponsorship deals sold by sales reps on Madison Avenue. The breakthrough came in October 2000, when it started selling search advertising using its AdWords system, with advertisers bidding for keywords in real time. This auction, combined with cookie-based personalization, still determines which adverts each user sees and their ranking on the page.⁹

From the launch of AdWords in 2000, Google was a textbook success based on network externalities—literally: that same year it hired as chief economist Hal Varian, who coauthored the key book, Shapiro and Varian (1999). It succeeded by meeting the needs of both markets better than the competition. Users received the most relevant and important search results quickly and at no cost, on an attractive, uncluttered page with no distracting pop-up or banner ads. The only advertisements were short, text-based, relevant, and clearly distinguished from the natural search results. Meanwhile, advertisers received an efficient, highly targeted way of reaching potential customers actively looking for information using specific keywords. They could pay per click or even per customer acquired, increasing accountability and reducing risk. Marketing investment rapidly shifted from other media like print classifieds, leading to dramatic revenue and profit growth. Page and Brin hired Eric Schmidt as CEO in 2001. Three years later, Google's initial public offering raised \$1.67bn for about 7% of the company, giving it a market capitalization of over \$23bn.

Big data and machine learning lie at the heart of Google's strategy. The more data it has about each user, the better it can understand the context and intention behind every search and serve relevant results and well-targeted advertising. Thanks to its expertise in artificial intelligence (AI) and natural language processing, users can now input direct questions rather than just search terms, and receive increasingly intelligent answers.

To support its core business, Google has developed many other free services such as Chrome, Android, and Gmail, with Google Accounts unifying each user's activity. The data generated by each service is used to enhance all of them and to improve advertising targeting, while the services also direct users to each other. Google further exploits its data by buying display advertising inventory from third party sites, adding its own data on

9. Google did not invent this approach. Overture (originally GoTo), another start-up, had successfully launched a version of real-time bidding for keywords in 1998 (Battelle 2006, 125).

those sites' visitors, and selling the integrated data—at a premium—to advertisers looking to reach those users. Through Google Cloud Platform (GCP), it also sells infrastructure capacity to other businesses.

Google's ability to create superior, free, widely accessible services creates a high barrier to market entry, as Microsoft and others have discovered. A rival has to run large initial losses and encourage users to switch to it despite its initial inferiority. Apple Maps is one recent attempt, only possible because Apple made it the default on iOS.

Google's video platform, YouTube, is a big business in its own right, with estimated annual revenue of \$4bn. But it is still reckoned to be loss-making because of its high costs: uploading, indexing, and storing over 50 hours of new video every minute; supporting several billion video views each day; paying content partners; plus R&D, advertising sales, and so forth (Winkler 2015). YouTube is a long-term investment aimed at capturing viewing and revenue from both traditional broadcasters and online-only players such as Netflix. Meanwhile, it too generates valuable data.

Since 2000, Google's most important move has been the 2008 launch of Android, aimed at ensuring that neither iOS nor Windows Mobile became the dominant operating system in a world of billions of mobile devices. Google made Android open source and collaborated with technology and service companies to make it the main global standard, giving Google an even bigger lead in mobile search (a 95% share in May 2017) than in desktop search, where Microsoft (Bing), Baidu, and Yahoo each have shares of 5%–8%—still an order of magnitude less than Google's 78% (Netmarketshare 2017).

In 2015, Google reorganized as Alphabet, a holding company with the core business as its main subsidiary. Alphabet's triple-class share structure enables Page, Brin, and Schmidt to take a long-term view, ignoring investor pressure for short-term returns. Other Alphabet subsidiaries include Waymo (self-driving cars), Nest (home automation), DeepMind (AI), Verily and Calico (life sciences), Sidewalk (urban infrastructure), and two VC funds. Alphabet aims to maximize synergies between these businesses. For instance, DeepMind provides cutting-edge machine-learning capabilities across the group and is also made available to others through GCP (Google Cloud Platform) and Google Assistant. Recently, Google's core business has also sought to develop new revenue streams that reduce its dependence on search advertising, launching devices such as the Pixel smartphone and the voice-activated Google Home hub.

Overall, Google remains unassailable in search and is making big bets in a wide range of other, mostly new, product markets.

Facebook

Facebook began in 2003 as Thefacebook.com, undergraduate Mark Zuckerberg's online version of Harvard's printed "facebook" of student mugshots. It drew on ideas from other early social networking sites such as Friendster and Myspace but, unlike them, accepted only people who registered in their own names and with a Harvard.edu web address. It was soon rolled out to other US colleges, funded through online advertising and investment by Zuckerberg's friends and family.

In July 2005, NewsCorp bought Myspace, the early market leader with 21 million users, for \$580m. Arguably, Myspace was already vulnerable because of its cluttered interface and other weaknesses, but NewsCorp then failed to invest in it and overloaded it with advertising, allowing Facebook to overtake it in unique global visitors in April 2008 (Albanesius 2009). Facebook kept growing, while Myspace went into decline: NewsCorp sold it for an estimated \$35m in 2011.

Facebook has two key features as a social network. First, for someone to add a "friend," both sides must agree. Second, its default assumption is that content posted by users is visible to all their "friends" unless one or both parties opts out. By creating engaging content at little cost to the company, users themselves generate the audience, which Facebook then monetizes by inserting targeted advertising among the posts. This model is highly scalable because variable costs are relatively low—mainly just more data centers and servers. Users' interactions and other behavior on the platform also generate extensive data for service improvement and advertising targeting.

Facebook's success has created its own challenges, however. As users' networks expand, content from their close current friends can be swamped by posts from "friends" who mean less to them, creating a need for algorithms to match users with the content most likely to engage them and with the most relevant advertisements. Adding "friends" from different personal networks (such as school, work, and—notably—parents) can also lead to self-censorship, further reducing the consumer value. To manage this tension, Facebook now has ways for users to post to user-defined groups within their networks and is reducing its dependence on user-generated content (UGC) by increasing the flow of professionally generated content (PGC)—news articles, opinion pieces, videos. Facebook is an increasingly important channel for PGC, although many producers are in a tug-of-war with it: they want engagement on Facebook to lead users onto their sites; Facebook wants to keep them on Facebook.

Facebook's pitch to advertisers is based on its huge reach and usage, highly targeted display advertising, and measurable short-term responses. By filling out "profiles" and following things they find interesting, users generate key targeting information. Facebook also increasingly enables social and psychological targeting: identifying which users are most central and influential within their social networks and when they are most likely to be receptive to specific advertising messages. However, both Facebook and Google have been criticized by advertisers for their unreliable, unaudited audience measures and other problems (Barwise 2017).

In March 2016, 79% of online US adults were active Facebook users, well ahead of Instagram (32%), Pinterest (31%), LinkedIn (29%), and Twitter (24%) (Chaffey 2017). But Facebook's market leadership is less secure than Google's because, as already noted, users can be members of several social networks ("multihoming") and many younger users prefer newer sites such as Snapchat.

Other social media range from message platforms (e.g., Apple's iMessages, Facebook Messenger, and WhatsApp, acquired by Facebook for \$19bn in 2014), to specialist professional (LinkedIn, now owned by Microsoft) and short message networks (Twitter), to social photo- and video-sharing platforms such as Flickr, Instagram (also acquired by Facebook, in 2012, for \$1bn), Pinterest, and Snapchat (which Facebook also reportedly tried to buy, but was turned down). These alternatives all threaten to draw valuable users away from Facebook by offering slightly different services. For instance, Snapchat is designed for more private, intimate, and fun interactions: the audience is selected-in and the default is that messages auto-delete. Where Facebook is unable to buy out a promising rival, it usually tries to copy its features: recent examples are Instagram "Stories," Facebook "Messenger Day," and WhatsApp "status," all emulating Snapchat "Stories" with growing success.

Amazon

In 1994, Jeff Bezos quit his well-paid job as a 30-year-old high-flier at a Wall Street hedge fund to found Amazon. Bezos, who remains chairman, president, and CEO, chose the name Amazon because it sounded exotic and started with an A—an advantage if it appeared in an alphabetical list—but also because the Amazon is the world's biggest river in terms of water flow and he wanted his business to be the world's biggest online retailer, which, in revenue terms, it is.

His core strategy was—and is—to build a dominant market share and brand in the consumer markets most suited to e-commerce; squeeze suppliers' prices; and reinvest the profits in price cuts, marketing, customer retention, transaction handling, and physical and digital distribution. In line with this, Amazon has consistently prioritized long-term growth over short-term profit: the prospectus for its 1997 IPO specifically said that it would “incur substantial losses for the foreseeable future” (Seglin 1997).

Bezos started with books because they were a good fit with online retailing: a huge number of low-ticket, standardized, easy to distribute products with a preexisting inventory, enabling him to launch quickly and offer many more titles, and at much lower prices, than even the largest physical bookshop. Bookselling also generated data on affluent, educated shoppers (Packer 2014). Over time, more and more product categories have been added as Amazon has refined its seamless online shopping experience and increasingly efficient distribution system.

Amazon's customer loyalty scheme Prime, first launched in 2005 in the United States and currently reaching 64% of US households (Hyken 2017), is now central to its business model. For a fixed fee, currently \$99/year or \$10.99/month in the United States, it offers subscribers unlimited free one- or two-day delivery (depending on the area), Amazon Video, Prime Music, unlimited photo storage, and other services. Rapid delivery encourages users to switch purchases from other retailers. Both Prime and the digital devices it sells at or below cost (the Kindle, Kindle Fire, Fire TV, and Echo home assistant) are aimed at making Amazon consumers' default e-commerce option. Amazon also advertises on TV, Google, and Facebook, and on many smaller websites through its affiliate link program. It has also acquired consumer guide sites such as Goodreads and IMDb, in which it has embedded “buy from Amazon” links and from which it also collects user rating data.

All this reinforces its core business model: relentless retail sales growth leading to increasing economies of scale in R&D, procurement, machine learning, marketing, and logistics. It then uses its superior capabilities not only to acquire more retail business but also to rent out infrastructure to other businesses: marketplace sellers pay to use Prime to deliver their goods, and businesses of all types buy cloud-based computing from AWS. Amazon Web Services is the most profitable part of the company: in the three months to March 31, 2017, it had an operating income of \$890m, 24% of its \$3.66bn revenue (Amazon 2017). Amazon Web Services sells both to Amazon itself (it grew out of a 2005 restructuring of the company's backend technology) and, increasingly, to others, making it the leading

supplier in the fast-growing cloud services market, followed by Microsoft (Azure), Google, IBM, and Oracle (Columbus 2017).

Amazon has substantial and still-growing market power as both a buyer and a seller. As the range of products it sells expands, users are now going straight to it to search for them, bypassing Google and enabling it to sell search advertising. Although the volume of searches is relatively small, they have the potential to generate disproportionate advertising revenue as they increasingly replace Google's most valuable searches, where consumers are actively looking for products. Amazon has more first-party consumer purchase data than any rival, to improve targeting, and can link both search and display advertising (e.g., on Amazon Prime Video) to actual purchases. Although still a relatively small player in digital advertising, it may challenge Google and Facebook in the longer term (Hobbs 2017).

Closely linked to Amazon's strategy and business model is its ultracompetitive company culture. Bezos's annual letter to shareholders always includes a copy of his first such letter in 1997, which famously said, "This is Day One for the internet." The aim is to keep behaving as if every day were still Day One. Amazon's distribution centers are nonunionized and increasingly automated, and it is testing drones and self-driving vans to reduce delivery costs. Accusations of exploitative labor management in its warehouses find their corollary in office staff also constantly monitored and required to work under unrelenting pressure. Those who survive this "purposeful Darwinism" receive few perks but benefit from a financial package heavily weighted toward stock options (Kantor and Streitfeld 2015).

Amazon has also been accused of anticompetitive activities including price discrimination and delisting competitors' products, such as Google Chromecast and Apple TV in 2015 and Google Home in 2016. Khan (2017, this volume) gives several examples of Amazon allegedly exploiting its market power in anticompetitive ways: predatory pricing of best-selling e-books; using its buying power and Fulfillment-by-Amazon (FBA) and its extensive data to create unfair advantage over retail competitors.

Amazon's dominance of consumer e-commerce outside China looks unstoppable. Its leadership in cloud-based computing, through AWS, seems almost as secure. As already noted, AWS's inside view of its clients' businesses gives it a strategic competitive advantage, especially in deciding which tech start-ups represent significant threats or investment opportunities. With the easiest product categories already covered, core revenue growth has slowed and the remaining categories are by definition harder, but Amazon is betting on game-changing innovations like drone delivery to reduce distribution barriers for these categories.

Amazon in 2017 announced a \$13.7bn takeover bid for the upmarket US grocer Whole Foods. This was its largest ever acquisition. Analysts disagree about the strategy behind this move and its chances of success, but it clearly represents a move toward integrated “omnichannel” retailing combining on- and offline channels and covering even more product and service categories including perishable groceries—an extremely challenging category. The shares of US store groups fell sharply on the announcement.

WILL THE MARKET END THE TECH GIANTS’ DIGITAL DOMINANCE?

In the first section of this chapter, we discussed a range of generic factors that make the tech giants’ markets winner-take-all:

- Economies of scale;
- Strong user brands and habitual usage;
- Attractiveness to talent (“employee brand equity”);
- Direct (within-market) network effects;
- Indirect (cross-market) network effects;
- Big data and machine learning;
- Switching costs and lock-in;
- Corporate strategies and cultures.

In the next section, we showed how each company has indeed come to dominate its market(s) in ways that reflect these winner-take-all factors.

Evans and Schmalensee (2016b) partly dispute this view. They argue that “winner-takes-all thinking does not apply to the platform economy,” at least for Google and Facebook, on the grounds that—although they dominate consumer search and social networking, respectively—in the advertising market they have to compete with each other and with other media. We disagree. Google and Facebook do, of course, have to compete for advertising. But advertising media are not homogeneous: advertisers use different channels for different purposes. Google completely dominates search advertising and Facebook has a dominant, and still growing, share of online, especially mobile, display advertising. Because marketing budgets are finite, they do compete indirectly against each other and against other advertising media—and other ways of spending marketing money (promotions, loyalty schemes, etc.)—just as all consumer products and services indirectly compete for consumers’ expenditure. But advertisers have no credible substitutes of comparable scale and reach as Google in search and

Facebook in online display advertising. The fact that they continue to use them despite the numerous problems that have been highlighted (fraud, audience measurement, etc.) reflects this lack of choice. Leading marketing commentator Mark Ritson (2016) described the emergence of the “digital duopoly” as the single biggest UK marketing issue in 2016—adding that he expected it to become even worse in 2017.

It is hard to see another company any time soon overtaking Google in search, Microsoft in PC software, or Amazon in e-commerce and cloud computing. Facebook’s lead in social networking looks almost as strong, despite the potential for users to “multihome” and its recent problems with audience measurement and so forth. This bullish view is reflected in these companies’ high Price/Earnings (P/E) ratios in Table 1.1, showing that the financial markets expect their earnings not only to withstand competitive pressures but also to continue growing faster than the market average for the foreseeable future. Some of this expected future growth presumably relates to the perceived long-term potential of their noncore activities, perhaps especially in the case of Alphabet, but it is hard to see how P/E ratios of 30-plus could be justified if their core businesses were seen as being under significant competitive threat.¹⁰

Apple’s lower P/E of 16 reflects its lower expected future growth rate as Samsung and other Android manufacturers gradually catch up with the quality and ease of use of its devices and ecosystem, boosted by the growing superiority of Google services such as Assistant, reflecting the high penetration of Android and Google’s lead in AI (Thompson 2017a). As Apple is increasingly forced to include Google’s services in its ecosystem, its price premium over Android devices—the big driver of its high margins—is likely to be eroded.

Of course, whether—and if so, how soon—this happens will depend on Apple’s continuing ability to come up with new, better products, content, and services to reinforce its dominance of the market for premium-priced mobile devices. In the wider mass market for mobile devices, Android is already the global standard, accounting for 82% of new smartphones shipped in 4Q16, versus 18% for iOS (Vincent 2017). On the plus side, Apple has an outstanding track record in product quality, ease of use, design, and branding. As the number of different types of device continues to proliferate—PCs (where Apple’s share is growing); mobile, wearable, and smart home devices; virtual and augmented reality (VR/AR); automotive,

10. Amazon’s P/E of 195 also reflects its strategy of reinvesting most of its profit to achieve additional long-term growth. This leads to a double whammy: artificially low short-term profits and high long-term growth expectations.

and so forth—Apple may be able to keep exploiting its ability to integrate devices and services into a superior, seamless user experience at a premium price.

In contrast, Google, Microsoft, and Amazon, like IBM before them, all fit the long-term pattern that dominant tech players are rarely displaced as market leaders in their core markets, because the winner-take-all dynamics are so powerful. Facebook’s position is almost as secure. Only Apple is in significant danger of seeing its margins squeezed by a gradual process of commoditization.

Competition beyond the Tech Giants’ Core Markets

For all five companies, the question remains whether, in line with the pattern discussed in the introduction, they will be *eclipsed* (as opposed to *displaced*) by a rival—either another large established player or a start-up—becoming the dominant provider of a new, important product or service that overshadows them. Microsoft has already been surpassed by Apple and Google in terms of profit and market capitalization (Table 1.1), and all five companies are acutely aware of the potential threats—and opportunities—presented by new product markets and technologies.

Major product markets currently of interest—in addition to Amazon’s recent move to transform grocery retailing through its Whole Foods acquisition—are transport, home automation, entertainment, healthcare, business, and professional processes, and a wide range of applications under the broad heading the “Internet of things” (IoT) that will generate even more data—and further increase society’s vulnerability to cyber attack. Key technologies include AI, voice and visual image recognition, VR/AR, cloud-based services, payment systems, and cyber security. All the tech giants are investing in several of these, both organically and through acquisition. Their access to vast amounts of user data makes them well placed to spot trends early, and their scale and profitability give them plenty of capacity to invest in and acquire new businesses and technologies.

The only national market of comparable scale to the United States is China. Chinese retail e-commerce is booming, with an estimated value already more than double that in North America: \$899bn versus \$423bn in 2016 (eMarketer 2016). Chinese tech companies operate under tight government controls and a constant threat of having their activities curbed, but benefit from protection from foreign competition and a somewhat cavalier view of privacy, data security, corporate governance, and intellectual property (not unlike the United States in the 19th century), although

Intellectual Property protection may improve as they build up their own patent portfolios and brands. China’s “big four” tech companies are Tencent (mobile messaging and other content and services), Alibaba (e-commerce, digital entertainment, and cloud), Baidu (search and AI), and Huawei (mobile devices). Reflecting broader differences in business culture, Chinese tech companies tend to be less focused than those based in the United States, but the two are starting to converge as the top US tech groups diversify beyond their core businesses (Waters 2017).

We can expect to see more Chinese tech successes over the next 10 years, increasingly based on innovation as well as imitation and with growing international sales, in competition with the US players. However, their current activities are still largely focused on Greater China and there is no realistic prospect of their offering a serious challenge to the United States elsewhere in the next few years.

If anyone does overtake one of these companies in the next few years, it is more likely to be also based in Silicon Valley or Seattle. In *The Death of Distance* (1997), *The Economist*’s Frances Cairncross predicted a sharp reduction in the economic importance of geography. This has not happened. In addition to the top five companies by market capitalization discussed here, three of the other nine tech firms in the global 100 most valuable public companies—Oracle, Intel, and Cisco—are also based in Silicon Valley.¹¹ Beyond the United States, there are just four Asian companies and one European one on the list.¹² So, including the top five, eight of the world’s top 14 public tech companies are based in or near Silicon Valley. No other country has more than one (although other Chinese tech giants will doubtless soon join the list).

Silicon Valley is also the leading cluster for tech start-ups. Of the top 50 global tech “unicorns”—companies founded after 2000 with a valuation over \$1bn—at the time of writing, 21 are US-based. Sixteen of these are in Silicon Valley, including Uber, Airbnb, and Palantir (big data analytics) ranked 1, 4, and 5, respectively (CB Insights 2017). The other five are scattered around the United States: even America has only one Silicon Valley.¹³

In conclusion, with the partial exception of Apple, the tech giants seem unlikely to lose their dominance of their core market(s) any time soon,

11. The only other US company on the list is New York-based IBM.

12. Tencent (China), Samsung (Korea), Taiwan Semiconductor, Broadcom (Singapore), and SAP (Germany).

13. For the various reasons for Silicon Valley’s dominance, see Hafner and Lyon (1998), Mazzucato (2015), Porter (1998), Bell (2005), Garmaise (2011), and Ben-Hahar (2016).

although they all, to varying degrees, face competitive threats at the margin. They are at greater risk of being overtaken by another company building a dominant share of a new, bigger, market. If and when that happens, the successful rival—either another tech giant or a start-up—is also likely to be based in Silicon Valley.

Do We Have a Problem?

How concerned should we be that market competition is unlikely to end Google, Microsoft, Facebook, and Amazon’s dominance of their core markets in the foreseeable future? That market dominance brings many benefits to consumers and other businesses. Current competition regulation is designed to prevent firms from using their market power to charge higher prices, or offer lower quality, than would prevail in a competitive market. It is unsuited to a platform context where, in Google’s case, consumers pay nothing and advertisers have a highly effective tool that did not exist 20 years ago and for which they pay a competitive, auction-based market price. Of course, incumbent industries disrupted by tech-based platforms (hotels by Airbnb, taxis by Uber, etc.) complain and highlight their real and imagined negative impacts. But much of this is just a normal part of disruptive innovation: the victims of creative destruction don’t like it.

On this basis, there are good arguments for light-touch, perhaps technology-specific, regulation of platform businesses (Laffont and Tirole 2000) but not, in our view, for no regulation at all. Parker, Van Alstyne, and Choudary (2016, 239–53) list a wide range of reasons why we need “Regulation 2.0” for these markets: concerns about platform access, fair pricing, data privacy and security, national control of information assets, tax, labor regulation, and potential manipulation of consumers and markets. Similarly, Khan (2017, this volume) argues for more sophisticated regulation to address a range of anticompetitive behaviors. To this list we might add concerns about cyber security, digital advertising (fraud, mismeasurement, etc.), the impact of fake news, the decline in professional journalism, and the contribution of social media to political polarization (Barwise 2017). Finally, recent research suggests that the inequality between firms in winner-take-all markets, including tech, is one of three big drivers of growing income inequality (the other two being outsourcing and IT/automation: Bloom 2017).

The responses to-date differ between Europe and the United States. European antitrust legislation focuses on ensuring fair competition (reflected in the Commission’s recent €2.4bn fine on Google for

“systematically” giving prominent placement in searches to its own shopping service and demoting rival services), whereas US legislation focuses more narrowly on whether market dominance leads to demonstrable consumer harm (Khan 2017, this volume; Thompson 2017b). Because the dominant tech platforms are all US-based, this is likely to be an area of growing transatlantic conflict.

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