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THE ROLE OF DIGITAL PLATFORMS IN SHAPING TECH VENTURE INNOVATION

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ABSTRACT

This chapter examines the multifaceted interactions between top digital platforms and technology ventures across capital, labor, innovation, and product markets. Exploring how venture investments, talent flows, strategic alliances, and competitive behaviors can shape the innovation ecosystem, the chapter highlights both the complementary and competitive dynamics between large incumbents and smaller entrants, and the benefits and potential inefficiencies that may arise from them, as demonstrated by the empirical and theoretical literatures. Throughout, the chapter identifies key areas for research that can support a rigorous evaluation of policy proposals concerning evolving market structures in the digital economy.

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1. Introduction

As information and communication technology (ICT) facilitates digital platforms in overcoming geographic and language barriers, the contrast between large digital platforms (commonly referred to as "big tech") and smaller technology ventures has become increasingly pronounced. This divergence has fueled ongoing debates regarding whether and how public policies should adapt to address the complex dynamics between them.

In this chapter, we emphasize that the interaction between big tech and technology ventures is inherently multifaceted. These entities may not only compete for final consumers but may also act as partners, complements, or participants in up- or downstream relationships at various stages of a venture's lifecycle. Drawing on research across multiple disciplines, we aim to provide a comprehensive perspective on the intricate relationships between big tech and technology ventures. Given the interconnected nature of these relationships, we suggest that public policies should consider this broader context when addressing specific interactions among these entities.

The remainder of the chapter is structured as follows. In Section 2, we define the terms "technology ventures" and "top digital platforms," and introduce a conceptual framework that outlines the lifecycle stages during which technology ventures may engage with digital platforms. Sections 3 and 4 summarize the interactions between technology ventures and top digital platforms in the markets for capital and labor, which are critical factors in a venture's success. Sections 5 and 6 examine the primary ways in which technology ventures interact with top digital platforms in the domains of innovation development and the final product market. Section 7 concludes with a discussion of future research directions and policy considerations.

2. Definition and Conceptual Framework

Classifying industries by technology is inherently challenging due to the constant evolution of technology. The U.S. Bureau of Labor Statistics (BLS) identifies high-tech industries as those where the share of STEM jobs is at least two and a half times the national average.[1] Using this criterion, 33 of the 206 industries defined by the North American Industry Classification System (NAICS) are classified as high-tech, contributing to approximately 12% of jobs and nearly 23% of output in the U.S. economy as of 2014 (Wolf and Terrell 2016). Alternatively, the Organization for Economic Co-Operation and De-

[1]STEM refers to science, technology, engineering, and mathematics.

velopment (OECD) uses R&D intensity, defined as R&D expenditure divided by gross value added, to identify high-tech industries. By this metric, high-tech industries include three manufacturing sectors (air and spacecraft, pharmaceuticals, and scientific research and development) and two service sectors (software publishing, and computer, electronic, and optical products) (GalindoRueda and Verger 2016).

Incorporating both STEM jobs and R&D intensity, Wu and Atkinson (2017) zoom into 10 technology-based industries.[2] They find that firms in these technology-based industries make up only 3.8% of all businesses but contribute disproportionally to R&D investment, R&D jobs, and exports in the U.S. economy. Within these 10 technology-based industries, they further highlight the role of startups. Defining startups as firms that are 10 years old or younger, they find that the total number of startups increased by 47% from 2007 to 2016, total employment increased by 20%, and their share of all technology-based employment increased from 31% to 33%. Furthermore, in comparison to all industries in the economy, they find that technology-based startups have, on average, a lower fifth-year survival rate, but roughly 6% of technology-based startups experience more than 25% employment growth year-to-year and these high-growth startups contribute to one-eighth of new jobs added to the economy every year.

More broadly, according to Decker et al. (2014), both the entry rate of firms (measured by the number of new firms divided by the total number of firms) and business dynamism (measured by the pace of job creation and job destruction) have declined in the U.S. since the 1980s, though the decline in high-tech industries (defined by the share of STEM jobs) only began after 2000 (Haltiwanger, Hathaway and Miranda 2014). Another common pattern is an up-or-out dynamic concerning startups, where young firms with high productivity (and high profitability) grow, whereas low-productivity firms contract and exit, and a small fraction of high-growth firms account for nearly all of the job losses associated with shrinking and exiting firms within their cohort (Decker et al. 2014).

A potential explanation for the mixed picture of startup dynamics is globalization and advances in information and communications technology (ICT). Arguably, ICT enables large, multinational firms to coordinate production and distribution networks in multiple locations, which then reshapes the incentives and dynamism of entrepreneurial activities across all sectors using ICT.

Based on these observations, we refer to technology ventures as firms operating in

[2] Namely pharmaceutical manufacturers, medical device manufacturers, computer and electronic manufacturers, semiconductor machinery manufacturers, semiconductor component manufacturers, aerospace manufacturers, data processing services, computer systems and design services, software publishing services, and R&D-performing services.

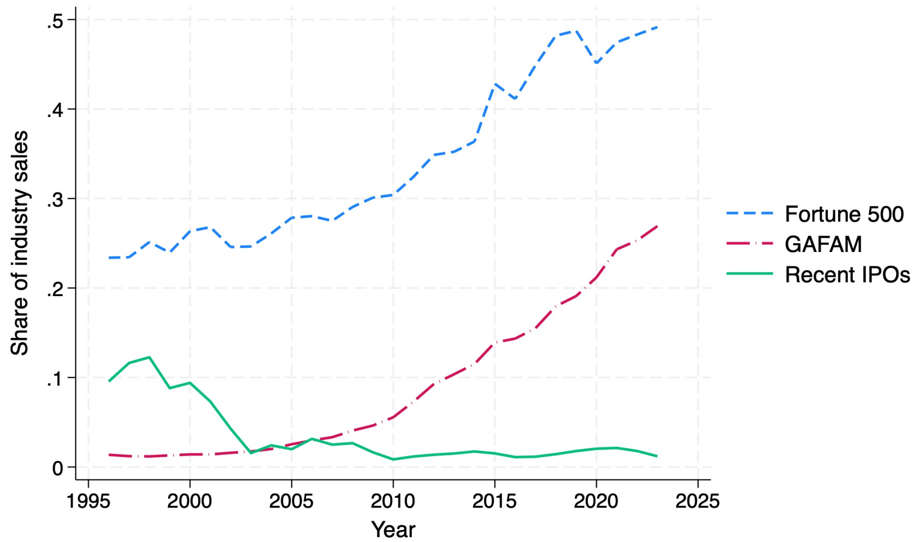

Figure 1. Big companies in ICT-intensive sectors are getting bigger (based on Compustat data for public firms listed in North America)

the high-tech industries (defined by either the share of STEM jobs or R&D intensity) that primarily use ICT. Naturally, many of them fall in "information" or "professional, scientific and technical services" by two-digit NAICS codes, but some of them may apply ICT to more traditional sectors and thus appear in retail trade, transportation and warehouse, finance and insurance, real estate, and other sectors in public filings.

The definition of "big tech" is even fuzzier. Instead of using an arbitrary threshold on some financial metrics, we use some empirical data to illustrate the relative importance of large firms in ICT-related sectors.

Leveraging firm-level data on sales from Compustat, we first identify a list of twenty 4-digit NAICS codes representing ICT-intensive sectors, ranging from hardware to software, telecommunications, and information services. Specifically, the vast majority (16) of these codes belong to the "Information" sector (two-digit NAICS code 51), while the remaining codes include "Professional, Scientific and Technical Services" (two-digit NAICS code 54), as well as "Manufacturing" (two-digit NAICS code 31-33). Finally, we also consider the 6-digit code "455219" which includes several online retailers such as Amazon. Using these identified categories as the overall basis for technology ventures in the ICT-intensive sectors, Figure 1 shows the share of sales of Fortune 500 companies within this base, the share of sales of Alphabet/Google, Apple, Meta/Facebook, Amazon, and Microsoft (so-called GAFAM), and the share of sales of all recent initial public offerings (IPO) from 1996 to 2023. We refer to an IPO as "recent" within the first two years following the year of the firm's IPO. Our calculation is based on Compustat, and thus limited to firms publicly traded in stock exchanges in North America.

In the past 28 years, both the sales share of Fortune 500 firms and the more specific share of GAFAM firms have increased substantially, while the share of recent IPOs has dropped from more than 10% in 1998 to 1.2% in 2023. Part of this is driven by a steady decline in the number of IPOs over time (Gao, Ritter and Zhu 2013; Huang, Ritter and Zhang 2023). However, independent of whether we define "big tech" as GAFAM or as all Fortune 500 companies that operate in ICT-intensive sectors, it is undeniable that many big tech companies have become larger over time, conditional on being publicly traded in North America and Canada.

Many of these big tech companies provide intermediary services that connect online or offline users on multiple sides (such as buyers and sellers, users and advertisers, game players and game developers, riders and drivers, guests and hosts), and thus satisfy the definition of constituting a platform per Rochet and Tirole (2003). As intermediaries, they define the ecosystems in which smaller technology ventures innovate, monetize, and serve final users.

In this chapter, we define "top digital platforms" (TDPs) as companies that serve as critical gateways for business users to reach end-users while maintaining entrenched and durable positions. This definition aligns with the "Gatekeeper" designation in the European Digital Market Act (DMA), which evaluates firms based on their market impact, gateway status, and entrenched position.[3] However, we do not necessarily limit TDPs to the relatively few gatekeepers designated by DMA. By definition, TDP companies themselves are technology firms or have a significant technology-related aspect, and they may be publicly listed or stay privately owned. In the remainder of the chapter, we refer to technology ventures (exclusive of TDPs) as TechVs and focus on the interaction between TDPs and TechVs.

Consider each TechV as being associated with a production function, with its main inputs being capital and labor, where labor can include the co-founders, key employees,

[3]Specifically, the DMA (available at: https://digital-markets-act.ec.europa.eu/about-dma_en) designates a firm as a gatekeeper when it meets three qualitative criteria: (1) it has significant impact on the EU market; (2) it provides a specified service that is an important gateway for business users to reach end-users; and (3) it enjoys an entrenched and durable position (or it is foreseeable that it will enjoy such a position in the near future). As of May 13, 2024, the Commission's designations confer gatekeeper status on 24 "core platforms services:" Alphabet (Google Maps, Google Play, Google Shopping, Youtube, Google Search, Google (ads), Google Chrome and Google Android), Meta (Facebook, Instagram, WhatsApp, Messenger, Meta Marketplace and Meta), Apple (App Store, Safari, iOS, and iPadOS), Amazon (Amazon Marketplace and Amazon (ads)), ByteDance (Tiktok), Microsoft (LinkedIn and Windows PC OS), and Booking (Booking.com). Therefore, more than one gatekeeper has been designated for certain services.

and hired workers, and capital can include financial resources as well as the technology inputs that the TechV already owns or could purchase or license. The outputs could be technological innovations in the form of patents and other intellectual property (IP) or final products and services targeting businesses or individual customers.

As illustrated in Figure 2, a TechV can interact with TDPs in each market of these inputs and outputs. As far as inputs, TDPs and TechVs can be natural complements in capital and labor: large, established TDPs have more financial resources but may or may not have the right human capital for their vision of future innovation and business, whereas young, smaller TechVs may have key talents with new ideas but lack capital to develop and commercialize their ideas. As a result, TDPs can invest in TechVs and nurture their growth. Alternatively, TDPs may compete with TechVs for the same talent or even acquire them to access key employees. On outputs, TDPs may collaborate with TechVs to develop innovations, and acquire new technology from TechVs via licensing or buy-outs. They can also collaborate to commericalize innovations, or act as competitors, complementors, or partners to each other in the market for final products and services.

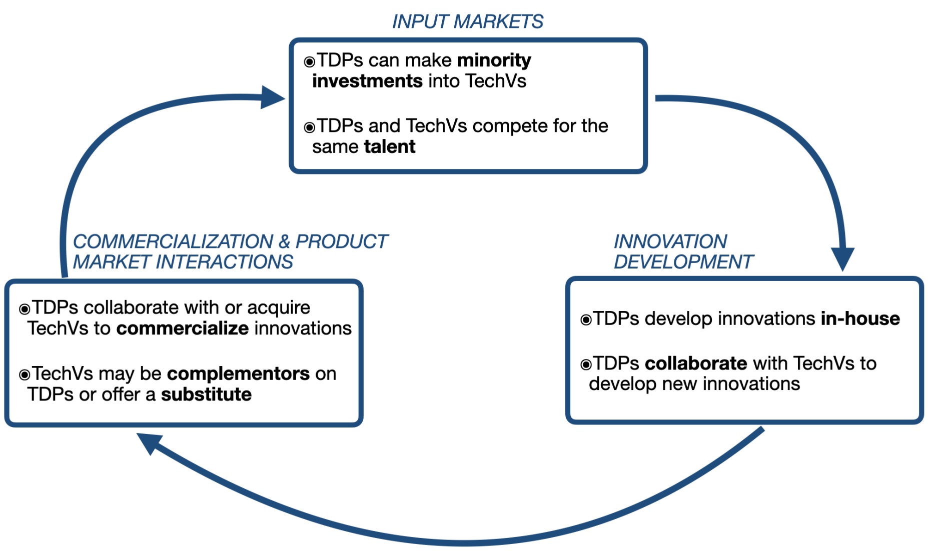

Figure 2. Interactions Between TDPs and TechVs

These interactions are dynamic: not only can they occur before, during, or after a TechV develops and/or commercializes a product, but interactions in the early stage of the TechV could also depend on what future interactions are expected to occur (or not occur) in the later stages of product development and commercialization. For example, whether and how a TDP may collaborate with the TechV during its innovation development may depend on the extent to which the TDP has invested in the TechV before it starts to innovate, and whether and how the two compete in the final product market may depend on their relationship in the initial funding and development stages. Over time, successful small TechVs may grow and become TDPs, while some large, established TDPs may shrink and become out-of-date.

3. Interactions in the Market for Capital

A TechV and a TDP may interact in the capital market primarily in two ways. First, a TDP can invest in the TechV as a minority equity holder, leaving the founding entrepreneur or other investors in majority control. This investment structure often arises when the TechV is a relatively young startup. Second, a TDP may acquire the TechV and obtain majority control after the TechV has accumulated sufficient operating capital, made progress in R&D, developed commercializable products, or generated substantial revenue. Strictly speaking, only the first arrangement involves a capital-market input, although the potential for future acquisition by a TDP may motivate an entrepreneur to establish a TechV at the outset.

More specifically, some TDPs have their own venture arms that function as corporate venture capitalists (CVC). For example, Google established Google Ventures in 2009, which has invested in more than 500 portfolio companies including 23andme, Stripe, Uber, and Robinhood.[4] As far as we can discern, most of these portfolio companies are technology ventures, and some of them have already gone public and even become TDPs themselves.

As summarized by Gompers and Lerner (2001), CVC began to surge in the late 1990s, partly because outside venture investment may offer a superior alternative to the internal, centralized R&D process of a large corporation, and partly because CVC may help large corporations adapt to new information and communication technologies accompanying the internet's rapid expansion. Using a sample of over 30,000 transactions by corporate and other venture organizations, Gompers and Lerner (2000) show that CVCs are significantly different from traditional venture capitalists (TVCs) in organizational structure, objectives, investment behavior, and the range of services offered to portfolio companies. They find that ventures backed by CVC are more likely to go public than those backed by TVC, especially when there is a strategic overlap between the CVC and the venture.

[4]The full list of Google Ventures' portfolio companies can be found at https://www.gv.com/portfolio, accessed on December 25, 2024.

Applying propensity-score matching to a sample of venture-capital-backed IPOs from 1981 to 2000, Ivanov and Xie (2010) confirm that CVC-backed ventures tend to receive higher IPO valuations than TVC-backed ventures and higher takeover premiums when acquired. Moreover, they show that strategic CVC-backed ventures exhibit higher IPO valuations than TVC-backed IPOs that have strategic alliances with other corporations. This finding suggests that corporate venture investors and their portfolio companies may enjoy stronger complementarities in assets or operations, possibly because these ventures can tap the corporate parent's resources for growth and benefit from the parent's industry-specific knowledge. Such advantages may take the form of preferential customer or supplier relations, marketing, sales, and distribution agreements, or joint research and product-development projects. Furthermore, CVC may provide funding to riskier ventures that TVCs are reluctant to finance, and CVC-backed ventures tend to be more innovative (as measured by patent outcomes) even though they are younger, riskier, and less profitable than TVC-backed ventures (Chemmanur, Loutskina and Tian 2014).

A more recent analysis by Liu (2024) attempts to dig into the mechanisms by which CVC helps to improve the patenting and IPO outcomes of portfolio companies, finding that the effect of CVC is stronger when the corporate investor is located in more downstream positions of the funded companies; however, there is no conclusive evidence to support the claim that corporate investors supply patented knowledge to these ventures for product-development purposes.

While startups may benefit from corporate venture investments, the corporate investor may gain as well because CVC investments can provide a "window" into new technologies (Maula, Keil and Zahra 2013), an opportunity to learn from startup failures and refocus internal R&D (Dushnitsky and Lenox 2005), an option to access new technologies if a startup succeeds (Ceccagnoli, Higgins and Kang 2018), and improved ability to identify promising acquisition targets (Benson and Ziedonis 2009).

Even if corporate venture investment can benefit both the TDP as the corporate investor and the TechVs in which it invests, its social benefits—in terms of more TechVs being funded, increased innovation, and more efficient allocation of R&D resources within and without the TDP investor—need to be traded off against potential inefficiencies. For example, the TDP may steer the direction of development such that those innovations that cannibalize its existing products or profits are discouraged (Denicolò and Panunzi forthcoming); if IP protection is weak, the TDP may appropriate the value of the innovation at the cost of the TechV's co-founders (Dushnitsky and Shaver 2009), which discourages innovative startups in the long run; and the TDP may gain a competitive advantage by learning about future competitors and act upon such information to thwart future competition.[5] We will review related literature in Sections 5 and 6.

In short, corporate venture investments by TDPs in TechVs have the potential to yield substantial social benefits but may also produce anti-competitive effects and inefficiencies. Although these considerations are not unique to platform markets, TDPs remain among the largest corporate venture investors, and innovation is a key driver of market outcomes in their core business areas. These factors underscore the importance of examining the forces discussed above.

4. Labor Market Interactions

Skilled, creative labor is essential for R&D-intensive technology ventures. From a TechV's perspective, a TDP may either enhance or constrain this labor input.

On one hand, many entrepreneurs are former TDP employees. By working at a TDP, they may have acquired crucial knowledge about market demand, customer-supplier relations, technology know-how, and managerial skills before establishing a TechV. This experience may help them recognize potential innovations or new business opportunities that large incumbents cannot address efficiently for technical or organizational reasons. For example, an industry estimate finds that former Apple employees have founded 597 venture capital-backed companies with a collective value exceeding $180 billion.[6] Another industry report, which tracks the LinkedIn profiles of employees laid off by technology companies in 2022–2023, finds that 13% of them have started their own companies.[7] Among all former employers tracked, Meta has the highest share of laid-off employees who become entrepreneurs (33%), followed by DoorDash (30%), Amazon (25%), Flexport (24%), Twitter/X (16%) and Shopify (15%).

On the other hand, TDPs can poach valuable employees from TechVs. While such employee flows may facilitate knowledge diffusion, it may also reduce the TechV's ability to innovate and appropriate the value of innovations. Bessen, Poege and Röttger (2023)

[5] Evidence from surveying managers of CVC programs suggests that "exposure to new technologies and markets" is a top objective of CVC programs, enabling established firms to gain superior information about technological bets placed by venture capitalists and entrepreneurs and to be well positioned to monitor their outcomes (Yost and Devlin 1993; Alter and Buchsbaum 2000).

[6] Source: "Ex-Apple staff are behind hundreds of top tech startups" by Andrew Orr on 2023/6/15, available at https://appleinsider.com/articles/23/06/15/ex-apple-staff-are-behind-hundreds-of-top-tech-startups.

[7] Source: "From Layoff Victims To Founders: How 2022–2023 Layoffs Create The Startup Wave?" by Bizreport on 2024/11/28, available at: https://www.bizreport.com/business/from-layoff-victim-to-founders.

find that large firms' hiring in local labor markets has a significant "crowding out" effect on startups located in the same commuting zones: a standard deviation increase in the share of ads posted by large firms raises startup pay offers by 5-10% for critical managerial, STEM, and sales jobs, and it reduces expected startup growth by 36%. Combining the employment history of over 760 thousand U.S. inventors with job information from the Longitudinal Employer-Household Dynamics (LEHD) Program at the U.S. Census Bureau, Akcigit and Goldschlag (2023) find that inventors are increasingly concentrated in large incumbents, less likely to work for young firms, and less likely to become entrepreneurs. Moreover, when an inventor is hired by an incumbent, compared to a young firm, they find that the inventor's earnings increase by 12.6% and innovative output declines by 6-11%.

One channel that facilitates employment flows from small startups to large incumbents is personnel visibility enabled by digital platforms. In 2016, a policy change enabled GitHub users to display their contributions more accurately on their profiles. Following this update, Gupta, Nishesh and Simintzi (2024) find that employees with one standard deviation higher GitHub contributions are 5.7% more likely to transit jobs to larger firms, predominantly at the expense of smaller companies. Such departures are found to reduce employment growth and productivity for smaller firms that had more productive employees before the shock.

Because labor mobility can benefit employees but hurt firms that lose productive workers, some employers require new hires to sign non-compete agreements that bar them from working for competitors for a certain period after termination. These agreements are controversial:[8] in principle, strong enforcement of non-competes can enhance an employer's incentives to innovate and limit the leakage of business secrets. This may be particularly important for TechVs, which are especially vulnerable if a key employee departs with critical know-how.[9] However, non-competes may also curtail employee effort and reduce information flows, potentially misallocating innovative talent and deterring entrepreneurship. Empirical evidence suggests that non-compete agreements bolster large firms' market and employment shares (Kang and Flemin 2020) and hamper the ability of employees to leave established employers and launch new ventures (Starr, Balasubramanian and Sakakibara 2018).

[8]The controversy intensified after the U.S. Federal Trade Commission (FTC) proposed a rule in January 2023 to prohibit non-compete agreements comprehensively. The final rule, published in May 2024, exempted senior executives. A district court halted the FTC from enforcing the rule in August 2024, and the FTC appealed that order in September 2024. The legal proceeding is ongoing.

[9]See the concern raised in https://www.hcamag.com/us/specialization/employment-law/non-compete-clause-ban-will-have-disastrous-effect-on-small-business/438418.

An extreme way for TDPs to gain access to TechV talent is to acquire the TechV outright. This "acquihiring" may appeal to acquirers because direct hiring could be more expensive or limited by non-compete clauses. As Meta/Facebook founder and CEO Mark Zuckerberg stated in 2010, "Facebook has not once bought a company for the company itself. We buy companies to get excellent people."[10]

A few theoretical papers raise policy concerns over acquihiring. Bar-Isaac, Johnson and Nocke (forthcoming) suggest that acquihiring may boost large incumbents' monopsony power in specialized labor markets. Benkert, Letina and Liu (2024) analyze a setting where two incumbents compete in one product market, whereas a startup operates in a different market but employs workers who could enhance either incumbent's efficiency if hired. Their model shows that acquihiring may result in inefficient talent allocation by preventing the rival incumbent from hiring these employees. This form of "talent hoarding" can reduce consumer surplus and amplify job volatility for the acquihired workforce. Still, a ban on acquihires may depress entrepreneurship because the option to sell talent can be an attractive exit strategy for venture investors, thus encouraging initial TechV formation. Some empirical studies have examined how acquirers integrate and utilize acquired talent. Kim (2024) finds that acquired employees experience significantly higher turnover rates compared to regular hires. However, this gap shrinks when the target firm remains structurally separated from the acquirer. Moreover, Boyacıoğlu, Özdemir and Karim (2024) show that when a startup possesses disruptive—as opposed to non-disruptive know-how—the acqui-hired team is more likely to be retained and integrated as a whole into an existing business unit, with the startup's founder being assigned a senior position.

Firms competing in the same labor market may agree not to poach each other's employees. Such collusive, no-poach agreements often involve large, established firms. For example, in 2010-2013, U.S. Department of Justice and a civil class action lawsuit accused Apple, Google, Intel, Adobe, Intuit, Pixar, Lucasfilm, and eBay of conspiring not to hire each other's employees. All of the eight defendants are headquartered in Silicon Valley, and at least four of them are TDPs according to our definition. By 2015, the defendants had dissolved the no-poach agreements. Apple, Google, Intel, and Adobe settled the class-action lawsuit for $415 million, and the other defendants settled for $20 million.[11]

[10]Source: "Mark Zuckerberg: 'We Buy Companies To Get Excellent People' " by Nathaniel Cahners Hindman on 2010/10/19, available at https://www.huffpost.com/entry/mark-zuckerberg-we-buy-co_n_767338.

[11]See https://www.justice.gov/atr/case/us-v-adobe-systems-inc-et-alfortheDOJcase, and https://

Gibson (2024) compares worker compensation before and after the Department of Justice investigation and finds that no-poach agreements lowered salaries at the colluding firms by 4.8% and depressed stock-based compensation and job satisfaction. The effect on innovation appears mixed. Ferrés, Kankanhalli and Muthukrishnan (2024) show that inventor cross-flow rates among these colluding firms declined significantly relative to comparable non-colluding firms. These anti-poach firms produced more substantial innovation outputs in separate technological domains, especially in areas covered by the agreements; this pattern was reversed after the agreements ended. The result may follow from lower innovation costs and reduced information leakage between colluding firms.

Nonetheless, it is conceivable that no-poach agreements might encourage lower employee effort at colluding firms due to weaker compensation growth, hinder other technology companies' access to talent, and perhaps boost entrepreneurship by restricting the flow of workers between TDPs.[12]

Recent work by Herrera-Caicedo, Jeffers and Prager (2024) finds that no-poach agreements are more likely among firms sharing executives or board members ("common leadership"). The authors measure labor-market overlap via LinkedIn data and discover that one-third of publicly traded U.S. firms share a director or executive with at least one other public firm, often in the same industry. According to their analysis, common leadership raises the probability of a no-poach arrangement by 12%, underscoring the need for antitrust policy targeting labor inputs. Interestingly, Clayton Act Section 8 prohibits interlocking directorates between firms competing in product markets,[13] yet it does not apply to labor markets.[14]

Several open policy questions arise. First, because overlap in product markets may differ from overlap in labor markets, it is unclear how to measure and distinguish them in practice. This makes it hard to examine interactions between product and labor market competition and design regulations that effectively account for these interconnected dynamics. Second, the overall welfare effect of common leadership remains unclear:

fortune.com/2015/09/03/koh-anti-poach-order/ for a summary of the settlement in the civil suit.

[12]Several studies have examined the factors driving entrepreneurship, highlighting roles for financing (Kerr and Nanda 2009), entry regulation (Klapper, Laeven and Rajan 2006), tax policy (Gentry and Hubbard 2000), and wages (Kong, Qin and Xiang 2021). Poschke (2024) show that low-wage employment and high self-employment rates characterize poorer economies, in which labor-market frictions lead to higher self-employment and unemployment rates.

[13]For instance, Google CEO Eric Schmidt served on Apple's board until Google introduced Android phones.

[14]In 2023, the FTC enforced Clayton Act Section 8 for the first time in four decades, prohibiting interlocking directorates between a private equity firm and a natural gas producer competing in the Appalachian Basin. Source: https://www.ftc.gov/news-events/news/press-releases/2023/08/ftc-acts-prevent-interlocking-directorate-arrangement-anticompetitive-information-exchange-eqt.

some forms of information exchange might be procompetitive even without direct product-market overlap, yet such overlaps might also generate anticompetitive outcomes in labor markets. Third, to what extent does venture investment contribute to common leadership? TechVs often raise multiple rounds of financing, and venture investors commonly participate in syndicates, creating ownership or board positions that link a TDP and a TechV in both labor and product markets. It is also possible for multiple TDPs to invest in competing TechVs, collectively resulting in indirect common leadership. These cross-relationships may undermine labor or product market competition. The FTC's inquiry into generative AI investments and partnerships indicates a potential concern in this domain.[15]

In sum, interactions between TDPs and TechVs in the labor market can shape the movement of employees, influence the formation of new ventures, and affect knowledge spillovers. These factors may ultimately have profound implications for innovation and market competition.

5. Innovation Development

If a TDP has already invested in a TechV in the capital market, it cares about how the TechV engages in innovation development and whether the effort leads to new technology or new products. However, even without any explicit interactions in the input markets, TDPs can still influence a TechV's innovation development indirectly because they can be a supplier, a customer, or a competitor to the TechV's innovation outcomes. They can also be a potential acquirer of the TechV after its innovation outcomes are realized. Consequently, the TechV has incentives to (or not to) pursue certain innovations while keeping in mind they may interact with TDPs and other firms down the road.

5.1. Who Innovates More: Big or Small?

Before examining how TDPs and TechVs jointly shape innovation outcomes, it is useful to review core incentives to innovate. Standard economic arguments posit that a firm may choose to innovate if the expected returns—incorporating both short- and long-term prospects and including the possibility of failure—exceed the costs of R&D. Over eighty years ago, Schumpeter (1942) introduced the idea of "creative destruction," positing that new ventures can disrupt existing incumbents, thus fueling economic growth. Acemoglu

[15] Source: https://www.ftc.gov/news-events/news/press-releases/2024/01/ftc-launches-inquiry-generative-ai-investments-partnerships.

and Robinson (2012) further propose that nations may fail to grow because their ruling elites block these beneficial waves of creative destruction.

The relationship among innovation, market competition, and firm size is complex.[16] On one hand, larger firms in more concentrated markets may be more able to capture the gains from R&D than smaller, competitive firms (Chamberlin 1962), implying that TDPs could have stronger incentives to innovate than nascent TechVs. On the other hand, incumbents might worry that new products could cannibalize their existing portfolio, and this replacement effect might reduce their incentive to innovate (Arrow 1962). Due to these opposing forces, an inverted-U relationship between product-market competition and innovation has been documented (Aghion et al. 2005).

Competition in highly innovative technology markets has typically been modeled as a race. Seminal papers have considered "memoryless" patent races assuming that the probability of developing a patentable innovation only depends on the current R&D expenditure, with no role played by the firm's past R&D experience. These analyses embody no notion of leadership as they study stationary races wherein firms are equally placed before the race (Loury 1979; Lee and Wilde 1980; Dasgupta and Stiglitz 1980; Reinganum 1982). Subsequent papers have explored the role of the position—whether a firm is ahead or behind the rival—in shaping that firm's strategy in the race to patent a technology. For example, Grossman and Shapiro (1987) examine the behavior of two firms competing in a two-stage patent race as they gain the lead or fall behind in the race. They show that the leader—which typically holds a greater market share—engages in R&D more intensively than the follower, and that both firms intensify their efforts when the gap in know-how between firms shrinks.

Regarding firm size, Akcigit and Kerr (2018) show that total R&D expenditures and patent counts tend to increase with firm size, but the intensity of innovation (measured by R&D expenditure or patent per employee) is higher in smaller firms. Note that the intensity difference between large and small firms—documented across industries—is conditional on firms engaging in innovative activities; without this condition, the difference would be reversed because the vast majority of small businesses are not necessarily innovative firms. Conditional on being innovative, Akcigit and Kerr (2018) find that smaller firms are more likely to explore new areas with major innovations rather than exploit existing areas. More recent research by Olmstead-Rumsey (2022) confirms that, on average, smaller firms have higher relative quality of patents than market leaders, but the relative quality of patents by smaller firms has declined significantly since 2000,

[16] For a review, see Bryan and Williams (2021).

as small firms have made relatively more incremental innovations over time.

In sum, it is challenging to assess whether the total volume, pace and quality of innovation tend to be greater, faster, or better if originating in small startups as opposed to large incumbents, nor does innovation automatically increase when a market consists of a large number of small firms rather than few large firms. After all, significant innovations often require considerable R&D expenditures in order to reap economies of scale and scope, especially in light of recent technology advances in ICT.[17] According to FastCompany.com, Nvidia ranked #1 in the World's Most Innovative Companies of 2024, Microsoft #3, and Youtube (a subsidiary of Alphabet/Google) #7.[18] In a report by the Boston Consulting Group (BCG 2020), Apple, Alphabet, Amazon, Microsoft, and Meta ranked #1, #2, #3, #4 and #10 among the 50 most innovative companies worldwide in 2020.[19] Many of these top innovators fall under our definition of TDP.

Even if small startups possess greater agility and innovation capacities, their ability to execute is contingent upon adequate funding, the anticipation of sufficient returns, and the dynamics of the ecosystem in which they operate, all of which may involve interactions with TDPs. Below we summarize the innovation literature with a specific focus on whether technology ventures form strategic alliances to innovate or stay at arm's length until a potential exit.

5.2. Innovation and Strategic Alliances

As discussed in Section 3, TDPs may invest in TechVs via corporate venture capital to influence or benefit from their innovation. However, equity ties are not the only route to collaboration. Two technology ventures might form a joint R&D partnership but compete in production, jointly cooperate in both R&D and production, or coordinate on standards in a standard-setting organization. They could even share a common investor but remain formally independent.

In a simple duopoly model, D'Aspremont and Jacquemin (1988) compare the wel-

[17] For example, according to a recent ruling in the DOJ's search engine case against Google, constructing a general search engine is an extremely capital- and human-resource intensive endeavor. Source: https://s3.documentcloud.org/documents/25032745/045110819896.pdf. In particular, the ruling cites a few pieces of evidence, including that (1) developing the technical infrastructure alone requires billions of dollars; (2) Google incurred $8.4 billion in costs in 2020 to operate its search engine; (3) monetizing the Google search engine via Google's search ads business cost the company another $11.1 billion in 2020; (4) Microsoft invested nearly $100 billion in search over the past two decades; and (5) the total capital expenditures required for Apple to reproduce Google's technical infrastructure for search is estimated to be $20 billion.

[18] Source: https://www.fastcompany.com/most-innovative-companies/list.

[19] Source: https://web-assets.bcg.com/img-src/BCG-Most-Innovative-Companies-2020-Jun-2020-R-4_tcm9-251007.pdf.

fare implications of two firms collaborating on pre-production R&D only, collaborating on R&D and production, or not collaborating at all. The key tradeoff is that R&D collaboration can reduce duplicative R&D investment and enhance R&D incentives if one firm's R&D effort has a positive spillover on the other's cost efficiency, but collaboration in production could reduce production due to increased market power. They find that collaboration solely in R&D improves total output relative to no collaboration, although collaborative R&D plus production can be socially optimal if spillovers are large.

Mathews (2006) considers a model in which an entrepreneurial firm and an established company can form an equity alliance. The established company benefits from the entrepreneurial firm's technological knowledge, but this enables it to threaten entry into the entrepreneurial firm's market. Equity transfers can noncontractually eliminate the established firm's entry incentive and improve efficiency for both firms. However, equity transfers also dilute the entrepreneur's incentives to innovate in new markets in the future; hence, the partners sometimes accommodate entry by the established firm, settling for reduced surplus in the contested market to preserve the value of the entrepreneurial firm's growth options.

Shelegia and Spiegel (2024) study the effects of partial cross-ownership among rival firms on their incentives to innovate. In their model, firms first make innovation decisions and then compete à la Bertrand. They find that cross-ownership increases the profit of a firm that is the only successful innovator, by reducing its incentive to undercut the firm that fails to innovate. This price effect boosts the incentive to invest and become the innovating firm. However, at the same time, cross-ownership creates a cannibalization effect, as investing in innovation reduces the rival's profit when it also innovates. In net, when stakes are asymmetric, as is typical with corporate venture investments, cross-ownership is likely to harm consumers when stakes are relatively small and the innovation is non-drastic. In contrast, when the stakes are sufficiently large such that the innovation is drastic, cross-ownership can benefit consumers if the relative cost of innovation is sufficiently large.

López and Vives (2019) focus on symmetric overlapping ownership, showing that if demand is not too convex, this can reduce investments and output when R&D spillovers are low. While their empirical focus is on common ownership of public firms by passive institutional shareholders, Antón et al. (2024) theoretically show that, in a Cournot oligopoly model with differentiated products and linear demand functions, an increase in the weight that a firm assigns to a rival firm's profit could increase the firm's R&D investment if and only if technological spillovers are sufficiently large relative to the degree of product differentiation.

Ghosh and Morita (2017) focus on partial cross-ownership in a homogeneous-product Cournot market. They find that partial equity ownership can increase the profitability of alliance partners by inducing knowledge transfer, but it also induces other firms to take more aggressive actions. This trade-off endogenously determines the level of cross-ownership, which can benefit consumers and/or improve welfare.

Theorists also highlight a few costs of R&D alliances. For example, partners may free-ride each other's R&D efforts because the success of R&D is uncertain, and the benefits of R&D outcomes accrue to all partners, whereas effort costs are private (Bonatti and Hörner 2011). Another cost could originate from a lack of communication. Though the free-riding incentive can be exacerbated by a lack of communication among R&D partners, Campbell, Ederer and Spinnewijn (2014) show that setting an optimal deadline on a research project can help overcome both problems. While free-riding and lack of communication may arise regardless of whether R&D collaboration is inside one firm or across firms, they can be more severe when an R&D alliance involves multiple firms, especially if these firms have conflicting interests in technology transfer and the final product market.

Empirical evidence indicates that alliances benefit partners by enhancing their ability to learn from each other's technologies (Mowery, Oxley and Silverman 1996). When partners differ in their expertise in intraorganizational collaborative innovation, Howard et al. (2016) show that increased social interaction between a novice technology firm and the experienced partner leads to significant improvements in internal collaboration among the novice firm's inventors. This finding suggests that TechVs can gain from collaborating with TDPs by learning through experience and developing collaborative routines that may later enhance their internal innovation efforts. Li, Qiu and Wang (2019) investigate the formation of alliances by technology conglomerates—defined as firms engaging in several technology fields with intense inventive activity—and their impact on innovation output. They show that technology conglomerates are more inclined to form alliances and that these partnerships lead to enhanced patent output in both quantity and quality. The improvement is driven by knowledge sharing and cross-fertilization between technology conglomerates and their alliance partners.

Moreover, Ceccagnoli, Higgins and Kang (2018) empirically study global pharmaceutical firms and their biotech partners. They find that decisions by pharmaceutical firms to make corporate venture investments in biotech firms—as a "wait-and-see" strategy—depend on their scientific capabilities, technological domains, and research pipelines.

These corporate investors tend to license high-value technologies from their biotech partners after technological uncertainty is reduced after the corporate venture investment.

Additionally, venture investors—including corporate venture arms—may invest in competing startups, creating indirect cross-ownership. Both Li, Liu and Taylor (2023) and Leccese (2023) examine the effects of such indirect cross-ownership. Li, Liu and Taylor (2023) show that VC investors may hold back projects, withhold funding, and redirect innovation at lagging startups, whereas Leccese (2023) shows that VC investors may have an incentive to channel more resources towards the higher-quality startup, at the expense of the other. Eldar and Grennan (2023) exploit the staggered introduction of liability waivers when investors hold stakes in conflicting business opportunities, and observe that same-industry startups inside VC portfolios benefit by raising more capital, failing less, and exiting more successfully.

5.3. Innovation at Arm's Length

In the absence of an explicit strategic alliance, TDPs and TechVs can still interact in innovation development at arm's length, because TDPs may be a supplier, an intermediary, a customer, and a potential acquirer of a TechV.

Many examples highlight TDPs as suppliers. For instance, OpenAI's Large Language Model is built on Google's Transformer architecture, where Google is a TDP and OpenAI is a TechV (though seemingly fast becoming a TDP itself). A more systematic example concerns cloud computing. Cloud services provided by Amazon, Google, Microsoft, Oracle, IBM, and other digital platforms can lower barriers to entry for computer software startups. Using the introduction of Amazon's cloud service as an exogenous shock, Ewens, Nanda and Rhodes-Kropf (2018) show that cloud computing has motivated venture investors to adopt a "spray and pray" strategy, fund more technology startups, and identify more productive startups in the process. Another example is crowd-sourcing platforms that promote knowledge exchange. As shown by Wright, Nagle and Greenstein (2023), more participation in GitHub—a platform for open source software—in a country is associated with an increase in the number of new technology ventures within that country in the subsequent year. They also find that GitHub contributions lead to new ventures that are more mission- and global-oriented and are of a higher quality.

A third example is software development kits (SDKs), which are broadly defined as collections of software tools and libraries that developers can use to create applications for specific platforms or hardware. Large TDPs such as Google, Amazon, Meta, and Adobe often provide SDKs free of charge for app developers. From app developers' perspective, these off-shelf SDKs can significantly reduce the costs of app development; from the TDPs' perspective, usage of their SDKs by app developers can help the app better integrate with their platforms, and facilitate data flows between them and app developers. Jin, Liu and Wagman (2024) demonstrate how SDK usage in Android apps has changed before and after the EU began implementing the General Data Protection Regulation (GDPR) in May 2018.

As an intermediary, TDPs build platforms that connect users on different sides. In this role, TDPs can connect TechVs to their intended user audiences, even if those users are far away and anonymous. Since an expanded customer base often implies greater expected profits, this alone could encourage TechVs to enter and innovate.

To the extent that TechVs count on gatekeeping TDPs to access end users, the rules that TDPs set for their platforms can play a crucial role in defining a TechV's market demand, product success, and innovation activity. For example, Aguiar and Waldfogel (2018*b*) show that new products in the recorded music industry have tripled between 2000 and 2008, largely because TDPs such as Apple Music and Spotify have lowered the cost of producing and distributing digital songs. More specifically, Aguiar and Waldfogel (2018*a*) find that being added to Spotify's Today's Top Hits raises streams by almost 20 million and is worth between $116,000 and $163,000, and inclusion on New Music Friday lists substantially raises the probability of song success, including for new artists.

A similar digital renaissance can occur in other TDP-enabled content creation. Using data on about 50,000 book publishing license deals, Peukert and Reimers (2022) demonstrate that digitization (including self-publishing on Amazon) has made the size of license payments more accurately reflect a product's ex-post success, and thus increased the efficiency of resource allocation across products of varying and hard-to-predict qualities.

More examples describe how the platform design of TDPs may affect the innovation incentives of third-party entities. According to Reimers and Waldfogel (2021), product ratings on Amazon help consumers find high-quality books more effectively than expert reviews in the New York Times, which in turn further motivates writers to write high-quality books. Leyden (2024) finds that an unexpected change in the rating system on Apple's App Store has significantly affected the frequency of app updating by app developers. Wu and Zhu (2022) study book performance on a Chinese novel-writing platform that connects novel writers with potential readers. They find that intensified competition on the platform led authors to produce content more quickly, and this response was stronger for revenue-sharing books than pay-by-the-word books. Although revenue-sharing authors exerted significantly more effort than paid-by-the-word authors, after competition on the platform intensified, both reader clicks and purchases of fixed-price (pay-by-the-word) books increased considerably more than those of revenue-sharing books. This is because the platform specifically increased its promotion of books for which it pays a fixed price, where the platform is the sole residual claimant.

These findings suggest that an intermediary platform does not only create a marketplace for individual creators and suppliers to connect with end users, but it can also leverage platform design to boost its own interests, potentially at the cost of some stakeholders. TDPs may have even more ways to influence the innovation incentives of third-party providers—many of which fall under our definition of TechV—if the TDPs compete or have the potential to compete directly with those providers in the final product market. A discussion of this fast-growing literature is in Section 6.

Additionally, even if TDPs are not yet suppliers, customers, competitors, or intermediaries of a TechV, they can be potential acquirers. Since IPO and M&A are the two most important ways to exit an entrepreneurial endeavor with financial success, and the relative importance of M&A has grown over time (Ederer and Pellegrino 2023), the prospect of a future acquisition is crucial for an entrepreneur's choice of what, when, and how to innovate. Another chapter in this handbook provides a more thorough review of technology M&A, so we will be brief here.

As highlighted in Jin, Leccese and Wagman (2023, 2024*a*), GAFAM firms—five of the largest TDPs—account for less than 2% of all majority control acquisitions of ICT technology ventures in 2010-2020 as recorded by S&P Global Market Intelligence. Other top acquirers, including private equity firms and large telecommunication companies, are also active in tech acquisitions; however, on average, GAFAM firms tend to acquire younger and more consumer-facing firms. GAFAM acquisitions are also less concentrated across tech categories than other top acquirer groups, due, in part, to a "first-adjacent-and-then-expand" strategy.

Theorists have expressed concerns that large incumbent acquirers may use M&A to kill potential competitors and thus stifle future innovation (Motta and Peitz 2021; Bourreau and Gautier 2024), but evidence of killer acquisitions stems primarily from the pharmaceutical space rather than technology ventures (Cunningham, Ederer and Ma 2021). While this can partly be attributed to the greater availability of data in the pharmaceutical space to define product overlap—in contrast with the "fluidity" in business areas overlap in technology markets—differences in market dynamics between the pharmaceutical and technology industries point towards potential heterogeneities in the incentives to discontinue acquired technologies. For example, the pharmaceutical industry is characterized by more intense patent competition (Levin, Klevorick and Nelson 1987; Cohen, Nelson and Walsh 2000; Schroth and Szalay 2010), which exacerbates the extent to which the overlapping target's innovation—if not discontinued—may erode the acquirer's profits. Moreover, acquisitions may enable the development of those targets' innovations that would have been impossible due to financial or other constraints (Fumagalli, Motta and Tarantino 2020), a mechanism that may be more relevant in technology markets due to the importance of complementary assets and the rapid pace of innovation required for market entry and growth.

Another concern is so-called "kill zones," where entry (and innovation) may decrease because the prospect of an acquisition by an incumbent platform reduces the incentives of early adopters to adopt the entrant's products or services. This theory, and the corresponding evidence provided by Kamepalli, Rajan and Zingales (2020), is specific to settings with network externalities such as social media. A third concern is so-called "reverse killer acquisitions," where platforms may buy innovations from startups instead of developing them in-house (Crawford, Valletti and Caffarra 2020).

Conversely, tech acquisitions, especially those by large TDPs, could be driven by economies of scale, economies of scope, elimination of double marginalization, reduction of duplicate R&D investments, and other efficiency reasons (Cabral 2021). Tech acquisitions by large TDPs may also encourage entry-for-buyout and thus spur startup innovations. While generally viewed as welfare-enhancing, entry-for-buyout incentives may lead to inefficiencies by distorting the direction of innovation towards excessive development—relative to the social optimum—of technologies that are complementary (Bryan and Hovenkamp 2020) or incremental (Cabral 2018) to the incumbent's business.

Motivated by the trade-offs surrounding the acquisitions of TechVs, Letina, Schmutzler and Seibel (2024) examine the impact of stronger antitrust enforcement within a model where both an incumbent and an entrant pursue innovation, selecting from various available projects. The firms' strategic choices influence not only their likelihood of innovating but also the degree of correlation between their innovation outcomes and those of their competitors. They find that prohibiting all acquisitions has a weakly negative effect on overall innovation. They use their model to assess several prominent antitrust policies, including bans on high-price acquisitions, changes to the tax treatment of acquisitions and initial public offerings, as well as the implementation of behavioral remedies. Within their model, they find that these interventions are likely to prevent acquisitions only when the entrant's standalone profits are sufficiently high.

Empirical evidence on how tech acquisitions affect startup investment, innovation, and market competition is quite mixed. Eisfeld (2022) uses a structural model to identify how entry-for-buyout and kill zone mechanisms affect startup entry in the enterprise software market. She finds that banning all venture acquisitions would reduce entry by 8-20%. Using data on acquisitions and venture capital funding in the U.S. from Crunchbase, Jin, Leccese and Wagman (2024*b*) find that acquisitions stimulate venture capital investment, particularly in areas with fewer ventures and more intense past M&A or VC investment activity. Of note, they show that acquisitions by big tech platforms and other large acquirers have a similar positive effect, whereas private equity buyouts lead to an even greater increase in venture capital activity. More broadly, Phillips and Zhdanov (2023) find positive correlation between lagged M&A activity and VC investments, leveraging variations in competition laws across countries.[20]

The empirical finance literature has typically focused on the relationship between M&A and innovation in the context of public companies, emphasizing how M&As can lead to synergies that help acquirers' innovation efforts (Zhao 2009; Bena and Li 2014) but also reduce the novelty of target's patents (Seru 2014).[21] However, private companies, and in particular technology ventures, represent a key driver of innovation and, in their context, different forces may be at play. For example, Farida, Fidrmuc and Zhang (2023) study acquisitions of private targets and find that they increase the quantity, quality, and value of acquirers' patents. Moreover, the paper argues that, differently from those involving public targets, these deals increase innovation synergies.

Analyzing the acquisition and patenting activities of 72 leading firms in the global chemicals industry, Ahuja and Katila (2001) demonstrate that acquisitions that do not involve a technological component do not significantly impact the acquirer's subsequent innovation output, in contrast to technological acquisitions. Within technological acquisitions, the absolute size of the acquired knowledge base enhances innovation performance. However, when the acquired firm's knowledge base is relatively large compared to that of the acquiring firm, innovation output declines. This is because integrating a relatively larger knowledge base requires substantial organizational changes, which can

[20] In the biotech industry, Stuart and Sorenson (2003) show that acquisitions of firms located in or near a metropolitan statistical area (MSA) increase the rate of new firm formation within the MSA, but only when the acquiring firm comes from outside the biotech industry.

[21] Arts, Cassiman and Hou (forthcoming) examine how the uniqueness and differentiation of a firm's technology portfolio influence its M&A activity. They find that firms with unique and differentiated technology are more likely to become targets and are associated with a higher acquisition price, whereas firms with less unique technology are more likely to become acquirers.

significantly disrupt existing processes. Miric, Pagani and El Sawy (2020) study how digital platforms differ from other tech ventures in using acquisition as a strategy to scale, documenting significant heterogeneity. Specifically, they find that platforms acquire earlier, initially targeting competing platforms from the same market niche. As they mature, platform companies begin to acquire non-platform companies from other market niches. Wang (2018) focuses on the relationship between exit via M&A and the direction of innovation, finding that entrepreneurs tend to develop innovations that are proximal to potential acquirers' patent portfolios to present themselves as attractive targets, especially when the potential acquirers' market is more concentrated. Warg (2022) finds supportive results but also shows that as the supply of venture capital increases, startups introduce innovations that are more independent of potential acquirers' assets.

A few empirical studies focus on the implications of venture acquisitions performed by GAFAM.[22] On the positive side, some have shed light on the beneficial effects on VC activities within the same market segment (Prado and Bauer 2022), alongside the absence of any reduction in entry by startups (Pan and Song 2023) or other incumbents via M&A (Jin, Leccese and Wagman 2023). On the negative side, Kamepalli, Rajan and Zingales (2020) provide an empirical example of reductions in VC investment in ventures similar to the target after major acquisitions by Facebook/Meta and Google/Alphabet. Affeldt and Kesler (2021) show that M&A deals completed by GAFAM may potentially stifle GAFAM competitors' innovation in the apps market. Thatchenkery and Katila (2023) show that innovation among complementors soared following a reduction in anticompetitive barriers associated with Microsoft, but their profitability dropped. Wen and Zhu (2019) find that after Google's entry threat in a particular market increases, affected developers reduce innovation and raise the prices for the affected apps. Gautier and Lamesch (2020) examine 175 acquisitions by GAFAM during 2015-2017 and find that a substantial portion of the acquired products and services are no longer supplied, maintained, or upgraded under their original brand names.

5.4. Related public policies

Two types of public policies—namely intellectual property (IP) protection and antitrust—may affect TDPs, TechVs and their interactions in innovation development.

[22] A smaller body of research has investigated the potential anti-competitive effects of acquisitions targeting a TDP's complementor and initiated by another complementor—rather than by the TDP itself. For example, using data from Apple's iOS App Store, Wang et al. (2024) demonstrate the entry-deterring effects of synergies that complementor acquirers can exploit.

The 2006 U.S. Supreme Court ruling in eBay vs. MercExchange presents an interesting example. In 2001, MercExchange—a technology development and online auction company founded in 1995—sued eBay (arguably a TDP by our definition) for infringing its patents, including one that covered eBay's popular "Buy It Now" function. Prior to the Supreme Court decision, if a patent was found valid and infringed, its owner could almost always obtain injunction relief (a legal order that stops the infringer from using the patent). But in the eBay case, the Supreme Court adopted a four-part test to determine whether the appropriate remedy for patent infringement is injunctive relief or monetary damages. This tends to reduce patent holders' bargaining power for infringement compensation because injunctive relief is no longer an automatic threat should the negotiation break down. In theory, this may reduce incentives to innovate as automatic injunctions yield more profit to the inventor, but when innovation is cumulative and complementary or IP rights are poorly defined, automatic injunctions can create a holdup threat for downstream innovators and thus dampen their innovation incentives. Empirically, Mezzanotti and Simcoe (2019) find no evidence that this change in patent policy has harmed the U.S. innovation system in terms of patenting, R&D spending, venture capital investment, or productivity growth. Since TechVs and TDPs may constitute upstream or downstream innovators relative to each other, it is unclear whether this particular decision has affected them differently.

However, researchers do find that large and small firms differ in their IP strategies. Using a nationally representative sample of firms from 2008 to 2015, Mezzanotti and Simcoe (2023) find that high-tech firms are, on average, more active in IP protection than firms in other industries, and larger firms tend to engage much more extensively in IP protection. Furthermore, the likelihood of technology transfer from small startups to large incumbents depends on the legal strength of IP protection. Simcoe, Graham and Feldman (2009) study the IP strategies of small entrepreneurs and large incumbents that disclose patents in 13 voluntary standard setting organizations (SSOs). Because entrepreneurs often rely on IP to earn a return on their innovations and may have a lesser ability to seek rents in complementary markets, they can defend IP more aggressively than large incumbents once it has been incorporated into an open platform. Using a sample of MIT inventions, Gans, Hsu and Stern (2002) find that patent protection increases the likelihood that an inventor licenses to an incumbent rather than commercialize the invention. Consistently, Arora and Ceccagnoli (2006) use a survey of industrial R&D to show that the impact of patent effectiveness on licensing one's own invention for revenue is weaker for firms that have specialized complementary assets in manufacturing. To the extent that large incumbents such as TDPs have more complementary assets than smaller technology ventures, their relationship with TechVs can be more vertical (as licensor and licensee of the technology) than horizontal (as rivals of commercialized products).

So far, we have primarily focused on scenarios wherein larger companies are the licensee of the technology because they are more likely to have complementary assets. The opposite case is also possible and can lead to important considerations and potential efficiency gains. Using drug development data, Hammoudeh, Krieger and Xu (2022) show that transferring R&D projects from established pharmaceutical incumbents to smaller startups improves innovation outcomes relative to projects retained by large firms, as measured by a higher likelihood to progress through development stages and receive regulatory approval. This is consistent with large companies prematurely shelving projects before the full value of the innovation is realized.

Another important policy area is antitrust. Traditionally, and particularly before the Microsoft case,[23] competition authorities have primarily focused on the effects of mergers and other contested practices on prices and output. However, in highly innovative markets where firms engage in dynamic competition for the market, policies that ignore dynamic incentives to invest in R&D may lead to significant welfare losses (Evans and Schmalensee 2002).

Segal and Whinston (2007) study the effects of antitrust policies in industries with continual innovation. Their findings suggest that restricting incumbent behavior through antitrust measures increases the profits of new entrants while reducing those of incumbents. Using this framework, they demonstrate that when long-term exclusive agreements are present, stronger antitrust enforcement promotes innovation and enhances consumer welfare. However, in a model that considers compatibility choices in industries with significant network externalities, increasing antitrust enforcement—by requiring incumbents to make their products more compatible—may actually hinder innovation.

Mermelstein et al. (2020) analyze merger policy and its impact on innovation incentives within a dynamic computational model. In their model, firms lower costs either through investments or mergers, while an antitrust authority has the ability to block mergers, albeit at a cost. The authority's decisions on merger approvals must balance a potential increase in market power against changes in productive efficiency resulting from the merger. These efficiency changes depend not only on the immediate cost savings that may be achieved by the merging parties due to economies of scale but also on the subsequent investment decisions of both the merged entity and its rivals. Under

[23] See https://casetext.com/case/us-v-microsoft-corporation for more detail (Civil Action No. 98-1232).

their model, they find that an optimal antitrust policy may differ significantly from one based solely on static welfare considerations.

Antitrust agencies can block mergers between TDPs and TechVs, and sue TDPs for monopolizing the market. For example, in 2020 Meta acquired Giphy—at the time the largest supplier of animated gifs to social networks such as Snapchat, TikTok and Twitter—but the U.K. Competition and Markets Authority ordered Meta to divest Giphy in 2022, following the concerns that the acquisition would not only limit choice for those on social media but also reduce innovation in digital display advertising.[24] Since 2017, the European Commission has charged Alphabet/Google with violating antitrust laws by favoring its own comparison shopping service (Google Shopping) over competitors,[25] using its dominance in online advertising to undercut rivals,[26] and using Android to cement its dominance in online search.[27] In the U.S., the Department of Justice sued Alphabet/Google in 2023 for monopolizing digital advertising technologies, partly via its 2008 acquisition of DoubleClick (a TechV with expertise in ad management technology).[28] The FTC sued Meta/Facebook in 2020, alleging that Facebook used anticompetitive mergers to gain monopoly power, particularly through its acquisitions of Instagram and WhatsApp.[29] In 2023, the FTC sued Amazon for engaging in exclusionary conduct that prevents current competitors from growing and new competitors from emerging.[30] In 2024, the US DOJ sued Apple for monopolizing smartphone markets by selectively imposing contractual restrictions on and withholding critical access points from developers.[31]

Besides case-by-case antitrust enforcement, legislators can adopt ex-ante regulations that limit the behavior of select TDPs. For instance, the European Union began implementing the Digital Markets Act (DMA) in 2022, imposing strict rules on how large TDPs (so-called "gatekeepers") collect data and how they can interact with smaller businesses and users. As of May 2024, seven TDPs—Alphabet/Google, Meta, Apple,

[24] Source: https://www.gov.uk/cma-cases/facebook-inc-giphy-inc-merger-inquiry.

[25] Source: https://competition-cases.ec.europa.eu/cases/AT.39740.

[26] Source: https://ec.europa.eu/commission/presscorner/detail/en/ip_18_4581.

[27] Source: https://ec.europa.eu/commission/presscorner/detail/en/ip_18_4581.

[28] Source: https://www.justice.gov/opa/pr/justice-department-sues-google-monopolizing-digital-advertising-technologies.

[29] Source: https://www.ftc.gov/news-events/news/press-releases/2020/12/ftc-sues-facebook-illegal-monopolization.

[30] Source: https://www.ftc.gov/news-events/news/press-releases/2023/09/ftc-sues-amazon-illegally-maintaining-monopoly-power.

[31] Source: https://www.justice.gov/opa/pr/justice-department-sues-apple-monopolizing-smartphone-markets.

Amazon, ByteDance, Microsoft, and Booking have been designated as "gatekeepers" under the DMA. The U.S. Congress has proposed a few bills that bear some similarities to the DMA, but none have been enacted into law.

In almost all of the antitrust cases, the DMA, and DMA-like regulations and regulatory proposals against TDPs worldwide, a primary concern is that certain conducts of TDPs may stifle innovation by other technology firms. Some of these concerns—such as TDPs' practice of favoring their own services (referred to as "self-preferencing")—relate to how TDPs and TechVs compete in the final product market, which we discuss in detail in Section 6. Consistent with this concern, Rong et al. (2024) show that China's Platform Guidelines, which introduced measures to restrict certain practices by TDPs, including price discrimination, self-preferencing, acquisitions, and CVC investments, ultimately weakened competition, reduced market entry, and diminished venture capital investment in these markets.

6. Commercialization and Product Market Interactions

Section 5 describes how a TDP may interact with TechVs as an investor, supplier, customer, intermediary service provider, or potential acquirer. In these vertical relationships, TDPs and TechVs are more-or-less complementary to each other rather than direct competitors. This section focuses on how TDPs and TechVs may compete horizontally in final product markets.

6.1. Head-to-Head Horizontal Competition Between TDPs and TechVs

In the simplest scenario, technology ventures have no vertical relationship other than competing in the final product market. For example, when Larry Page and Sergey Brin founded Google in 1998, they used the PageRank algorithm to build a search engine better than existing techniques. At least in that time, Google competed with Yahoo, Ask, and other search engines, without significant other relationships. Similarly, DuckDuckGo, Neeva, Perplexity.ai, OpenAI, and other TechVs have attempted to compete with Google's search engine.

The ongoing DOJ case against Google concerns exactly whether Google (as a TDP) has taken actions to harm competition in the market of online search. In principle, size, age, and other natural differences between TDPs and TechVs do not necessarily imply their competition may reduce consumer welfare. Larger sizes and longer market experiences may give TDPs a competitive advantage over younger and smaller TechVs in terms of better access to affordable capital, better ability to attract innovative talent, economies of scale and scope including in operation and in data as an input, and a first-mover advantage in brand recognition and customer loyalty. Competition on these merits can be healthy and beneficial to society.

At the same time, TDPs may also abuse their dominant position in a market and attempt to monopolize the market with exclusive or nearly-exclusive conducts. In U.S. vs. Google case on online search, the district judge has found Google a monopolist in the markets of "general search services" and "general search text ads."[32] While being a monopolist itself does not necessarily violate antitrust laws—a firm may obtain its monopoly position through merit—it is problematic if the monopolist attempts to maintain the monopoly through anticompetitive conduct. More specifically, the judge ruled that Google has illegally monopolized the markets by using exclusive revenue-sharing contracts with Apple, Mozilla, Samsung, AT&T, Verizon, and other internet and smartphone services to set Google's search engine as the default for final consumers. These exclusive contracts were found to have anticompetitive effects in slowing down the innovation development of other search engines by both large TDPs such as Microsoft and smaller TechVs such as DuckDuckGo and Neeva. As of today, the case is still ongoing for potential remedy and appeal, but facts discovered in the case have highlighted the horizontal interactions among TDPs and TechVs as direct competitors in the final product market, along with vertical TDP-TechV interactions as they are upstream and downstream complementors to each other in adjacent markets.

Such multi-dimensional interactions in focal and adjacent markets are not uncommon for technology ventures. Following a taxonomy defined by S&P Global Market Intelligence, Jin, Leccese and Wagman (2023) compare technology categories with and without GAFAM acquisitions. They find no evidence suggesting that a category with any GAFAM acquisitions is correlated with a slowdown in the number of new acquirers acquiring in that category. This finding suggests that, although GAFAM firms are more likely than other acquirers to follow a first-adjacent-and-then-expand strategy in tech acquisitions, such acquisitions do not shield GAFAM from potential competition that may arise from other GAFAM members or other firms that acquire in the same categories.

This empirical pattern, together with the ongoing Google search case, introduces additional nuances to how TDP-TechV interactions may influence competition in the final product market. On one hand, the asymmetry between TDPs and TechVs in terms of resources, size, scope, and market experience affects the nature of their head-to-head

[32]Source: https://s3.documentcloud.org/documents/25032745/045110819896.pdf.

competition; on the other hand, TDPs operating outside the focal product market may leverage TechVs in the market (for instance, through M&A) to enter and compete with the incumbent TDPs in the focal market.

How to deal with these nuances is a growing challenge for antitrust agencies. The U.S. DOJ and FTC have attempted to address the challenge by adopting new merger guidelines in December 2023, with more explicit considerations regarding mergers that may eliminate a potential entrant in a concentrated market (Guideline #4), mergers that are part of a series of multiple acquisitions (Guideline #8), and mergers that involve a multi-sided platform and may affect competition between platforms, on a platform, or to displace a platform (Guideline #9).[33] Because merger guidelines are a non-binding statement, their impact on legal enforcement of antitrust issues remains to be seen.[34]

6.2. Platform Governance and First-Party Products in the Hybrid Platform Model

Another concern in TDP-TechV competition relates to the potentially anticompetitive strategies that a TDP might adopt when it not only provides intermediary services to third-party TechVs on its platform but also offers—or plans to offer—substitutable final products or services that directly compete with these TechVs. The hybrid model of allowing both first-party and third-party offerings in the same marketplace is quite common in practice: online shopping marketplaces (such as Amazon, JD.com, and Walmart, among others) offer private-label products that compete with third-party offerings in the same category; game consoles (such as Microsoft Xbox, Nintendo Switch, and Sony Playstation) provide in-house and third-party games side-by-side to individual gamers; app marketplaces (including the Apple App Store and Google Play Store) offer both in-house and third-party apps serving similar purposes; and online search engines list the platform's own products in search results (e.g., Google Shopping) next to those of competitors (e.g., Yelp).

One TDP strategy to address (potential) TDP-TechV competition is to establish barriers to entry for potential entrants and thus avoid becoming a hybrid platform for the focal final product. A lack of interoperability is one example. Interoperability, defined as the extent to which products from different firms can be used together or exchangeably, is a crucial factor in digital markets characterized by network effects. In

[33] See https://www.justice.gov/atr/merger-guidelines for the full content of the 2023 merger guidelines and https://www.justice.gov/opa/pr/justice-department-and-federal-trade-commission-release-2023-merger-guidelines for a press release.

[34] A more detailed discussion of the new merger guidelines can be found in Athey and Nevo (2023); Jin and Wagman (2023); Kaplow (2024); Hovenkamp (2024); Salop (2024); Carlton (2024); Shapiro (2024).

these markets, when a TDP's product dominates a niche, new firms may have an incentive to enter and imitate the offering. To ensure profitable entry, entrants will typically seek interoperability with incumbents' products as a way to penetrate the market and gain a share of the customer base. Conversely, incumbents tend to resist interoperability, aiming to maintain their dominant position and create entry barriers for potential competitors (Katz and Shapiro 1985).[35] Consequently, mandating interoperability has attracted the attention of regulators as a potential remedy for increasing entry and competition in markets wherein TDPs operate with network effects and a lack of interoperability may constitute a barrier to entry (Kades and Scott Morton 2020).

The incentive to deny entrants access to a TDP's platform can manifest even prior to the TDP having its own offering in the final product market. Motta and Peitz (2021) show that when a platform anticipates offering its own first-party app, it may find it optimal to deny access to its platform to a third-party app. By doing so, the platform ensures that the third-party app remains a weaker future competitor, effectively foreclosing the market. Although this approach incurs short-term costs due to the loss of third-party app participation, it can provide significant long-term competitive benefits by reducing potential rivalry. For example, in 2021, the Italian Competition Authority concluded that Google had engaged in anticompetitive behavior by preventing EnelX's app JuicePass—a service for recharging electric vehicles—from accessing Android Auto. This happened even if, at the time, Google did not offer a directly competing service, though it was reportedly planning to add similar functionalities to Google Maps.

An alternative TDP strategy is to first welcome third-party sellers to the platform (often while charging commission fees) and then imitate or improve upon their offerings. While such imitation expands consumers' choice sets in the final product markets, it may raise a "self-preferencing" issue.

As summarized in Hagiu, Teh and Wright (2022), the hybrid model of selling own and third-party products on the same platform introduces a mixture of pro- and anti-competitive considerations. On the positive side, some types of products may be more efficiently provided by the platform, while others may be more efficiently provided by third-party sellers. Offering all of them in the same marketplace can provide one-stop shopping benefits to users. On the negative side, the platform may want to favor its own products over those of third-party sellers, and consequently distort competition in the marketplace. Such self-preferencing can happen if the platform steers consumers

[35] Farrell and Saloner (1986) explore a similar setting, highlighting the roles of "excess inertia" and "excess momentum" in dynamic competition.

towards its own products (e.g., via search and recommendation algorithms), or if the platform obtains proprietary information on third-party products and then uses that opportunistically to decide whether to copy and compete on the more successful offerings, potentially leading to reduced incentives for third-party sellers to invest or innovate.

While these self-preferencing practices sound intuitive and alarming, they do not automatically imply harm to consumers. Because platforms earn commission from third-party sales, they only have incentives to steer users away from third-party products if their own products generate greater net profits for the platform. Since greater net profits from own products could be driven by the platform's better ability to produce and distribute the product than third-party sellers, such steering could benefit consumers while hurting the profits of affected third-party sellers.

Using a theoretical model to analyze these tradeoffs, Hagiu, Teh and Wright (2022) find that an outright ban of such a hybrid model can harm consumer surplus and welfare, even when the platform engages in product imitation and self-preferencing. They argue that policies that prevent imitation and self-preferencing by a platform may generate better outcomes than an outright ban. Similarly, Madsen and Vellodi (2025) show that an outright ban on data usage has an ambiguous effect on innovation, whereas more flexible rules controlling when and what data are made available can always improve the effectiveness of regulation.

Using a model with a logit-form demand system, Anderson and Bedre Defolie (2024) describe the economic underpinnings of the hybrid platform model when consumers face a continuum of differentiated products, including the platform's own products and third-party sellers' fringe products. In contrast, they find that consumers can be harmed under the hybrid platform model relative to a pure platform offering third-party products only, even though the hybrid model improves the platform's own quality of products or reduces its costs. This counterintuitive result occurs because a better own product leads the platform to generate more sales from its own product and raise the commission fee for third-party products, which in turn leads to fewer third-party products on the platform, ultimately reducing variety and consumer surplus.

Dendorfer (2024) argues that a hybrid platform has incentives to commit to treating third-party and own products equally ex-ante (when consumers sign up) if such a commitment is credible to consumers. In particular, the platform profits from selling a first-party product because it reduces double marginalization, which in turn leads to lower prices for consumers. When the platform allows its own products to compete directly with third-party offerings, increased competition squeezes the profit margin of third-party sellers and further reduces double marginalization. This not only benefits consumers but also generates more platform revenues from commission fees; hence, the platform has no incentives to engage in self-preferencing ex-ante. Interestingly, the platform does have a strong incentive to engage in self-preferencing ex-post (after consumers sign up to the marketplace); hence, the platform's ability to credibly commit to no self-preferencing ex-ante depends on its reputation in fairness and transparency regarding data and algorithm usage.

Turning to empirical patterns, Zhu and Liu (2018) document Amazon's strategic entry into third-party sellers' product spaces. They find that Amazon is more likely to target successful product spaces, and less likely to enter product spaces that require greater seller efforts to grow. While Amazon's entry discourages affected third-party sellers from subsequently pursuing growth on the platform, it increases product demand and reduces shipping costs for consumers. Using deep learning tools, Korganbekova and Korganbekov (2024) analyze visual and textual similarity measures between 624 Amazon Basics and 2 million third-party seller products. They find significant and consistent similarities between private-label and third-party products across multiple product categories. They also find that Amazon takes an average of 2.5-3 years to imitate a product, while it takes longer (approximately 5 years) to replicate smaller sellers' products. Zhu (2019) summarizes the platform's product entry into platform users' product spaces in a few other markets.

Concerns may also arise when TDPs choose to provide tighter integration with first-party—rather than third-party—products, which has the potential of hurting third-party sellers. Li and Agarwal (2017) examine the effects of Facebook's (Meta's) integration of Instagram on consumer demand for first-party applications and competing third-party applications. They find that integrating Instagram raised consumers' value, significantly boosting Instagram's use for photo sharing on Facebook. This led to a positive spillover effect for large third-party apps, which experienced a slight increase in demand, but reduced the demand faced by smaller third-party apps. Overall, demand for photo-sharing applications increased, suggesting that Facebook's integration strategy benefited the ecosystem as a whole.

At times, merely the threat of platform entry, rather than actual entry, can change the behavior of third-party sellers on the platform. As shown by Wen and Zhu (2019), app developers on the Android mobile platform adjust innovation efforts (rate and direction) and value-capture strategies in response to the threat of Google's entry into their markets. They find that affected developers reduce innovation and raise the prices for the affected apps, and shift innovation to unaffected and new apps after the threat of platform entry increases. It is unclear how the reduced and redirected innovation affects the overall welfare from innovation: since many apps already offer similar features, Google's entry threat may reduce wasteful development efforts.

The presence of platform entry, or entry threat, and the platform's impact on affected third-party sellers on the platform, do not automatically imply evidence for or against self-preferencing. A few recent papers attempt to detect whether platforms that employ the hybrid model treat their own and third-party products differently.

Using a custom browser extension to collect consumer search data among a panel of study participants, Farronato, Fradkin and MacKay (2023) find that Amazon-branded products are indeed ranked higher than observably similar products in consumer search results, and the prominence given to Amazon brands is 30 percent to 60 percent of the prominence granted to sponsored products (i.e., products in highlighted positions, rather than appearances in organic search results).

Similarly, Waldfogel (2024) tracks over 8 million Amazon search results in 22 Amazon domains, finding that, conditional on rudimentary product characteristics, Amazon's own products receive search ranks that are 24 positions better, on average, throughout the sample period. Moreover, shortly after the EU designated Amazon a "gatekeeper" platform in September 2023 under its Digital Markets Act (DMA), the Amazon rank differential fell from a 30-position advantage to a 20-position advantage, whereas other major brands' rank positions were unaffected. Surprisingly, the changed Amazon search rankings appear in both Europe and other jurisdictions; thus, it is difficult to conclude whether the change is driven by something other than the EU DMA or that the gatekeeper designation by the DMA has spillover effects in non-EU jurisdictions.

The above two studies share a common caveat: Amazon and third-party products may vary in unobservable attributes that could justify the ranking difference even without self-preferencing. To address this caveat, Farronato, Fradkin and MacKay (2024) run a field experiment using a custom browser extension that randomly varies the set of products observable to consumers on Amazon.com. In the absence of Amazon brands, they find that consumers substitute toward comparable third-party products but exhibit no additional search effort and do not shift shopping to other retail websites. They conclude that no evidence suggests Amazon discriminates in favor of its own products in search results.

Focusing on Amazon's algorithm in product recommendation (rather than search ranking), Chen and Tsai (2024) find that products sold by Amazon receive substantially more "Frequently Bought Together" recommendations across popularity deciles. They show that when an Amazon product is out of stock, identical products sold by third-party sellers face an eight-percentage-point decrease in the probability of receiving a recommendation. They argue that the pattern is most explainable by the economic incentives underpinning platform steering, and that the steering lowers recommendation efficiency.

The mixed evidence concerning platform entry into third-party sellers' product spaces calls for a unified framework to detect the presence and harm of self-preferencing. Reimers and Waldfogel (2023) make the first laudable attempt in this direction. They develop a simple equilibrium framework in which consumers choose among ranked alternatives, while the platform chooses product display ranks based on product characteristics and prices. They define the platform's ranks to be biased if they deliver outcomes that lie below the frontier that maximizes a weighted sum of seller and consumer surplus. They also compare two bias testing approaches, using Monte Carlo simulations as well as data from Amazon, Expedia, and Spotify.

As researchers and policymakers search for a principled way to define, detect, and analyze self-preferencing, a few fundamental questions arise. First, since most TDPs are for-profit platforms and have a fiduciary duty to their shareholders, arguably every business decision made by TDPs can have a more favorable impact on the profitability of the platform itself than on third-party sellers on it. How to classify which self-interested TDP decisions meet or do not meet the definition of self-preferencing is still an open question. Second, the welfare standard that should be applied to potential self-preferencing behavior—should the objective be the welfare of final consumers only, the welfare of final consumers and third-party sellers, or the welfare of all platform users plus the profits of the TDP in question—is also an open question. A third open line of inquiry is the extent to which the aforementioned two questions should apply to a small set of select TDPs rather than to all digital platforms or all technology ventures.

7. Conclusion

This chapter provides a review of a wide range of interactions between top digital platforms (TDPs) and technology ventures (TechVs), and the corresponding cross-disciplinary literature, highlighting a number of ways in which these relationships can influence the development and diffusion of innovation.

Taken together, the chapter demonstrates that TDP–TechV interactions are multi-faceted, from input markets of capital and labor to output markets of technology transfer and final products, spanning financing, labor-market competition, cooperative R&D, product-market rivalry, and regulatory policy. TDPs may act as investors, suppliers, customers, intermediaries, competitors, and acquirers of TechVs, and their interactions are strategic, dynamic, and highly relevant to public policies.

This array of relationships calls for a nuanced understanding of both firm-level strategies and public policy frameworks. On one hand, large TDPs may help resource-constrained TechVs to accelerate and commercialize their innovations; on the other hand, TDPs' scale, market power, interoperability, and/or self-preferencing, among other aspects, may or may not dampen competition or distort innovation incentives.

We identify a few areas that may benefit from future research. First, although many of the scenarios identified in this chapter—from horizontal price competition to raising rivals' costs and exclusive dealing—have long existed, multi-sided platforms introduce a network dimension that could amplify or alter these classical behaviors. For instance, self-preferencing can be viewed as analogous to store brands in traditional brick-and-mortar retail, yet the data-driven feedback loops that characterize modern platforms may significantly affect its scale and scope. Identifying precisely how network effects influence platform conduct, and how that conduct differs from non-platform market structures, remains an important empirical and theoretical challenge.

Second, as technology firms engage simultaneously in upstream (e.g., cloud services, SDK provision) and downstream (e.g., final product markets, app stores) activities, the lines between vertical and horizontal competition are increasingly blurred. Further work might examine how TDPs integrate across multiple market segments and how these cross-segment strategies shape TechVs' incentives to innovate, enter, or exit. Researchers may also examine whether TDPs can leverage vertical integration to mitigate some forms of double marginalization while exacerbating other competitive concerns, such as merger-related entry deterrence or non-compete enforcement.

Third, self-preferencing practices need more precise definitions and empirical evaluation. On one hand, platforms have always been free to engage in self-interested business decisions; on the other hand, policymakers and courts increasingly scrutinize conduct that may harm consumer or third-party welfare. Future research might refine methodologies for detecting and quantifying the net welfare effects of platform steering, imitation, and product entry. In parallel, additional work is needed to clarify whether—and under what conditions—harms to third-party sellers, or to smaller TechVs that rely on the platform, should be factored into the standard antitrust analysis.

These research directions underscore the dynamic nature of platform-based digital markets. The interplay between TDPs, TechVs, and other market participants will continue to shape how innovation and competition evolve in the digital economy.

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