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Chapter 7

Competition in the Digital Economy: New Technologies, Old Economics

Digital markets have become an integral part of Americans' daily lives. Over 14 percent of retail shopping now happens digitally (U.S. Census Bureau 2022), and digital markets now account for more than $2 trillion in value (over 10 percent of gross domestic product) and employ 8 million workers in the American economy (Highfill and Surfield 2022). The economic forces operating in digital markets are not particularly new; however, when combined with the scale afforded by digital settings, the low costs of connecting with others, and the large amounts of data being collected, the economics of these markets lead to new implications for how these markets look, how they operate, how they make an impact on the economy and society, and how they should be regulated.

Nearly all digital markets feature positive "network effects"—meaning that the value of a product or service increases as the number of users grows (i.e., as the "network" gets bigger)—so having fewer, larger service providers can benefit users. A social media website, for example, is of little value to its users if it has very few users; it is, in fact, more convenient to have all your friends accessible via the same website. In addition to network effects, digital settings enable a global scale and the unprecedented collection of data, which can all favor the rise of dominant firms. These forces can also act as barriers to entry, preventing new firms from challenging dominant ones.

Healthy competition among many firms pushes companies to produce goods at their lowest possible cost, offer products and services at the best prices, provide better wages and working conditions, create new technologies,

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and develop and sell new products that people want to buy. This, in turn, ensures that economic agents make the best use of society's resources. In contrast, dominant firms with significant market power may use this power to increase prices, reduce quality, and lower output, making consumers and other market participants worse off. This is why regulations are necessary to ensure that the competitive process is protected and to maintain a level playing field for all market participants.

This chapter reviews some of the potential economic benefits delivered by digital markets, such as lower search costs and increased variety. The chapter also explores other characteristics of digital markets that differentiate them from their offline counterparts, including the ability of firms to gather a huge variety and volume of data on users, potentially without their knowledge, either by running experiments or simply monitoring users' behavior, and rapidly process these data to derive significant value. These data can be used to improve firms' product offerings, which can benefit users, or for other purposes, such as personalized pricing, which may benefit firms but harm users.

The chapter closes with a discussion of the regulation of digital markets. Regulators' challenge is to deliver all the benefits of competition—such as innovation, privacy, and low prices—in a setting where economic factors may drive markets toward fewer competitors. As a result, regulators should seek to lower barriers to entry and also prevent a dominant firm from exploiting its power either in the same or a related market, or to engage in practices that harm consumers or other market participants in other ways. For regulators overseeing digital markets relative to offline ones, new areas of concern include the misuse of consumer data and collusion by pricing algorithms. Overall, digital markets present significant opportunities to benefit society if regulators, enforcers, and courts can adapt to the new digital landscape.

The Benefits of Digital Markets

In this chapter, the term "digital markets" encompasses the interfaces that electronically bring together various agents for economic or social purposes. Although there is no unanimously accepted definition of digital markets or what goods and services they include, the chapter refers to these diverse interfaces—including app stores, operating systems, search engines, social media platforms, web browsers, and online marketplaces. Unlike many offline settings, where buyers and sellers typically transact directly with one another, most digital markets involve an intermediary that brings together different agents and facilitates their interactions. In addition, "marketplaces" include not only traditional marketplaces—where buyers sell tangible items to consumers, as would occur in offline markets—but also markets where different economic agents are being matched. For example, an online job search website would be classified as a "market," as would a ride-sharing application on a mobile phone that connects drivers with riders.

In many cases, users may value the additional convenience of having interactions facilitated digitally (Goldfarb and Tucker 2019). Digital markets have also provided other benefits to consumers by creating new forms of price competition and saving time from travel or searches for goods and services, among others. For example, one early study (Brynjolfsson and Smith 2000) found that Internet retailers' prices were 9 to 16 percent lower and that they changed their prices by increments up to 100 times smaller as compared with traditional retailers, suggesting that they have lower costs for instituting price changes and that these savings are partially passed on to customers. However, other studies have produced more nuanced results, such as a more recent study (Cavallo 2017), which finds that online and offline prices are often identical among the largest firms. In e-commerce, digital markets allow for greatly increased product variety because there is much less of a physical inventory constraint when products are shipped directly to consumers. Digital markets also have benefits for businesses. They can potentially compete in markets that would otherwise be too costly to enter. The next sections further explore the value of these aspects of digital markets.

Reducing Search Costs

The seminal work of Stigler (1961) explores the value of lowering search costs. Digital markets theoretically enable perfect price comparisons across the universe of retailers of the same good at low cost, and also lower the acquisition costs of information. For example, digital marketplaces like eBay and Etsy are able to reduce search costs—such as the costs incurred to find a particular product or service, including the cost of the time spent looking—by bringing together and matching large numbers of buyers and

sellers that would otherwise spend a great deal of time searching for one another to transact a unique item. An early study in the digital era (Brown and Goolsbee 2002) found that the Internet led to lower prices for term life insurance. Other studies from the same period found that digital markets reduced prices for consumers, such as estimates of an average of 2 percent saved by customers of online car-buying referral services (Scott Morton, Zettelmeyer, and Silva-Risso 2001) and an average of 16 percent saved by consumers shopping for electronic products using an online price comparison tool (Baye, Morgan, and Scholten 2003). More recently, researchers have investigated the potential trade-offs between reducing search costs and increasing the potential for collusion; issues related to collusion are addressed later in the chapter.

In theory, digital markets should be inherently more competitive, thanks to the low search costs and increased price transparency, all else being equal. However, one natural response by firms to combat this is to introduce obfuscation. Ellison and Ellison (2009) document that firms face a very high price sensitivity of consumers in online marketplaces that make price comparisons easy. As a result, sellers undertake price obfuscation behaviors, such as making product descriptions complicated so that comparisons are difficult, creating multiple versions of the same product, and attempting to "upsell" consumers who were drawn to an initial low price. Such behaviors have been documented in multiple government sources and findings, or engage in so-called drip pricing strategies (Blake et al. 2021; FTC 2017; CFPB 2022; White House 2016).

Increased Variety

Consumers have also benefited from increased access to variety in both products and services that has been enabled by digital markets. Brynjolfsson, Hu, and Smith (2003) estimate that the benefits to consumers attributable to increased product variety among online booksellers may be 7 and 10 times larger than those from increased competition and lower prices. Quan and Williams (2018) estimate that the value of the online footwear market is 5.8 percent greater than the traditional local retail market due to the increased variety available, and Gentzkow (2007) finds that a free online version of a newspaper in Washington was worth $0.35 per reader per day, or a total gain of about $52 million per year in 2021 dollars. One study also found the availability of online services meant that consumers in smaller, less densely populated places could be better connected to national markets, increasing their access to a larger variety of goods and services (Sinai and Waldfogel 2004). It is worth noting, however, that if a particular firm achieves dominance in a market, the variety offered becomes something that this firm can control.

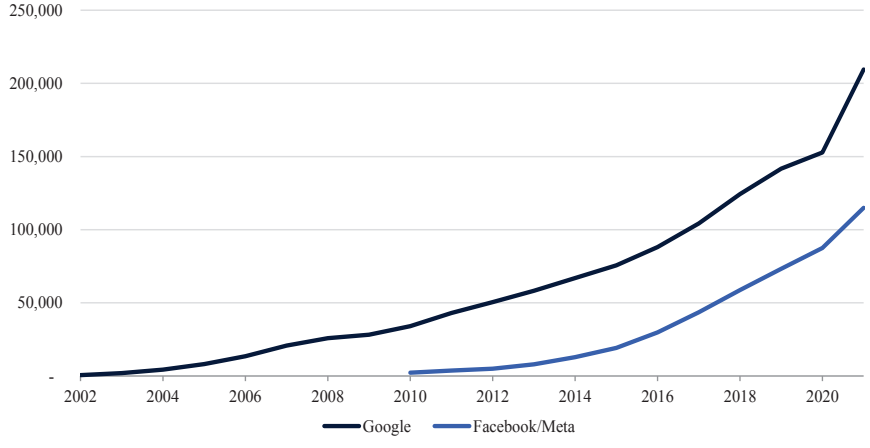
"Free" Products and Services

The set of products and services available in digital markets that appear to be "free" for consumers is large (e.g., Internet search engines, email, digital maps, music streaming, video streaming, price comparison tools, and online games). Research has shown that consumers value online tools like search engines and email services in thousands of dollars per year (Brynjolfsson et al. 2019). This phenomenon is not unique to digital markets; broadcast television and radio are free for those with a television set or radio, and some newspapers are offered for free. This apparently free access is often made possible by business models that depend on advertising revenue and collection of user data to subsidize consumer products and services. For example, figure 7-1 shows the exponential growth in advertising revenue for Google and Facebook, which enables them to offer a number of ad-supported products and services. A counterpoint to many "free" goods and services is that they could have negative externalities, meaning that there are external costs to society beyond the prices being paid for them. In other words, these products may not be free after all; instead, users are paying for them—for instance, by indirectly "selling" their data. The chapter elaborates on this dynamic in the next section.

Given that so many products and services have zero monetary costs for consumers in digital markets and that these markets have become so large and pervasive, it is possible that U.S. current national accounts are missing

Figure 7-1. Growth in Advertising Revenue by Digital Platform, 2002–21

Millions of 2021 dollars



Sources: U.S. Securities and Exchange Commission, Bureau of Economic Analysis, and CEA calculations.
Note: Google revenue includes advertising revenue across Google Search, YouTube, and Google Network members. Facebook/Meta revenue includes all advertising revenue. Nominal values are adjusted by the U.S. Personal Consumption Expenditures Price Index (chain).

much of the value that is created in these markets. One paper proposes a way to account for this with a new measure of gross domestic product, called "GDP-B" (Brynjolfsson et al. 2019).

Many have also argued that some of the innovations in digital markets have had unintended or negative side effects on society more generally. Box 7-1 explores research on the broader societal implications of digital markets.

Box 7-1. The Societal Implications of Digital Markets

Many digital services serve not only economic purposes but also important social and political ones. As Americans spend more time online, these services are becoming an important conduit for learning and sharing information about contemporary events and social movements, both domestically (Suh, Vasi, and Chang 2017; DeLuca, Lawson, and Sun 2012; Carney 2016; Mundt, Ross, and Burnett 2018) and internationally (Gorodnichenko, Pham, and Talavera 2021; Aday et al. 2013). Online services, including social media platforms, also play an increasingly large role in political campaigns and advertising, as evidenced by the growing amount that politicians spend on digital advertising (Williams and Gulati 2017; Barrett 2021).

This increase in the political information circulating online has influenced how Americans engage in politics. For instance, being exposed to online political information like social media advertisements has changed how people express their beliefs, including through their voting behavior (Beknazar-Yuzkashev and Stalinski 2022; DiGrazia et al. 2013). In addition, these effects often extend across networks of friends and social contacts (Bond et al. 2012; Jones et al. 2017).

Social media platforms may exacerbate political polarization (Allcott et al. 2020). One study found that exposure to Twitter bots disseminating opposing views reinforced preexisting political positions (Bail et al. 2018). Levy (2021) conducted an experiment showing that social media algorithms limited exposure to news outlets with opposing views, increasing polarization. Conversely, other studies have suggested that the role of social media platforms in spurring political polarization is limited (Prior 2013; Fiorina and Abrams 2008; Boxell, Gentzkow, and Shapiro 2017).

Racism, sexism, and discrimination also exist online, and in some cases, this can escalate to more hateful content and conduct. In an experiment conducted on eBay, Ayres, Banaji, and Jolls (2015) found evidence of racial discrimination, with Black sellers making less than white sellers, despite selling the same product: baseball cards. Similar results were found by Doleac and Stein (2013). Expanded broadband Internet access has also been associated with a rise in hate crimes (Chan, Ghose, and Seamans 2016), as has reliance on social media and support

for Islamophobic policies (Lajevardi, Oskooii, and Walker 2022). One particularly salient example involved Microsoft, which launched an artificial-intelligence-powered Twitter bot (automated online social media accounts are known as "bots") named "Tay" in 2016 that was intended to learn as it interacted with users. The bot lasted one day before it was taken down for tweeting racist, misogynistic, and transphobic content (Victor 2016). A similar fate befell a South Korean chatbot after it began using homophobic slurs (McCurry 2021).

Another concern involving online services is their ability to easily spread misleading or factually incorrect information. For example, one study found that fake news stories were widely circulated during the 2016 presidential election, with inaccurate stories favoring at least one of the two candidates being shared roughly 38 million times (Allcott and Gentzkow 2017). Bots were also found to play a role in spreading and amplifying misinformation during the COVID-19 pandemic (Himelein-Wachowiak et al. 2021; Xu and Sasahara 2022; Ayers et al. 2021), which became factors in COVID-19 vaccine hesitancy (Garett and Young 2021; Neely et al. 2022; Pierri et al. 2022).

Finally, as social media plays a more central role in society, significant concerns have been raised about their effect on mental health, particularly among younger users. In 2021, the Surgeon General released a report titled "Protecting Youth Mental Health" (U.S. Surgeon General's Advisory 2021) that specifically cited the dangers that arise when social media companies "[focus] on maximizing time spent, not time well spent." The report called for additional research on the specific risks and harms presented by social media platforms.

How Is Competition Different in Digital Markets?

Economists are interested in encouraging competition because competition typically results in markets that deliver consumers and other market participants the best choices, highest quality, and lowest prices, among other benefits. When many firms are offering similar products to consumers, consumers will choose to buy at the lowest prices, which gives firms an incentive to lower their prices. It also gives an incentive for firms to improve the quality of the product they offer by innovating, as this may be a means to attract consumers. If instead there is a single firm offering a product, that firm is likely able to increase its price or diminish its quality without losing many of its customers, as their customers do not have any good alternatives. This is why economists typically view a market dominated by a few large firms as unlikely to be good for consumers or other market participants.

This section introduces the main characteristics of digital markets and discusses how they can lead to markets becoming dominated by only a few large firms. None of these characteristics are unique to digital markets; but, as argued later in this chapter, network effects in combination with vast amounts of data and the unlimited scale possible in digital settings can result in concentrated markets.

Big Data

In digital markets, huge amounts of data are generated as a by-product of activity. While a traditional retailer can observe what products you decided to purchase, digital retailers observe what you searched for, what you were shown, and what you ultimately decided to buy. Further, given that online retailers control search results and site layout for each individual separately, they are able to use these data to personalize your experience in a way that traditional retailers could never do. Because of this, users' data can have increasing returns to scale and scope (Bergemann and Bonatti 2019) especially at smaller initial scales. The result is that data can serve as a barrier to entry for new firms that reduces competition.

In addition, the flexibility of the digital setting makes the process of conducting experiments much easier by greatly lowering the cost and increasing the scale at which firms can run experiments (e.g., Dubé and Misra 2023). The data gathered from experiments can be used to further improve product quality and the user experience but may also be used to set prices, manipulate behavior, or to pursue price discrimination strategies that ultimately lead to consumers being worse off. This research raises important questions about how consumer data are gathered and used, how technology may lead to consumer harm in some settings, and whether this suggests a role for regulation.

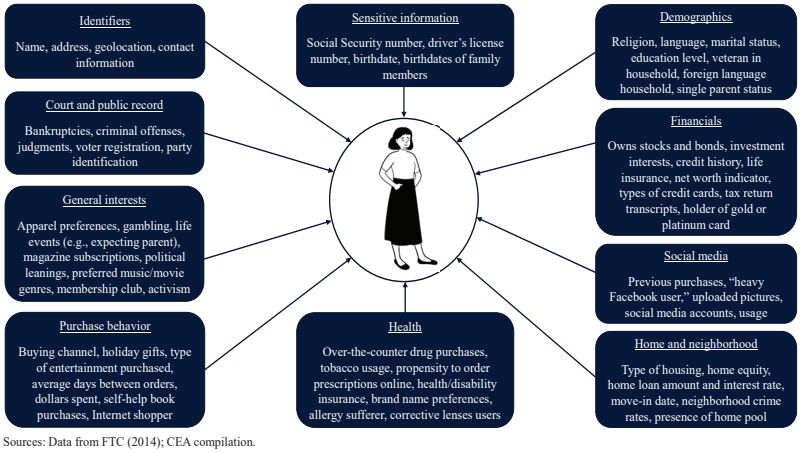
Related to the previous discussion of "free" products, users are often paying for services with their data as the "price" is the associated loss of privacy without further compensation. In fact, some products and services exist solely for the purpose of collecting valuable and sensitive user data. These data may be used in ways of which users are unaware; they may be used for targeted behavioral advertising, personalized pricing, or sold to firms known as "data brokers," which aggregate user data from multiple sources to sell as a product. Box 7-2 explores the types of information collected and sold by data brokers. The existence of data brokers could be negative for consumers, if their data are used in inappropriate ways, or possibly positive for consumers, if data are a barrier to entry and data brokers enable more firms to enter the market. The Federal Trade Commission (FTC) called attention to the data broker industry as early as 2014 with a report calling for greater transparency (FTC 2014).

Box 7-2. Consumer Data as a Business Model

At the nexus of big data are companies known as data brokers, which serve two primary functions: acquiring data and monetizing data (Crain 2018; Gu, Madio, and Reggiani 2021). These firms compile data from a variety of sources, including through public government records or through cooperative agreements, whereby a data broker and another entity like a retailer mutually share their records. Alternatively, brokers can purchase or license consumer data from retailers, banks, brokerages, and other data brokers (U.S. Senate 2013; FTC 2014). Using a combination of information gathered and inferences made based on these data, brokers assemble profiles and segments of consumers to predict how they might behave; for instance, their propensity to purchase certain products or services (FTC 2014; Mishra 2021).

Although Americans may be aware that their data are being collected to be resold, theoretical and empirical studies have suggested that users might be unaware of the scale or degree to which they are being monitored (Crain 2018; Choi, Jeon, and Kim 2019; Acquisti, Taylor, and Wagman 2016). In fact, almost every American has had their data collected by one, and likely many, of the major brokers, given that multiple brokers have information on nearly every American. For example, by 2014, one broker, Acxiom, had more than 3,000 data points on nearly every U.S. consumer and information on 700 million people globally (FTC 2014). Others had information on 99.99 percent of all U.S. properties or payroll data from 1.4 million businesses (Sherman 2021). One data set used for marketing purposes had over 75,000 elements,

Figure 7-i. How Data Brokers Aggregate Data from Government, Commercial, and Publicly Available Sources to Build In-Depth Profiles of Consumers



Sources: Data from FTC (2014); CEA compilation.

including markers for whether someone was a whiskey drinker, had life insurance, enjoyed romance novels, or used yeast infection products (U.S. Senate 2013). In some cases, these data sets can also identify individuals as financially vulnerable. For example, some tags that might be associated with a profile include "rural and barely making it," "tough start: young single parents," and "zero mobility" (U.S. Senate 2013). Figure 7-i provides examples of the different types of data that a broker might collect on (or infer about) a single individual to build out a profile that it may sell to its clients.

In August 2022, the FTC filed a lawsuit against one of these data brokers, Kochava Inc., for selling individuals' precise geolocation and movement data, including "to and from sensitive locations . . . associated with medical care, reproductive health, religious worship, mental health," and shelters for at-risk populations (FTC 2022). According to the lawsuit, Kochava claimed that on average, it was "observing more than 90 daily transactions per device." The FTC alleged that Kochava's clients who purchased the data would be able to identify or infer an individual's identity (based on their nighttime location) as well as whether they visited sensitive locations, such as a reproductive health clinic, a place of worship, or a domestic violence shelter.

Network Effects

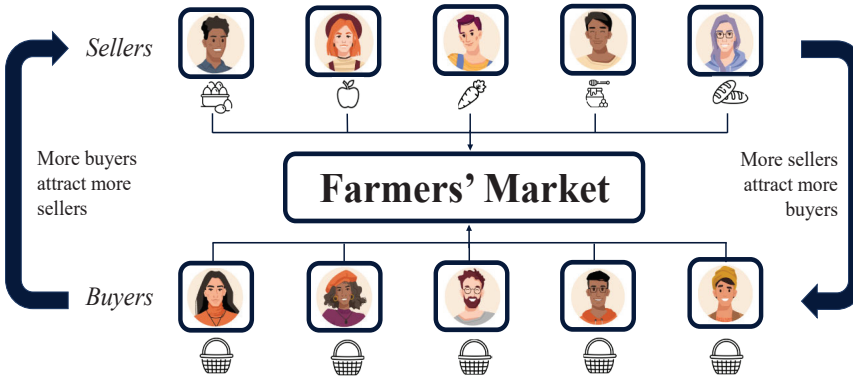
Network effects refer to any situation where the value of a product or service to an economic agent depends on the number of users (i.e., the size of the network) engaging with it. For example, the value of a messaging app depends on the number of users it has. Or the value of an e-commerce website for buyers depends on the number of sellers on the website, and vice versa. In many markets with network effects, the principal economic benefit comes from interactions between different types of participants (Rochet and Tirole 2003). Research has demonstrated the importance of network effects in many digital and traditional markets (Gandal 1994, 1995; Saloner and Shepard 1995; Rysman 2004); and with the proliferation of digital markets, network effects have become increasingly salient. A central feature of digital markets for determining competitive outcomes is the strength of network effects.

Network effects can be categorized in two ways: direct and indirect. Direct network effects are benefits or costs derived from the total number of users that belong to the network, and the benefit or cost to a user increases with the number of other users. Take, for instance, a video-conferencing service. There is little incentive for users to join if there are few other users; but as the user base grows, the service becomes more and more appealing to

consumers. This is an example of a positive network effect, which is common to social media and instant messaging, among others. In contrast, congestion is a common form of negative network effect in telecommunications networks. Cellular data networks suffer from reduced speeds when a large number of users are accessing the network simultaneously, for instance.

Indirect network effects occur when groups of different users interact and a given user benefits (or suffers) from having more users on the service from the other group(s). This situation exists for services such as e-commerce marketplaces, app stores, job-matching services, and food delivery services. For example, if a certain job-posting website has the most applicants looking for jobs, employers will find that site most appealing for posting jobs. Similarly, applicants will be more likely to look for openings on the website that has the most employers posting jobs on it. This creates a reinforcing cycle of more job applicants looking for jobs and more employers posting job openings. Another example would be marketplaces—either digital or brick-and-mortar—where more sellers attract more buyers, and vice versa. This dynamic is illustrated using a neighborhood farmers' market in figure 7-2. A farmers' market exhibits indirect network effects because the benefits for buyers and sellers increase with the number of agents of the other type present. As the farmers' market attracts more sellers offering more varieties, the value of going to the market increases among potential buyers. And because more buyers are circulating in the market, the value of going to the market for potential sellers of additional goods increases. Of course, if the farmers' market became too crowded, additional buyers and sellers would start to create negative congestion effects. Digital markets do not face this physical space constraint and therefore can continue to grow as more buyers and sellers enter the market.

Figure 7-2. Network Effects Are Present in Many Markets—Not Just Online



Sources: Eggs, honey, bread, and basket icons from Freepik via flaticon.com; face icons from Adobe Stock images.

Network effects have been considered a potential source of market power—the ability to raise prices without losing many customers—since before the rise of digital markets. In general, the presence of network effects constitutes a barrier to entry that raises the costs for new competitors to enter the market. If a new firm wanted to start a rival food delivery app to compete with an established firm, the new firm would be at a tremendous disadvantage because consumers and restaurants would likely see more value in the established firm's network than in a start-up with a small network. Caillaud and Jullien (2003) describe how network effects create a chicken-and-egg problem that can hinder competition. In order for start-up competitors to attract buyers to a new e-commerce service and away from a

Box 7-3. Glossary for Describing Digital Markets

two-sided market	A two-sided market is a market where a firm enables interactions (i.e., acts as an intermediary or platform), bringing together two sets of parties (e.g., buyers and sellers) to transact and operate. For example, a ride-sharing service operates in a two-sided market by connecting riders and drivers.
network effects	Network effects refer to phenomena where the value of a product or service increases or decreases as the number of users increases or decreases. For example, as more people sign up for a messaging service, it becomes a "better" service compared with a messaging service that has few users.
multi-homing	Using more than one competing service provider is referred to as multi-homing. For example, users may switch between two different ride-sharing services to take advantage of different prices or a shorter waiting time.
tipping-point market	A tipping-point market is a "winner-take-all" market, where consumers flock to one or a few firms as opposed to patronizing many firms. For example, the market of social media platforms often "tips" in favor of dominant social media platforms with many users (as opposed to numerous platforms with few users).

more established one, the competitor needs many sellers; but to attract sellers, they need many buyers. This dynamic can inhibit competition and can make a market susceptible to the phenomenon known as tipping.

A tipping point is generally defined as a critical juncture beyond which a significant and potentially unstoppable change takes place. The application of tipping points to the economics of firms that bring together two different types of economic agents to intermediate their interaction—these markets are referred to as "two-sided markets"—goes back to Fudenberg and Ellison (2003), who identified the role of what we now label as network effects in creating the conditions for dominant firms to emerge. These markets often "tip" in favor of the leading firms, meaning that one or two firms drive out their competitors and dominate the market. Box 7-3 is a glossary of the terms used to describe digital markets.

Multi-Homing

Another pivotal factor of digital markets for determining competitive outcomes is the degree to which one type of user elects to use only one service among a group of competitors, which is referred to as "single-homing." In other cases, users may be willing to use multiple competing services, or "multi-home," such as when a consumer pulls up two different ride-sharing applications on their phone to compare prices. All else being equal, if users are willing to use multiple, competing services, then these services are less able to raise prices or set terms that are unfavorable to users because they are more willing to take their business elsewhere (Teh et al., forthcoming).

When one side of the market multi-homes and the other single-homes, competition between services for users that only use one will be fierce (Armstrong 2006), because the service is the exclusive means by which the multi-homing side can reach those single-homing users, allowing higher prices to be charged on the multi-homing side (Jullien, Pavan, and Rysman 2021). Hence, users' willingness to use multiple, competing services can limit market power, giving the service an incentive to hinder users from multi-homing (Scott Morton et al. 2021). This can be accomplished through the use of switching costs—that is, costs that users would incur if they tried to transfer their business to a competitor (Scott Morton et al. 2019). Firms can impose switching costs through exclusive contracts or agreements, loyalty programs, termination fees, or a lack of data portability.

When Do Markets Tip?

Tipping occurs more easily in digital markets than offline markets due to their combination of positive network effects, valuable data, and a potentially massive scale. Whether a market will tip depends, however, on the willingness of users to switch between different services for the provision

of goods and services (i.e., whether they multi-home). When positive network effects exist and consumers have a high propensity to use a single service, digital firms can often leverage network effects to entrench their market power. For instance, a social media platform may be incentivized to limit the ability of nonusers to connect and share content with users. For a consumer, this means that if he or she quits the platform, it would essentially sever the connections the user has made with other users of the application. This can keep the consumer locked in to a service, even if they have other concerns—for instance, regarding their privacy. Ultimately, as users are incentivized to join the largest network(s), the market can tip in favor of one or more dominant firms (Kades and Scott Morton 2020).

Once a market has tipped in favor of a dominant firm, potential entrants that might want to offer innovative new features or charge lower fees would face a very uphill climb in establishing themselves. That is, the benefits of competition we would normally expect will not be realized. A dominant firm also has an incentive to acquire any potential entrant to prevent competition in the market. Dominant firms may further exploit their dominance in a market to give themselves an advantage in other markets, harming competition. Four factors are credited with preventing tipping in a two-sided market: product differentiation, multi-homing, interoperability, and congestion (Jullien, Pavan, and Rysman 2021).

Product differentiation. If a competitor offers a higher-quality experience or other differentiated features beyond its role as an intermediary, it can draw enough customers who find these services valuable to enable it to survive. One example of how firms attempt to differentiate is to have superior recommendation algorithms so that they are better able to match consumers with products. Another is how firms make the process of transacting as simple as possible, thus requiring less effort on behalf of buyers and sellers.

Multi-homing. When users of a service are willing to also use competing services, neither service has much market power over those users. Therefore, neither is likely to achieve dominance. Firms know this, and thus they actively engage in behavior that makes it more difficult for users to also use a competing service. Their tactics include things like having exclusive content, for example, among competing streaming services. If all video-streaming services offered the same content, consumers would likely choose the one with the lowest price; but once a streaming service has exclusive content that consumers demand, consumers will not be as willing to switch to other services. Another approach might be to have a loyalty program that makes users less willing to use other services.

Interoperability. Making services "interoperable"—able to exchange data between themselves—weakens the network effects of either individual service. With interoperability, network effects no longer exist at the firm level; rather, they would aggregate at the market level (Kades and Scott

Morton 2020). Take the example of short-message/messaging service (SMS) text messaging. This clearly has a positive network effect, given that the value of SMS text messaging increases as more people have mobile phones that can send and receive these messages. This network effect is not firm-specific because the SMS text network is interoperable between cellular carriers and telephone operating systems. In contrast, an app like iMessage by Apple is only available on Apple devices and has no interoperability with Android messaging apps, so the network effect is firm-specific to Apple. By broadening network effects from only accruing at the firm level to covering the entire market, interoperability directly challenges the mechanism that can entrench the market power of dominant firms and spurs competition in the market. Open standards that allow interoperability between different firms' products—for example, the universal serial bus standard—are one way to achieve network effects at the market level and encourage robust competition.

Congestion. Finally, congestion—a negative network effect—tends to make the growth of some services beyond a certain size untenable due to the degradation of services as users are added to the network. In most digital markets, this is of less concern as the scale of most services is limitless before encountering congestion; however, as a social network grows, it may be subject to greater problems of fraud, cybersecurity attacks, and content moderation.

Of these factors, firms operating in digital markets have the ability to control their degree of product differentiation and interoperability as well as to influence the tendency toward multi-homing (Athey and Scott Morton 2022). Regulators of these digital markets want to bring the benefits of competition to the economy and protect consumers either by acting to prevent markets from tipping in the first place or taking action in markets that have tipped.

The Role of Law and Regulation in the Digital Market

Economists often evaluate the benefits and costs of an action or innovation in terms of its value to society as a whole. When represented mathematically, this is called the "social welfare function." This function includes the benefits and costs for consumers, producers, and the government as well as any benefits or costs for society stemming from inefficiency or externalities. These benefits and costs are not only measured in terms of prices and quantities for the economy's goods and services but can also include effects on less tangible things like innovation, inequality, and well-being. All these concerns may inform the priorities of regulators and law enforcement in digital markets; this section focuses on the direct implications of the economic model underlying competition in digital markets.

U.S. antitrust laws seek to promote competition and protect market participants, including workers, consumers, sellers, and buyers from anticompetitive mergers and business practices. The enforcement of these laws is conducted by the U.S. Department of Justice (DOJ) and the FTC as well as by other Federal and State agencies. In addition, agencies such as the Federal Communications Commission and the FTC also have relevant regulatory (i.e., rulemaking) authority. The Biden-Harris Administration's competition policy is overseen by the White House Competition Council, which was established by the President's "Executive Order to Promote Competition in the American Economy," which was issued on July 9, 2021 (White House 2021).

The antitrust agencies monitor the conduct of firms, with a specific focus on mergers, monopolization, unfair methods of competition, and collusion. Before the 1980s, the antitrust agencies focused heavily on mergers and monopolization activity because firms that control a significant share of the market (or potentially all of it, in the case of a monopoly) generally have a greater ability to raise prices and reduce quantities or engage in other anticompetitive practices in an effort to maximize their profits. Though the focus of antitrust agencies shifted away from monopolization activity for a time, enforcement against monopolies has seen renewed attention in the past several years. The FTC also has authority to deter unfair or deceptive acts and privacy and data security degradations, which can intersect with competition oversight. A recent example of such practices is the $5 billion fine imposed on Facebook in 2019 for misleading consumers about their privacy on the platform (FTC 2019).

The DOJ and FTC are also guided in their enforcement activities by a body of case law that has been developed over the last century. Much of this case law has focused on regulating mergers, particularly mergers between competitors selling the same or very similar products ("horizontal mergers"), with the aim of balancing the potential efficiency gains from the combination passed on to consumers against the risks posed by the loss of competition between the merging firms, such as higher prices or reduced innovation. As discussed above, digital markets, in combination with network effects, are predisposed to become highly concentrated and be controlled by a few large firms. Though concentration alone is neither procompetitive nor anticompetitive, highly concentrated markets are more susceptible to anticompetitive practices. Existing competition laws and regulations written before the emergence of digital markets may not have fully anticipated how these markets would function and may therefore be insufficient to ensure robust competition and protect consumers and other market participants.

Network Effects Create a Competitive Moat

If network effects at the firm level are sufficiently strong, having larger firms may be better for customers. For example, as noted above, messaging services may be more useful when they have more users. Competition among many small, incompatible messaging services is unlikely to benefit consumers, given the fixed costs and returns to scale. And yet, left to its own devices, a dominant messaging service would likely raise prices above a competitive level, provide lower quality, potentially innovate less, or do all of the above. This would be seen as a market failure, which should be addressed via regulation, nationalization, or antitrust enforcement (Joskow and Rose 1989; Joskow 2007; Smiley and Greene 1983).

Further, network effects have long been recognized as potentially becoming an "economic moat"—a protective barrier that guards a profitable business (the "castle")—in that they lead to customers being locked in to certain products, making mass migration to a new product unlikely unless accompanied by a simultaneous technological advance somewhere else in the ecosystem (Bresnahan 2002). New entrants are less likely to be successful when facing an entrenched firm with network effects or the benefits of scale, eliminating some benefits of competition.

The messaging service example is illustrative, in that a potential solution to bringing back the benefits of competition in the presence of network effects may be interoperability, although interoperability alone may not suffice to fully restore competition. Interoperability expands the benefits of network effects from the firm level to the market level. Requiring that competing services interoperate is one remedy that can dissolve some of the anticompetitive outcomes of network effects because all competitors would share the same network effect. Thus, interoperability would mean that both old and new services would need to compete on other dimensions like quality to keep users on their services.

Another related tool is data portability, the idea that consumers can take, or "port," their data to a different service. This reduces the switching cost created by network effects. For example, imagine that a user wants to switch from one music streaming service to another. One barrier for the consumer would be having to give up their playlists and liked songs. Data portability would allow the user to download and port these playlists to another streaming service, thereby reducing the barrier to switching. Both data portability and interoperability can make it more appealing for a potential entrant to introduce a competing service and increase the likelihood of new innovations being able to succeed.

The Challenge of Preserving Competition in Digital Markets

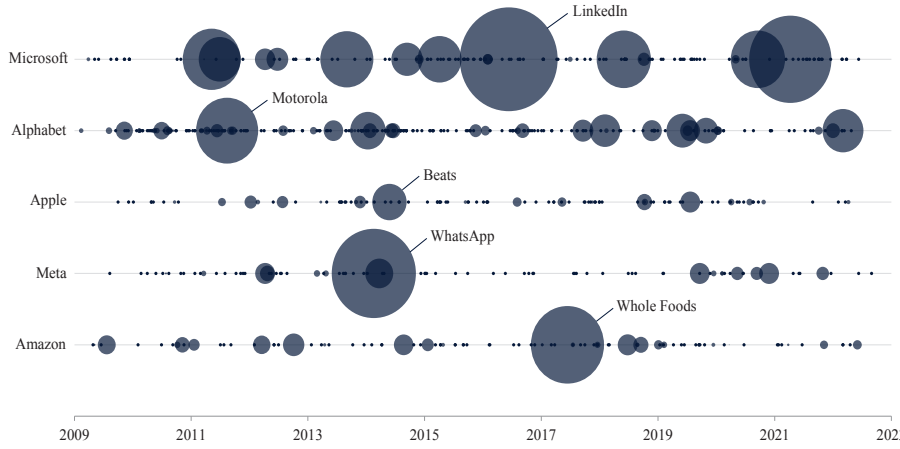
Traditional competition policy analysis often focuses on estimating changes in prices to assess effects on consumers. However, this approach faces new challenges in digital markets arising from several sources—notably, the provision of free goods and services, and the cross-subsidization in markets with indirect network effects. For "free" goods with no monetary price, in a more competitive market, the true price could be negative (e.g., consumers could be paid to watch ads or fill out surveys with their personal data), or service could be better. As a result, demonstrating anticompetitive harm may require alternative measures rather than prices.

Research into the effects of mergers in digital markets demonstrates heightened complexity in the expression of competitive effects. Chandra and Collard-Wexler (2009) empirically show that mergers of firms in two-sided markets may not lead to higher prices on either side of the market in an application to the Canadian newspaper industry; and Song (2021) shows that mergers between firms in two-sided markets can lead to either higher or lower prices after the merger, but that even agents that experience higher prices may be better off due to increased network effects. Another study, of the merger of two platforms for pet-sitting services (Farronato, Fong, and Fradkin, forthcoming), found that on average consumers were not substantially better off with one platform than two competing ones because the network effects were not large enough to balance the losses due to higher prices and reduced variety after the acquired platform was shut down. In markets with indirect network effects, policies intended to increase competition may need to account for how an intervention on one side will affect the well-being and behavior on both sides of the market because pricing is linked to the costs and price sensitivity of users on both sides (Evans 2003; Wright 2004).

These challenges are exacerbated by the scale of the task of protecting competition in digital markets. For example, large tech companies are highly acquisitive. Figure 7-3 shows that the volume and value of mergers and acquisitions among tech firms is large, a trend that has drawn the attention of antitrust authorities. Reviewing these acquisitions for anticompetitive harm requires significant resources due to the complexity of the markets, the sophistication of the firms, and the need to look beyond the impact on retail prices alone.

Finally, digital markets can be highly dynamic, appearing and evolving rapidly. This can limit the ability of regulators to use current and historical data to analyze market behavior. In addition, it can be quite difficult for regulators to identify nascent competitors and potential entrants in assessing proposed mergers. Further, when antitrust authorities do identify such anticompetitive mergers (DOJ 2020), the lack of prices for the potential entrant

Figure 7-3. Completed Acquisitions by Large Tech Firms



Sources: Bloomberg; Crunchbase; Mergr; Alphabet; Meta; Amazon; Google; Microsoft; TechCrunch.
Note: The dark blue circle radius is proportional to the deal size, and the small black dots indicate acquisitions with no publicly available price. Deals include completed mergers-and-acquisitions deals by the specified firm as of the fall of 2022.

or lack of significant market share for the nascent competitor are again problematic for traditional competition analysis, since anticompetitive harm has often been demonstrated using economic models showing that mergers would lead to higher prices. These challenges underscore the need for further research and approaches to evaluating competitive effects in complex digital environments. This is work the antitrust agencies are well positioned to do, in concert with academics and other stakeholders.

Preventing the Extension of Dominance into Adjacent Markets

Digital markets with network effects, big data, and a global scale have tended to coalesce on a small number of dominant firms. An obvious concern is that firms could exploit their dominance in one market to gain market power in or dominate adjacent markets. This type of conduct could be illegal under Section 2 of the Sherman Antitrust Act.

Today, there are many examples of digital markets where a dominant firm also competes in an adjacent market: Google and Apple operate app stores, in which their own apps compete with other apps; Amazon operates an e-commerce marketplace, where its Amazon Basics brand competes directly with those from other firms; and Microsoft operates a video game marketplace, where they also compete as a video game developer. In these situations, one concern is that the dominant firm could have an unfair advantage for its competitive products, known as "self-preferencing." For example, Apple was alleged to give its own apps higher priority when a person searched its app store (Mickle 2019).

If dominant firms exploit their dominance to give their own offerings an advantage, consumers may not get the full benefits of competition. One approach a regulator or legislature might take to improving the functioning of certain markets is to prohibit self-preferencing and similar practices. However, such a ban could be challenging to enforce, as a regulator would need to show that self-preferencing is intentionally built into a service instead of just occurring organically because, for example, the owner's products have received better reviews.

A related concern about marketplace operators that compete on their own marketplaces is the issue of how competitors' data are used. Marketplace operators are able to gather extensive data on competitors' products and customers, and they may have an incentive to use those data strategically, either in the design of their own competing products or in their pricing or promotional strategies. They could also intentionally limit what data from the site are available to competitors. Any of these actions would further put competing firms at a competitive disadvantage. A regulator may want to prohibit the use of competitors' data or insist on the fair treatment of marketplace data for all firms in order to reset the competitive landscape, although enforcement of such a regulation could be a challenge requiring significant monitoring and oversight.

The ability of a dominant firm to extend its dominance into adjacent markets is a threat to competition. Society may miss out on certain innovative products if entrepreneurs realize that their product may just get copied by a dominant marketplace operator and, therefore, decide against investing in developing it. In addition, the better product may not "win" on an uneven playing field. Regulators can address this market failure by clarifying who owns what rights to the data collected and leveling the playing field for all firms in online markets. An overview of some of the approaches that regulators are taking, both internationally and in the U.S., is presented in box 7-4.

Preventing the Misuse of Consumer Data

Assessing the competitive effects of data usage and policies can be difficult. Research suggests that when data can be used to reduce a firm's exposure to risk, it can lead to increased innovation or efficiencies, potentially driving down prices (Eeckhout and Veldkamp 2022; Kirpalani and Philippon 2020; Competition Bureau Canada 2017). However, data can also become a barrier to entry that insulates firms from competition. Prüfer and Schottmüller (2022) show that under certain conditions, a data advantage can lead to market tipping. In addition, the ability of firms to collect massive amounts of data about individuals raises clear concerns about privacy and also about data protection, as leaks of massive data sets could expose individuals to

Box 7-4. International and Subnational Efforts at Regulatory Reform

Numerous antitrust and consumer protection efforts are occurring both internationally and in the United States at the State level. For instance, the European Commission has proposed a pair of new laws focused on regulating digital markets—the Digital Markets Act (DMA) and the Digital Services Act (DSA) (Council of the European Union 2022).

The DMA aims to promote competition by establishing rules about the types of conduct in which large "gatekeeper" firms can engage (European Parliament and European Commission 2022). In order to be designated a "gatekeeper," in each of the last three financial years, a firm must have had at least 10,000 annual business users established in the European Union, 45 million monthly users established or located in the European Union, and €7.5 billion (about $7.4 billion in 2021 dollars) in annual revenue across the EU or a €75 billion market capitalization (about $74.4 billion in 2021 dollars). It must also provide the same "core platform" services—for example, web browsing, messaging, and social media—in at least three EU member states. To foster competition between firms and reduce barriers to entry, the DMA lays out requirements by which gatekeepers must abide. For example, gatekeepers must allow for data portability and must make messaging services interoperable. They must also be more transparent about their mergers and acquisitions and must allow users to uninstall predownloaded software on the gatekeeper's operating system. At the same time, the DMA also restricts gatekeepers from engaging in certain business practices, like preferencing their own products over those of competitors on their platform ("self-preferencing") or combining users' personal data across the gatekeeper's different core platform services. The DMA also prohibits gatekeeper firms from engaging in certain price-setting practices and creating operating terms that discriminate against certain businesses and app developers. For instance, the DMA makes it illegal for gatekeepers to make business users sign agreements to not offer better terms on other platforms (known as most-favored-nation clauses). These agreements have the potential to dampen competition, raise prices and fees, and reduce entry by competitors offering lower-priced alternatives (Boik and Corts 2016; Baker and Chevalier 2013; Wang and Wright, forthcoming).

While the DMA primarily focuses on regulating the conduct of a few very large firms in an effort to promote competition, the DSA addresses the wider societal implications associated with digital markets and establishes regulations focused on filtering illegal content and protecting the fundamental rights of consumers online (European Parliament and Council of the European Union 2022). For example, the DSA requires that firms inform users about how and why advertisements are being targeted to them. It also bans firms from using personal data

to target advertisements if the firm is reasonably aware that the user is a minor. In addition, the DSA includes numerous other provisions, such as requiring online intermediaries to moderate illegal content (including hate speech), while giving regulators wide-ranging powers to request access to very large online platforms' business practices and algorithms.

In addition to new laws being passed abroad, certain States of the United States are also passing new regulations targeting digital markets, with a specific focus on consumers' data rights. As of late 2022, five States—California, Colorado, Connecticut, Utah, and Virginia—had passed comprehensive State-level regulations on consumer data and privacy rights in digital markets (NCSL 2022; Connecticut 2022). For example, Connecticut passed a law in 2022 that gave consumers more control over how their data could be collected, used, or accessed (Connecticut 2022). Once the law takes effect, in July 2023, consumers will have the right to access, correct, and delete records of their personal data. Connecticut residents will also be able to opt out of having their personal data sold or used for targeted advertising.

identity theft or other financial harm (Ichihashi 2020; Chapman and Bodoni 2022; O'Sullivan 2021).

For all these concerns about the misuse of data and protection of privacy, a practical intervention is to regulate how data can be collected, used, shared, and stored. The authors of one study explore mediated data sharing to reduce the correlation between users' data and thus to mitigate externalities that create excessive data sharing (Acemoglu et al. 2022). They propose sharing data with a third party that would transform their data to remove correlation with other users before sharing it with services requested by the user. Other policies that might impose fewer costs include "right-to-be-forgotten" provisions, which create time limits on data retention (Chiou and Tucker 2017).

Monitoring Pricing Algorithms and Collusion

Concerns have been raised that pricing algorithms could facilitate explicit price collusion by reducing uncertainty about consumer demand. O'Connor and Wilson (2021) suggest that this improved forecasting could either lead to lower prices and increased consumer benefits or enhance the ability of firms to support collusive arrangements. Other studies of retail gasoline markets have raised concerns about online price disclosure and experimentation facilitating the coordination of prices across firms (Luco 2019; Byrne and de Roos 2019). A simple example would be the use of posted prices

Box 7-5. Artificial Intelligence and Digital Markets

A fundamental aspect of the operation of digital markets is using artificial intelligence (AI) to translate the data available to firms into actionable predictions, recommendations, and decisions (OECD 2019). Many of the features that make digital markets so appealing to users are powered by machine learning and other algorithmic tools (Brown 2021). Indeed, many of the key features of digital markets—efficient matching, low search costs, an unmatched variety of products, and personalization of prices—are made possible by a combination of data availability and the application of AI techniques like neural networks, natural language processing, or other forms of machine learning. Though the use of these algorithms can improve the experience of users and increase firms' profitability, there are ongoing concerns that they will displace workers; introduce racial or other sorts of bias into these systems; make digital marketplaces even harder to regulate; and meaningfully impact individuals' or communities' rights, opportunities, or access to critical resources or services.

For ride-sharing companies like Uber and Lyft, machine learning is the key to their ability to set prices to assure that there are enough drivers on the road to meet customer demand (Liu et al. 2022). AI also allows social media platforms to optimize their content. TikTok relies on its algorithm's ability to use its wealth of data to select content that will keep users engaged longer (Smith 2021; Wall Street Journal 2021). Further, the ability of firms like Amazon to have the products that a customer is looking for in stock without having to maintain a surplus inventory is driven by AI-based predictions about demand at any given point in the future (Amazon 2021). All these features of digital markets are made possible because of the combination of data and algorithms.

However, the reach of AI in digital markets raises concerns that there could be a wave of automation of jobs (Sisson 2022). Even in cases where AI augments existing labor, as with Uber's algorithmic management of its drivers or Amazon's of its warehouse workers, some workers report deep levels of frustration and resentment due to such concerns as the degree of surveillance and the lack of transparency about AI decisionmaking (Möhlmann and Henfridsson 2019).

AI also has been shown to perpetuate and potentially exacerbate biases already present in society. There is a robust literature on this relationship, with findings of discrimination based on race alone found in algorithmic risk assessments in the health care space, facial recognition systems, and natural language processing (Obermeyer et al. 2019; Furl, Phillips, and O'Toole 2002; Caliskan 2021). Major players in the digital market have long struggled with these issues; for example, Amazon's attempt to build an AI-based hiring program resulted in a system that taught itself to prioritize male candidates and penalize résumés that

mentioned women's colleges and made other references to women (Dastin 2018). These biases can be both intentional, as when Facebook's AI-based advertising made it possible for advertisers to exclude specific users based on their race, and unintentional, as when women were shown fewer career ads because the cost to advertise to women was higher online (Zang 2021; Lambrecht and Tucker 2019). Even when an algorithm itself does not increase bias, differential rates of utilization of the algorithm can deepen racial and gender disparities, as in the case of Airbnb's Smart Pricing tool (Zhang et al. 2021).

As governments around the world consider how best to regulate digital markets, they are confronting the fact that AI's role in this market introduces levels of opacity and complexity that can hinder reasonable efforts at oversight (European Parliament 2022; Kroll 2021). Further, complexities emerge in assessing the intent of firms, which can be an important part of many regulatory systems (Chin 2019). Processes like algorithmic audits have been proposed as tools to overcome the "black box" features of AI that can create substantial information asymmetries between firms and regulators (Guszcza et al. 2018). These audits have received attention in areas related to hiring, and they are being actively considered both internationally and within the United States (Lee and Lai 2021; Engler 2021; Digital Regulation Cooperation Forum 2022). In 2022, the Biden-Harris Administration released the "Blueprint for an AI Bill of Rights" (White House 2022), which outlines five principles to guide AI system design that will protect the American public.

online to institute price matching, enabling firms to potentially achieve a higher price than they could achieve if their rivals' price was uncertain, as price-matching policies remove the incentive for competitors to lower prices. There is evidence that artificial-intelligence-based algorithms can potentially adapt to raise prices in a coordinated fashion, even if they have not been explicitly programmed to do so (Harrington 2018). This form of tacit collusion may be difficult to detect. In addition to the possibility of collusion through the use of algorithmic pricing, the use of automated software can support prices above competitive levels. This can intensify merger price effects in ways that are not accounted for in a traditional merger analysis and also generate greater price dispersion in the market (Brown and MacKay, forthcoming). In order to guard against the threats of tacit collusion and explicit price fixing enabled by pricing algorithms, antitrust authorities may require additional resources (i.e., computing, personnel, and financial resources). Box 7-5 explores other ways in which artificial intelligence affects the functioning of digital markets.

Conclusion

Although the basic economics of digital markets are well understood, when combined with the effects of scale and the data collection potential of the digital world, they raise new concerns. Many digital markets have become dominated by a few firms or even one firm, and these dominant firms have incentives to protect their existing position, to extend their market power into other markets, and to exploit the huge amounts of data being gathered on their users.

Governments must ensure that the benefits of competition—such as innovation, privacy, choice, and low prices—are realized while protecting market participants and promoting a fair and contestable playing field. Competition regulation and enforcement must adapt to the changes brought on by the digital revolution, given that harm to competition, market participants, workers, and consumers is now being manifested in novel ways. Creating digital markets that work for everyone would allow their full potential to be shared by all Americans.